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ABSTRACT

The objectives of this study were to determine the strength and importance of the relationships among features of oral and written language proficiency and their accompanying thought processes, and to dimensionalize variables that may be manipulated to assist development of disadvantaged children. Test scores from measures of langua,e/thinking proficiency, such as problem solving, listening, abstract quality of thinking, and reading achievement (15 variables in all), were collected from 312 fifth-grade students randomly placed in experimental and control groups, who had completed all pretests and post-tests, and from 153 sixth-grade students who had completed retention tests. Experimental-group children had received instruction in problem solving, listening, and abstract thinking. The major method of statistical analysis consisted of principal-axis factor analysis of the 15 variables, with varimax and oblique rotation. Results showed that three factors could be extracted and interpreted--reading achievement, verbal abstract thinking, and problem solving. An implication of the study was that socioeconomic status, possibly more than I.Q., is a crucial influence on reading performance. (Author/JM)

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RELATIONSHIP OF THOUGHT PROCESSES TO LANGUAGE RESPONSES IN DISADVANTAGED CHILDREN

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SUMMARY OR ABSTRACT

Objectives of the Inquiry. The primary objective was to determine the strength and importance of the relationships among features of oral and written language proficiency and accompanying thought processes, especially creative problem solving. Additionally, the goal was to dimensionalize variables that may be manipulated to assist development of disadvantaged children, i.e., children classified as having low IQ and low socio-economic status (SES).

Data Sources and Method. Test scores from measures of language/thinking proficiency, such as problem solving, listening, abstract quality of thinking, and reading achievement (15 variables in all) were collected from 312 Ss in 24 fifth-grade classes who had been assigned randomly to experimental and control treatment groups and who had completed all pretests, postests and a subsample of 153 Ss with scores from 10 variables who had completed retention tests in the sixth grade. Experimental group children had received instruction in problem solving, listening, and abstract thinking. The major method of statistical analysis consisted of principal-axis factor analysis of the 15 variables, with varimax and oblique rotation.

Results and Conclusions. Results from the factor analyses showed that generally there were three factors which could be abstracted and interpreted. Moderately high correlations were observed in most analyses among the oblique factors. The three factors most consistently obtained were described as I--reading achievement, II--verbal abstract thinking, and III--problem solving. It soon became apparent that the two different standardized reading tests (Stanford reading and STEP) did not cluster together consistently, especially for the experimentally trained group, and especially on the postests and the retention tests. On occasion the reading tests were found on factors that were uncorrelated. The third factor described as problem solving appeared better defined and with higher loadings for trained groups than for untrained groups at both IQ and SES levels. Reading variables were more related to the problem-solving factor when the basis for classification was SES. In general, measures of listening were more likely to cluster with measures of abstract thinking than with measures of reading. It did not appear that any of the measures clustered together so consistently as to suggest redundancy of measurement or instrument factors, or that separate abilities were not being measured at times, except in the case in the STEP reading subscores. Comparisons were made with earlier factor analyses.

Importance of the Study. Results were discussed in terms of three "theories": Independent Skills Theory, Global Skills Theory, and Hierarchical Skills Theory. It was suggested that teachers might use the battery to locate groups of pupils along a continuum of language and thought proficiency. The shifts in factor structure when the comparison was made with IQ as the basis and then SES as the basis may imply that socio-economic status, possibly more so than IQ, is a crucial influence on reading performance.

Introductory Section

Background for the study. The purpose of this study was to determine the strength and importance of the relationships among features of oral and written language proficiency and accompanying thought processes, especially creative problem solving. Additionally, the goal was to dimensionalize variables that may be manipulated to assist development of disadvantaged children, i.e., children classified as having low IQ and low socio-economic status. Training in solving problems and subskills of listening and abstract thinking (in sum, language-reasoning skills) may be the key to aiding disadvantaged children to compete in our culture.

The significance of this area is emphasized in the popular and research literature. Today's children face the ever-ascending impact of mass media which tends to make them develop certain sets. Television, a medium of high involvement, may be likened to a giant cooky-cutter shaping and molding the ability of children to think. Bronfenbrenner (1967) described experiments suggesting the contagion of agressive behavior witnessed through mass media. Television does not appear to be effective in dealing with complex, abstract issues. Seligman (1969) has suggested that a society whose families breed more and more protest-prone youth is breeding trouble for itself and that if the society is also hit by a communication media, TV, that encourages "commitment" and discourages analysis of complex issues, it is in even worse shape. Finally, if both events occur in a period of rapid change, the problem becomes crucial.

Russell (1956) noted that most experiments for the improvement of language/thinking skills have dealt with short-range rather than long-range teaching, with isolated rather than with generalized techniques based on a framework of ideas. In addition, a mandate has appeared to come from parents. According to a recent Gallup poll, 93% of parents queried thought that classes for pupils in how to think were desirable. These classes would help pupils learn to analyze problems, to figure out things for themselves, and to develop new solutions. The poll indicated that there was uniformly high approval of this idea in all areas of the country and among all segments of the population (Gallup International, 1966).

In the Manifesto of the Huntington Teachers and Writers Conference is the claim that in desperation teachers have wanted to throw out the existing English curriculum to get to the children. Reading texts, the report claimed, were peopled with bloodness, trivial, vapid stereotypes. Classrooms were filled with children having no constructive goals, no self-motivation, incapable of more than surface communication, children sitting and supposedly absorbing isolated facts while their powers of questioning, search and solving atrophied. The English classroom was declared a disaster area.

Finally, specifically for the deprived, it has been suggested that IQ scores of some disadvantaged children are low on conceptual learning and problem-solving ability (Jensen, 1969). But little or no investigation has been made of experimental assistance of these abilities for low IQ or disadvantaged children at the 10-year-old level or even of the relationships among these variables before and after a program for improvement. IQ tests may simply not be adequate to measure processes of thinking

(Voyat, 1969). Voyat suggests that the process of interacting with the environment should be emphasized rather than a specific response already decided upon by the test constructor or teacher. He quotes Piaget as saying that the goal should be not to increase the child's amount of knowledge, but to create possibilities for a child to invent and discover.

The research literature relevant to the variables of the present study have been reviewed elsewhere--for problem solving (Lundsteen, 1968; Lundsteen, in press 1969b), for abstract thinking (Lundsteen, in press 1970), and for listening (Lundsteen, in press 1969a and 1969c). In light of apparent problems, attempts were made to construct curriculum and measurement to promote and to test higher mental processes within the context of the language arts period in school. Some of the stimuli were shown via an experimental series on educational television.[1] Significant differences were found in favor of the groups having the experimental curriculum (Lundsteen, in press 1969c).

A next step appeared to be the analysis of the relational and factor structure among the experimental variables and classificatory or organismic variables. This factor analysis was the substance of the present investigation. These analyses may assist in building models that include supposed major factors and help to determine the relative influence of each. Major interest was in the variable of the training for creative problem solving which was common to all experimental groups.

Methods. The sample for the factor analyses consisted of 312 fifth-grade children completing all tests with boys and girls approximately equally divided within the two treatment groups. Table 1 gives the descriptive data for the sample as to number, socio-economic status, verbal IQ, Stanford reading test, Word Meaning, and Paragraph Meaning for the experimental and control groups and for high IQ and low IQ. The children, who lived within Santa Barbara and Ventura Counties, California, came from 29 different schools and 9 school districts. All pupils came from classes which were volunteered to be assigned randomly to any treatment group. In the earlier work there appeared to be no significant difference between the experimental and the control groups on IQ (Level D, Verbal Form 1, Lorge Thorndike). The sample was split into parts on the variable of IQ at the median score of 103 with a range from 104 to 149 for upper and 62 to 103 for lower IQ level. The range on the Stanford Achievement Test, reading portion was from a grade level low of .6 to a high of 8.9 with a mean of 5.4 for the total sample. The distribution for socio-economic status (SES) had few cases in the fifth category and most cases clustered at either end of the distribution. The range was 1-5 for low and 6-9 for high SES.

It was necessary, and probably not too detrimental, that all pupils knew they were participating in an experiment for the following reasons: the control of testing via educational television; the large number and unusual nature of tests, which would have made disguising as normal classroom procedure unlikely; and the geographical location in the United States where experimentation is common.

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[1] This earlier research was supported by the Charles F. Kettering Foundation.

Table 1

DESCRIPTIVE DATA FOR SAMPLE

Group	N	Socio-economic Status M	Socio-economic Status SD	Verbal IQ M	Verbal IQ SD	Stanford Word Meaning[a] M	Stanford Word Meaning[a] SD	Stanford Paragraph Meaning[a] M	Stanford Paragraph Meaning[a] SD
Experimental	177	5.43	2.43	105.77	16.71	22.64	8.59	33.50	11.42
Hi IQ	93	6.17	2.31	118.22	11.40	28.02	6.25	40.77	8.47
Lo IQ	84	4.62	2.30	92.00	9.09	16.68	6.68	25.44	8.49
Control	135	4.54	2.37	102.10	15.05	21.39	9.16	31.35	12.59
Hi IQ	64	5.25	2.23	115.27	8.21	27.87	5.43	40.61	8.44
Lo IQ	71	3.90	2.32	90.23	8.45	15.55	7.80	23.01	9.52
Experimental									
Hi SES	101	7.34	1.04	110.16	17.18	24.59	8.39	36.43	11.10
Lo SES	76	2.91	1.01	99.95	14.19	20.04	8.16	29.59	10.65
Control									
Hi SES	60	6.90	1.04	107.55	12.54	24.37	8.05	36.65	11.43
Lo SES	75	2.65	1.08	97.73	15.53	19.01	9.29	27.12	11.86

[a] Raw scores collected in the fall of the fifth-grade year

The measurement is presented briefly in Table 2 in which a description is given as well as reliability coefficients. Table 2 is used as a legend for Table 3 and others. Test-retest reliabilities were computed for each of the STEP Reading subscores, as no values appeared to be available from the test publisher. Measurement fell into three groups and has been detailed elsewhere: problem-solving measures (Lundsteen, in press 1969b); three measures of abstract thinking (Lundsteen, in press 1970); listening measurement (Lundsteen, in press 1969a); and the reading measurement (Lundsteen, in press 1970). The Stanford reading test was used for two purposes: (a) to describe the sample and (b) to check maintenance of reading a year later for the earlier experimental study (Lundsteen, in press 1970).

Table 3 indicates the intercorrelations between the measurement for total experimental and control groups on the pretests (N = 312). Table 4 indicates the means and standard deviations of these 15 variables for both control and experimental groups together on the pretest and for control and experimental separately on the postest.

Tests were created to measure some of the variables of listening, problem solving, and abstract thinking because no other measurement was available. There were the usual problems with experimental tests: grossness and lack of validity studies. However, the fact that the experimental groups having the treatments represented by each of the measurements scored higher than the controls appears to give some empirical evidence of validity (Lundsteen, 1963; Lundsteen and Michael, 1966; Lundsteen, 1968; Lundsteen, in press 1969b). The scale for assessing socio-economic status was constructed by John Caffrey for the Palo Alto School District and contained nine categories. The scale with examples, some of which were added during the collection of data, is found in Appendix A.

The treatments in this investigation are divided into experimental and control conditions. In the earlier study the experimental treatment had been divided into three emphases. For each treatment there was the common core of problem-solving experiences, but one group received extra practice on problem solving, another group spent the same amount of time on listening instruction, and a third group spent their alloted time on qualitative levels of thinking (concrete, functional, and abstract). The results of the earlier experiment indicated that if the goal was the increase of creative problem solving that there was no significant difference among the experimental groups; all were better than the control, and each treatment appeared to contribute something for one of the problem-solving tests from one of three IQ groups--high, medium, and low (Lundsteen, in press 1969b). Believing that all the experimental treatments were desirable and needing a large number of subjects for the factor analyses, the investigators decided to combine the experimental treatments. An elaboration, however, of the three major portions of the experimental treatment follows:

(1) The experimental treatment consisted of problem solving including concepts within four areas: problem, hypotheses, planned procedure, and planned evaluation. Within these areas there were 12 flexibly ordered steps with 7 qualities in problem solving. Examples of qualities sought were: construction of testable hypotheses, causal thinking, multiple alternatives, and evaluative thinking. The extra practice or emphasis

Table 2

TITLES, ACRONYMS OR ABBREVIATIONS, HIGHEST POSSIBLE RATING OR NUMBER OF ITEMS, RELIABILITIES, AND BRIEF DESCRIPTIONS FOR DEPENDENT VARIABLES

Description of Measurement

No.	Title	Items or Rating	Test-re-test	N	KR 21	N	Inter-rater[a]
1.	Choose a Meaning--Abstract (CHMA) Definitions selected for 20 words from choices constructed to represent qualities: abstract, functional, concrete, or error	20	.69	21	.65	200	...
2.	Tell the Story and Make a Plan (CLSA) Four openended stories with 12 questions followed by four multiple choice answers constructed to represent qualities: abstract, functional, concrete, or error	48	.89	14	.71	200	...
3.	Critical Listening--Speaker's Purpose (1 LUND) After short selection, three choices as to purpose--to be funny, to give facts, to persuade--according to standard given pupil	24	.71	16	.51	125	...
4.	Critical Listening--Propaganda (2 LUND) After short selection of propaganda, four choices as to analysis of device, three choices as to judgment, and three choices as to reason for judgment according to standard given pupil	28	.71	95	.75	124	...
5.	General Listening (PRAT) After oral presentation, 30 multiple choice questions concerning main idea, detail, summary, sequence, and inference or relationship	20	.64	54	.71	200	...
6.	Written Composition (WRIC) A composition written concerning a problem with a friend rated on a five-point scale for each of 12 steps in a problem-solving process	180	.53	26	...	...	.87
7.	Tell the Story and Make a Plan (OPST) Two openended stories with 12 steps or question types each designed to elicit written answers and measure choice points during a problem-solving process, which was rated on seven qualities (See Appendix B and C.)	1224	.74	26	...	...	.90

Table 2 (con't)

TITLES, ACRONYMS OR ABBREVIATIONS, HIGHEST POSSIBLE RATING OR NUMBER OF ITEMS, RELIABILITIES, AND BRIEF DESCRIPTIONS FOR DEPENDENT VARIABLES

Description of Measurement

No.	Title	Items or Rating	Test-re-test	N	KR 21	N	Inter-rater[a]
8.	Write a Meaning--Abstract (WRMA) Definitions written by pupil for 10 words rated as abstract, functional, concrete, or error and judged by 3 judges, abstract score only	30	.87	23	...	...	.90
	Sequential Tests of Educational Progress (STEP Reading, Form 4A) ETS						
	Subscores						
9.	(1) Reproduce Ideas	23	.79	77	...	...	...
10.	(2) Translate Ideas, Make Inferen.	13	.78	77	...	...	...
11.	(3) Analyze Motivation	9	.74	77	...	...	...
12.	(4) Analyze Presentation	14	.70	77	...	...	...
13.	(5) Criticize	15	.77	77	...	...	...
	Stanford Achievement Test, Reading (STAN) (Form X)				(KR 20)		(Split-half)
14.	Word Meaning (WM)	48	...	...	90	1000	.90
15.	Paragraph Meaning (PM)	64	...	...	92	1000	.93

[a] The N on which the interrater reliability is based is 200.

Table 3

INTERCORRELATION MATRIX

Pretests Total Experimental and Control Group Combined

Var. No.	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.40	.32	.43	.41	.22	.26	.50	.36	.42	.31	.36	.41	.42	.42
2		.21	.42	.41	.16	.30	.42	.42	.42	.40	.38	.37	.48	.46
3			.36	.35	.14	.24	.28	.26	.27	.21	.34	.31	.26	.28
4				.48	.20	.29	.40	.41	.45	.46	.44	.44	.39	.44
5					.24	.31	.43	.45	.47	.42	.50	.47	.48	.53
6						.41	.14	.17	.31	.21	.19	.20	.27	.28
7							.26	.39	.39	.36	.37	.34	.48	.47
8								.41	.42	.41	.46	.44	.50	.52
9									.74	.75	.74	.76	.63	.60
10										.72	.75	.73	.64	.62
11											.72	.71	.62	.63
12												.76	.62	.64
13													.67	.63
14														.86
15														

Table 4

MEANS AND STANDARD DEVIATIONS FOR TOTAL EXPERIMENTAL AND CONTROL COMBINED ON PRETESTS AND FOR EXPERIMENTAL AND FOR CONTROL ON THE POSTESTS

Var.	Test	E & C Pre		E Post		C Post	
		M	SD	M	SD	M	SD
1	CHMA	6.64	2.84	8.56	3.21	7.61	3.02
2	CLSA	14.46	5.52	22.86	6.12	20.91	6.38
3	1 LUND	13.62	3.04	14.55	2.80	14.04	3.12
4	2 LUND	16.49	4.61	19.38	4.62	17.28	4.95
5	PRAT	11.49	3.54	12.09	3.02	11.30	3.58
6	WRIC	50.25	12.42	63.65	16.59	51.89	10.29
7	OPST	198.23	79.54	331.07	108.33	300.96	92.76
8	WRMA	4.31	4.93	8.80	6.89	7.60	6.39
9	STEP 1	17.12	4.49	17.38	4.34	16.77	4.66
10	STEP 2	9.04	2.64	9.43	2.49	8.53	2.73
11	STEP 3	6.69	2.08	6.93	1.88	6.37	2.28
12	STEP 4	9.08	3.09	9.40	2.98	8.67	3.18
13	STEP 5	9.81	2.91	10.17	2.77	9.32	3.00
14	STAN WM	22.10	8.86	22.64	8.59	21.39	9.16
15	STAN PM	32.57	11.99	33.50	11.42	31.35	12.59

was simply a repetition of the concepts and problem-solving behaviors, e.g., the concept of missing data and search strategy. Practice was with a new context or story material or a different area of language acquisition, e.g., oral language, writing, or within the area of spelling problems. The content was frequently problem episodes from award winning children's literature; the emphasis was on "people problems" in varying geographic locations and with various ethnic groups. Principles of human relationship were applied to the problem.

(2) The listening training dealt with 6 general listening skills and 40 behaviors in critical listening arranged in a tentative instructional hierarchy, e.g., identifying common elements in several selections of propaganda, naming elements for a judgmental standard, constructing a standard for judging propaganda. The 6 general listening skills were: selecting facts and details, sequential ordering, selecting main idea, summarizing, relating, and inference making.

(3) The abstract emphasis (or the treatment involving qualitative levels of thinking--abstract, functional, and concrete) consisted of noting and practicing the usefulness of these levels of thinking during various situations and in various language units of classes, relations, and systems--to use Guilford terminology. Grouping and labeling of simple to more complex categories on the concrete level was conceived to be the prerequisite to the similar mental skills on the functional level. Without the solid base of concrete and functional quality in thinking, abstract thinking was likely to be superficial if not inaccurate. Sample behaviors were: recalling and naming details from data on the concrete level, grouping and labeling data in an abstract category, selecting a definition on an abstract level, applying abstract quality of thinking to problem-solving choice points. Levi (1966) suggested (by way of related research) in her work on remedial techniques in disorders of concept formation that for a child who has apparently a normal or dull-normal intelligence and who is of an age where the attainment of logical principles of categorization would ordinarily already be appropriate, but seems to be inadequate, a series of exercises should be devised to stimulate classificatory activity mediated through speech.

The control group used in the present analyses received both pretest and postest. A questionnaire was sent to each control teacher in order to obtain a description of her yearly program in language arts. The completed returns showed that teachers were using state adopted texts, county guides and that most were involved in other projects to the extent that no generalized feelings of neglect or lack of motivation could be uncovered. Control teachers were assisted with test administration by aides whenever necessary. In other words, every effort was made to control the Hawthorne effect. Some reading exercises stressed categorization to such an extent that training somewhat similar to the experimental group with emphasis on abstract thinking may have existed in some control classes.

In the fall all pupils received the battery of experimental pretests including mental ability and reading from the Stanford Achievement Test. Then all pupils in experimental groups had 23 weeks of instruction, 3 lessons weekly, each 30 minutes in length. This 90 minutes fulfilled the state-required time to be spent on language arts. In the spring all pupils received the battery of experimental postests and also the Sequential Tests of Educational Progress, (STEP) Reading. Test scores from these measures were the source of the data for the present analyses.

The major method of statistical analysis for the present study consisted of a principal axis factor analysis with varimax and oblique rotation of the 15 variables with a program by Fruchter (1968) designed for the CDC 6600 at The University of Texas at Austin. The correlation matrix is presented for the tables accompanying the first analysis. The computer program used goes through an iterative process for estimating communalities and for determining the number of factors. The process stops on the first pass when the sum of the eigenvalues exceeds the sum of the entries in the principal diagonal or when a negative root is encountered, whichever occurs first. On subsequent passes the process of extracting factors stops when the variance of the extracted factors exceeds 101 per cent of the sum of the communalities estimated in the preceding iteration. This estimation procedure is reiterated four times.

Findings

Total, experimental, and control group results. The investigators avoided naming the factors, feeling that a name implied a cross identification or an interpretation with more certainty than is warranted by the results (French, 1951). Instead, the investigators used an overall Roman numeral system to identify all the factors in the order in which they appeared in the analyses and used descriptive interpretations rather than names. These interpretations were shortened for convenience in referring to factors. Ten factors in all finally appeared and they are referred to consistently by the Roman numeral assigned. On occasion one of the three major factors appeared to split into minor factors, thus the need to assign numerals in progressive fashion for purposes of identification.

The first factor analysis made was for the pretest with the experimental and control groups combined. The correlation matrix was presented earlier in Table 3. Table 5 presents the rotated orthogonal factor matrix. The loading on the simple oblique reference axes, and the correlations among the reference vectors are shown in Table 6. Arbitrarily, factor loadings of .40 or greater in the orthogonal solution were selected to indicate the major composition of a factor.

The three factors which were extracted from the 15 pretest variables have been identified tentatively as: I--a reading achievement factor (high loadings on tests 9 through 15); II--a verbal abstract thinking factor mainly from the tests of listening and abstract thinking (high loadings on tests 1-5, 8, and, marginally, 15); and III--a problem solving factor (high loadings on variables 6, 7, and also 14 and 15). It was not surprising that the reading variables should cluster together (factor I); it came as a surprise, however, that the abstract thinking and listening variables should be found on the same factor (factor II). (On the postest for the control group shown in Table 8, however, this factor was not so well defined.) The relation between the first two factors was moderately

Table 5

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTOR MATRIX)

Pretests, Total Experimental and Control Groups Combined

Var. No.	Acronym	Factor No.			
		I	II	III	$\underline{h}^2$
1	CHMA	.17	.64	.17	.46
2	CLSA	.27	.49	.22	.36
3	1 LUND	.15	.43	.12	.22
4	2 LUND	.29	.58	.15	.44
5	PRAT	.31	.56	.23	.46
6	WRIC	.08	.14	.49	.26
7	OPST	.23	.20	.62	.47
8	WRMA	.29	.59	.15	.45
9	STEP 1	.81	.28	.17	.76
10	STEP 2	.73	.33	.27	.72
11	STEP 3	.78	.26	.21	.72
12	STEP 4	.77	.35	.17	.75
13	STEP 5	.77	.35	.16	.74
14	STAN WM	.57	.37	.49	.71
15	STAN PM	.54	.41	.50	.71

Table 6

V-MATRIX (REFERENCE STRUCTURE)

Pretests, Total Experimental and Control Groups Combined

Var. No.	Acronym	Factor No. I	II	III
1	CHMA	-.09	.51	-.01
2	CLSA	.03	.33	.07
3	1 LUND	-.04	.33	.00
4	2 LUND	.03	.44	-.03
5	PRAT	.04	.39	.05
6	WRIC	-.11	-.01	.43
7	OPST	-.03	-.01	.52
8	WRMA	.04	.43	-.03
9	STEP 1	.60	.00	-.01
10	STEP 2	.49	.05	.08
11	STEP 3	.57	-.02	.04
12	STEP 4	.54	.08	-.03
13	STEP 5	.54	.08	-.03
14	STAN WM	.26	.08	.31
15	STAN PM	.22	.13	.31

MATRIX (CORRELATIONS AMONG REFERENCE VECTORS)

	I	III
II	-.48	-.39
III	-.32	

high, as indicated by a correlation of -.48* between the reference vectors for these two factors. (Correlations are always reported for the reference vectors.)

When the sample was split into experimental and control groups on the pretests the factor structure for the two groups was basically the same. It seems reasonable that there would not be much difference in the factor structure from the two groups--experimental and control--on the pretests before treatment. Interest lay in what would occur in the factor structure after treatment.

The postest factors for the experimental group in comparison with pretest factors indicated that the loadings for Stanford reading subtests were smaller on factor I (containing reading tests) and were now loaded to criterion value (≥ .40) on factor II (containing abstract thinking and listening tests). Factor III now clearly contained high loadings only on the two problem-solving tests. (See Table 7.)

The postest factors for the control group in comparison with pretests factors showed some dispersal of loadings. Four factors emerged rather than three, with two of the listening variables (critical listening to propaganda and general listening) splitting off to form the fourth factor. The correlations among these factors were not high and were about the same as for the pretests. On factor II (verbal abstract thinking) three of the six variables failed to meet the criterion value. (See Table 8.)

Comparison of the postest factors of the experimental group with the postest factors of the control group showed a much sharper delineation for factor III (problem solving) for the experimental group who had received training in problem solving. The most interesting comparison of the factor structures, however, occurred when the control and experimental samples were split at high and low IQ levels.

High and low IQ. The next step in the factor analysis was to compare structures within the experimental and control groups for pretests and postests when the pupils were divided into categories of high and low IQ.

First, the structure for the high IQ, experimental group on the pretests is presented in relation to the postests. Then comparison is made between IQ levels within postests for experimental and control groups. In general on the pretests, four factors were obtained for each high IQ group, experimental and control, and six factors for each low IQ experimental and control group.

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* The negative sign indicates an obtuse angle between the simple reference vectors. The primary axes for two factors tend to be positively related when their simply axes are negatively related and the negative sign should therefore not be interpreted as a negative relationship between the two factors.

Table 7

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Postest, Experimental

Var. No.	Acronym	Factor No. I	II	III	h^2
1	CHMA	.34	.60	.07	.48
2	CLSA	.35	.61	.24	.55
3	1 LUND	.26	.54	.10	.37
4	2 LUND	.31	.49	.23	.40
5	PRAT	.25	.66	-.01	.50
6	WRIC	.16	.06	.70	.52
7	OPST	.25	.38	.59	.56
8	WRMA	.15	.60	.25	.44
9	STEP 1	.72	.33	.19	.67
10	STEP 2	.74	.31	.31	.74
11	STEP 3	.72	.33	.17	.65
12	STEP 4	.77	.32	.15	.73
13	STEP 5	.72	.44	.14	.74
14	STAN WM	.45	.65	.22	.67
15	STAN PM	.43	.64	.26	.67

Table 8

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Postest, Control

Var. No.	Acronym	Factor No. I	II	III	IV	h^2
1	CHMA	.29	.67	.35	.09	.66
2	CLSA	.29	.36	.45	.39	.56
3	1 LUND	.19	.63	.06	.29	.52
4	2 LUND	.38	.24	.17	.65	.65
5	PRAT	.26	.34	.40	.50	.59
6	WRIC	.12	.07	.38	.04	.16
7	OPST	.20	.07	.64	.32	.55
8	WRMA	.41	.41	.48	.12	.58
9	STEP 1	.81	.21	.29	.31	.87
10	STEP 2	.68	.29	.29	.31	.73
11	STEP 3	.76	.13	.31	.35	.81
12	STEP 4	.72	.35	.33	.17	.77
13	STEP 5	.77	.26	.29	.14	.77
14	STAN WM	.55	.32	.60	.12	.77
15	STAN PM	.46	.29	.69	.19	.80

The factor structure on the pretests for the high IQ, experimental group was basically the same as for the total group, except that the two Stanford reading test subscores split off from factor I (reading achievement) to form the major loadings of the fourth factor. Factor IV was highly correlated, however, with factor II (problem solving). One of the abstract variables (CLSA), moreover, did not meet the criterion value. (See Table 9.)

The factor structure on the pretests for the low IQ, experimental group was basically the same as both the total pretest and the high IQ level. (See Table 10.) The factor structure on the pretests for the high IQ, control group again showed the standard factor structure of three basic factors with the two Stanford reading variable forming the basis for the fourth factor. (See Table 11.) The factors appeared to be uncorrelated.

On the pretests for the low IQ, control group the factor structure was basically the same, but the splitting off of variables was different from that of the low IQ, experimental group. Factor V (listening) was loaded purely on all three listening variables (the only time in which this result was observed), but was correlated highly (.51) with factor I (reading achievement). For the control, low IQ group, both of the variables that did not reach criterion value (WRIC and WRMA) entailed the ability to put thought into writing. (See Table 12.)

Finally, factor analyses for the postest data are found in Tables 13 through 16. First, the factor structure for the high IQ, experimental group retained only a portion of the pretest structure. Factor I, reading (with the STEP reading tests), continued as the most consistent of all the factors. Factor II (verbal abstract thinking) for the postests (which was consistently loaded on the abstract variables and the listening variables) appeared, but without criterion values on the two variables of critical listening and WRMA. The two problem-solving measures were differentiated. (See Table 13.) Factor X (problem solving with critical listening) was correlated (-.49), however, with factor II (verbal abstract thinking).

The low IQ, experimental group factor structure for the postests after training in problem solving changed from six factors on the pretests (five of which were highly correlated) to four uncorrelated factors. (See Table 14.) Factor I (loaded on the STEP reading variables) was no longer correlated with factor IV (loaded on the Stanford reading variables); the two reading tests were differentiated after training. Factor III (problem solving) was almost identical with the pretest structure.

The factor structure for the high IQ, control group on the postests presented the same number of factors as in the pretests, four in all. Factor I (STEP reading subscores) was almost the same. However, there appeared to be minor shifts in the post-structure for the high IQ control, when compared to their pre-structure. (See Table 15.)

Table 9

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Pretest, Experimental, High IQ

Var. No.	Acronym	Factor No. I	II	III	IV	$\underline{h}^2$
1	CHMA	.08	.18	.56	.19	.39
2	CLSA	.26	.04	.24	.33	.24
3	1 LUND	.11	.03	.49	.08	.26
4	2 LUND	.27	.06	.66	.12	.52
5	PRAT	.36	.22	.47	.26	.46
6	WRIC	-.04	.69	.02	.05	.48
7	OPST	.20	.68	.16	.04	.53
8	WRMA	.06	-.05	.51	.24	.32
9	STEP 1	.53	.07	.06	.24	.35
10	STEP 2	.68	.26	.22	.17	.61
11	STEP 3	.48	.08	.08	-.01	.25
12	STEP 4	.73	-.08	.28	.12	.63
13	STEP 5	.75	-.05	.13	.27	.66
14	STAN WM	.20	.03	.29	.78	.74
15	STAN PM	.27	.15	.40	.63	.65

Table 10

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Pretest, Experimental, Low IQ

Var. No.	Acronym	Factor No. I	II	III	IV	V	VI	$\underline{h}^2$
1	CHMA	.05	.67	.26	-.12	.12	.02	.55
2	CLSA	.21	.55	.15	.11	-.00	.09	.39
3	1 LUND	.06	.11	.19	-.03	.47	.04	.27
4	2 LUND	.22	.39	.06	.07	.42	.49	.63
5	PRAT	.11	.46	-.01	.12	.20	.19	.31
6	WRIC	.07	.03	.75	.09	.21	-.11	.63
7	OPST	.10	.22	.79	.24	.06	.19	.77
8	WRMA	.16	.60	-.05	.16	.03	-.03	.41
9	STEP 1	.82	.14	.07	.15	-.12	.10	.75
10	STEP 2	.80	.18	.26	.13	.05	.03	.76
11	STEP 3	.77	.16	.04	.24	.01	.24	.74
12	STEP 4	.76	.14	-.02	.16	.13	-.00	.64
13	STEP 5	.76	.17	.02	.16	.28	-.11	.73
14	STAN WM	.38	.11	.22	.76	.02	-.15	.81
15	STAN PM	.29	.15	.15	.79	-.04	.20	.80

Table 11

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Pretest, Control, High IQ

Var. No.	Acronym	Factor No. I	II	III	IV	h^2
1	CHMA	.26	.72	-.05	-.01	.59
2	CLSA	.03	.49	-.06	.28	.33
3	1 LUND	.05	.23	.50	-.16	.33
4	2 LUND	.25	.38	.13	.17	.26
5	PRAT	.15	.52	.23	.30	.43
6	WRIC	.15	-.15	.40	.13	.22
7	OPST	.03	.05	.70	.32	.60
8	WRMA	.42	.63	.05	.04	.58
9	STEP 1	.69	.35	.17	.10	.64
10	STEP 2	.75	.17	-.01	.25	.66
11	STEP 3	.61	.10	-.04	.15	.40
12	STEP 4	.69	.11	.27	.12	.57
13	STEP 5	.64	.25	.13	.10	.50
14	STAN WM	.30	.21	.10	.83	.83
15	STAN PM	.27	.22	.20	.75	.72

Table 12

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Pretest, Control, Low IQ

Var. No.	Acronym	Factor No.						
		I	III	IV	V[a]	VIII	IX	h^2
1	CHMA	.13	-.01	.16	.14	.91	.01	.89
2	CLSA	.17	.20	.51	.32	.18	.40	.62
3	1 LUND	.11	-.03	.00	.60	.10	-.09	.39
4	2 LUND	.20	.20	.05	.52	.21	.21	.45
5	PRAT	.32	.06	.23	.54	-.16	.12	.49
6	WRIC	-.00	.30	.19	-.04	-.06	.23	.18
7	OPST	.17	.91	.16	.14	.05	-.01	.90
8	WRMA	.24	13	.35	.14	03	.17	.24
9	STEP 1	.89	.03	.17	.19	.08	.08	.88
10	STEP 2	.69	.11	.23	.14	18	.17	.62
11	STEP 3	.76	.01	.39	.15	.03	.26	.83
12	STEP 4	.76	.14	19	.30	-.03	-.10	.74
13	STEP 5	.78	.10	.27	.14	.10	-.10	.73
14	STAN WM	.40	.22	.78	-.01	.14	.01	.84
15	STAN PM	.32	.09	.76	.07	07	.02	.70

[a] The factor that was designated as II in the other analyses did not appear as such in this analysis. Instead it was split up among three factors designated as V, VIII, and IX. Six factors were obtained in this analysis; no factors are actually skipped. The factors obtained in any one analysis are all shown and given a consistent coding of Roman numerals, but these factors appearing on this table and some of the tables which follow may not appear sequentially or in numerical order if a factor has split into two or more factors resulting in the skipping of some code numerals. A complete listing of factors is given in Table 17.

Table 13

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Postest, Experimental, High IQ

Var. No.	Acronym	Factor No.				
		I	II	III	X	$\underline{h}^2$
1	CHMA	.20	.44	-.10	.19	.28
2	CLSA	.18	.47	.12	.33	.37
3	1 LUND	.19	.26	-.19	.51	.40
4	2 LUND	.42	.24	.00	.49	.47
5	PRAT	.21	.48	-.18	.31	.41
6	WRIC	.04	.02	.69	.07	.48
7	OPST	.11	.07	.37	.70	.64
8	WRMA	.11	.38	.11	.35	.29
9	STEP 1	.49	.25	17	.06	.34
10	STEP 2	.70	.18	.21	.25	.64
11	STEP 3	.45	.11	-.03	.06	.22
12	STEP 4	.75	.16	-.08	.18	.62
13	STEP 5	.73	.31	-.06	.15	.65
14	STAN WM	.22	.79	.03	.06	.67
15	STAN PM	.30	.77	.11	.09	.71

Table 14

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Postest, Experimental, Low IQ

Var. No.	Acronym	Factor No.				
		I	II	III	IV	h²
1	CHMA	.21	.47	.09	.04	.28
2	CLSA	.34	.56	.12	.24	50
3	1 LUND	.21	.57	.11	.06	.39
4	2 LUND	.16	.34	.15	.30	.25
5	PRAT	.15	.65	-.05	.19	.49
6	WRIC	.17	.11	.71	.17	.57
7	OPST	.27	.21	.63	.16	.54
8	WRMA	.01	.54	.23	.10	.35
9	STEP 1	.77	.20	.13	.20	.69
10	STEP 2	.75	.24	.24	.17	.70
11	STEP 3	.72	.25	.11	.32	.70
12	STEP 4	.78	.12	.14	.16	.67
13	STEP 5	.72	.30	.18	.11	.65
14	STAN WM	.30	.24	.29	.68	.69
15	STAN PM	.25	.17	.13	.83	.81

Table 15

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Postest, Control, High IQ

Var. No.	Acronym	Factor No.				
		I	II	III	VI	h²
1	CHMA	.32	.63	.25	-.21	.60
2	CLSA	.07	.26	.50	.31	.42
3	1 LUND	.09	.78	-.01	.08	.62
4	2 LUND	.24	.31	.23	.42	.39
5	PRAT	.16	.42	.44	.10	.41
6	WRIC	.01	.02	.03	-.26	.07
7	OPST	.01	-.15	.51	.05	.28
8	WRMA	.25	.23	.47	.04	.34
9	STEP 1	.69	.18	.26	27	.65
10	STEP 2	.70	.12	.33	-.00	.62
11	STEP 3	.65	-.02	.12	.18	.47
12	STEP 4	.72	.14	.13	-.26	.62
13	STEP 5	.69	.29	.05	-.02	.56
14	STAN WM	.34	.19	.69	-.13	.65
15	STAN PM	.29	.16	.80	-.24	.81

In comparison with the structure of the high IQ experimental postests, there appeared to be distinguishable differences especially with regard to the problem-solving variables. For the experimental group that had been trained, the loading on OPST (problem stories) was higher (.69 versus .51) and was distinguished from the Stanford tests of reading. Also for the trained group, the loading for WRIC (problem solving in a written composition) was high (.69) and distinctive, whereas for the untrained group this variable never reached even close to criterion value.

The factor structure for the low IQ, control group on the postests decreased from six factors found on the pretests (three of which were highly correlated) to four factors on the postests (two of which were highly correlated). (See Table 16.) The correlation between factor III (problem solving) and factor I (reading) was almost the same (-.46). Factor II (reasoning with abstract thinking and listening) was distinguishable on the postest. The Pratt test of general listening did not reach criterion level and was spread at a .3 loading over three factors including factor II.

In comparing low IQ control with low IQ experimental groups on the postests, it appeared that factor I (STEP reading subscores) was almost identical. Factor III (problem solving) showed identical structure, but the loadings for the low IQ experimental group were higher than for the low IQ control. In addition, factor III was not correlated with factor I (reading), as was the case for the control group. Thus as previously, the factor structure for the trained group was more precise, consistent, and clear-cut than for the untrained group.

Summary of the two IQ levels. In Table 17 is shown the factor numbers designated by Roman numerals and tentative labels assigned to them. The following are the highlights from the results of the structural changes for the experimental and control groups differentiated by levels of high and low IQ. First, in general, the basic structure appeared to consist of three major factors: I--reading achievement, II-verbal abstract thinking, and III--problem solving. It soon became apparent that the STEP and the Stanford reading tests did not cluster together consistently (especially on the postests), were distinguishable, and even existed on factors that rarely correlated. The factor with most fluctuation was factor II containing the three abstract thinking and the three listening variables. On occasion the abstract thinking variables clustered with the reading variables and the problem-solving variables, especially in the case of the control group untrained in problem solving. In the administration of the tests of abstract thinking, listening skill may have been involved. Furthermore, it should be remembered that experimental treatments were combined. Otherwise, more separation of these variables might have occurred after training had these two treatments (abstract and listening) been kept separate. There was, however, little mean difference among treatment groups after training on the abstract variables and on the variable of general listening (PRAT) (Lundsteen, in press 1970).

Table 16

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Postest, Control, Low IQ

Var. No.	Acronym	Factor No. I	II	III	IV	h^2
1	CHMA	.06	.52	.04	.30	.36
2	CLSA	.24	.51	.43	.30	.59
3	1 LUND	.17	.61	-.04	-.03	.40
4	2 LUND	.54	.44	.23	.14	.56
5	PRAT	.34	.36	.36	.16	.40
6	WRIC	-.01	-.09	.64	-.06	.42
7	OPST	.24	.22	.61	.25	.53
8	WRMA	.36	.26	.09	.56	.52
9	STEP 1	.85	.12	.14	.26	.83
10	STEP 2	.74	.30	.05	.20	.67
11	STEP 3	.77	.11	.19	.37	.78
12	STEP 4	.70	.27	.07	.26	.64
13	STEP 5	.73	.05	.08	.39	.70
14	STAN WM	.38	.11	.01	.78	.77
15	STAN PM	.34	.10	.16	.68	.61

Table 17

LIST OF FACTORS IDENTIFIED

Factor No.	Tentative Title
I	Reading achievement
II	Verbal abstract thinking
III	Problem solving
IV	Stanford reading
V	Listening comprehension (PRAT, 1 LUND, 2 LUND)
VI	Critical listening (to propaganda, 2 LUND)
VII	Abstract definition, written (WRMA)
VIII	Abstract definition, selected (CHMA)
IX	Abstract response to problem step selected (CLSA)
X	Problem solving with critical listening (OPST, 1 LUND, 2 LUND)

As previously mentioned .40 was the minimum criterion loading used to include variables in interpreting the composition of the factors. Factor III, problem solving, appeared much better defined with higher loadings and was more independent for trained groups than for untrained groups at both IQ levels. The two problem-solving measures were differentiated on occasion. The variable of critical listening to propaganda appeared to split off and form a singlet in some analyses.

In general, the measures of listening were more likely to cluster together with measures of abstract thinking than with measures of reading. Subscores, especially in STEP reading and usually in Stanford reading, tended to cluster together according to the test to which they belonged. It did not appear that any of the measures clustered together so consistently as to suggest redundancy of measurement or instrument factors or that separate abilities were not being measured, except in the case of the STEP subscores. The two tests of reading (STEP and Stanford) were rarely on the same factor, and never associated after the experimental training.

High and Low socio-economic status. The next step using factor analysis was to compare structures within the experimental (E) and control (C) groups for pretests and postests when the pupils were divided into the two categories of high and low socio-economic status (SES). First, an investigation was made of the question: What percentage of pupils are both in the low SES division and also in the low IQ division? According to a simple count, in the experimental group, 63% of the pupils (or 48 out of 76 low SES members) were consistently low, i.e., both in the low SES and in the low IQ groups. For the control groups the results was almost the same, 64% (or 48 out of 75 low SES members). Thus, approximately two-thirds were consistently low. Inspection showed also that there were small differences between the two sexes as to the consistency figures. Although the consistency was considered high, it was not thought high enough to rule out the value of looking at factor structure for high and low SES as well as high and low IQ in order to make comparisons.

In general three factors were extracted for each group, experimental and control, with the exception that four factors (as determined by the iterative factoring criterion) were extracted for each low SES group, experimental and control on the postests only. As in the previous analysis, pretest structure is presented first and then postest structure.

The factor structure on the pretests for the high SES, experimental group was basically the same as for the high IQ, E group on the pretests, with minor changes in the loadings on factor I and factor III. The loadings, however, for the IQ level appeared a bit more inconsistent and erratic than for the high SES. (See Table 18.)

The factor structure on the pretests for the low SES, experimental group was basically the same as for the low IQ, E group, with the standard factors I, II, and III. Low IQ structure, however, split into six factors at the beginning of fifth grade. Thus, the major change was the lack of splits among the listening variables. For the low SES group, the reading factor was highly correlated with the problem-solving factor (-.69); while for the low IQ group it was not. (See Table 19.)

The factor structure on the pretests for the high SES, C group showed no anomolies and consisted of the basic three factors. Factors I and II were correlated (-.47) for this group but not when the split was made for IQ. This earlier IQ level analysis also had a fourth factor with loadings on the two Stanford reading tests. (See Table 20.)

On the pretests for the low SES, C group the factor structure was again basically the same; three factors (the basic ones) were found, with factor II appearing relatively slight and retaining only three of the six variables usually above the criterion cutoff value. Factor II did not split into three separate abstract singlets, nor the listening triplet, as the structure for the IQ group had done. Again, the variable of writing an abstract definition (WRMA) did not reach criterion value for the low group. Factor I (reading) and factor III (problem solving) were again appreciably correlated (-.47). (See Table 21.)

Table 18

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Pretest, Experimental, High Socio-economic

Var. No.	Acronym	Factor No. I	II	III	$\underline{h}^2$
1	CHMA	.18	.74	.21	.62
2	CLSA	.36	.43	.01	.31
3	1 LUND	.11	.52	.14	.31
4	2 LUND	.21	.51	.11	.32
5	PRAT	.28	.62	.18	.49
6	WRIC	-.01	.13	.80	.65
7	OPST	.28	.26	.69	.62
8	WRMA	.24	.65	.02	.48
9	STEP 1	.73	.19	.02	.57
10	STEP 2	.74	.27	.34	.73
11	STEP 3	.75	.15	.09	.59
12	STEP 4	.76	.32	.05	.68
13	STEP 5	.78	.28	.07	.70
14	STAN WM	.62	.46	.15	.62
15	STAN PM	.59	.52	.23	.67

Table 19

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Pretest, Experimental, Low Socio-economic

Var. No.	Acronym	Factor No. I	II	III	$\underline{h}^2$
1	CHMA	.27	.18	.37	.24
2	CLSA	.29	.22	.34	.25
3	1 LUND	.22	.18	.24	.14
4	2 LUND	.36	.46	.15	.36
5	PRAT	.34	.43	.18	.33
6	WRIC	.10	-.02	.59	.36
7	OPST	.06	.22	.75	.61
8	WRMA	.25	.48	-.01	.29
9	STEP 1	.78	.36	.31	.83
10	STEP 2	.80	.23	.27	.77
11	STEP 3	.69	.35	.25	.66
12	STEP 4	.76	.36	.07	.71
13	STEP 5	.78	.35	.14	.75
14	STAN WM	.30	.74	.31	.74
15	STAN PM	.27	.82	.24	.81

Table 20

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Pretest, Control, High Socio-economic

Var. No.	Acronym	Factor No. I	II	III	$\underline{h}^2$
1	CHMA	.24	.72	-.11	.59
2	CLSA	.12	.49	.24	.31
3	1 LUND	.15	.27	.09	.10
4	2 LUND	.23	.51	.20	.36
5	PRAT	.27	.42	.32	.35
6	WRIC	.03	.08	.53	.29
7	OPST	.17	.13	.65	.46
8	WRMA	.32	.64	.16	.54
9	STEP 1	.82	.37	.10	.81
10	STEP 2	.80	.28	.19	.75
11	STEP 3	.74	.27	.09	.62
12	STEP 4	.78	.26	.17	.70
13	STEP 5	.81	.24	.02	.71
14	STAN WM	.72	.30	.48	.83
15	STAN PM	.63	.27	.49	.70

Table 21

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Pretest, Control, Low Socio-economic

Var. No.	Acronym	Factor No. I	II	III	$\underline{h}^2$
1	CHMA	.24	.38	.21	.24
2	CLSA	.21	.52	.44	.50
3	1 LUND	.14	.58	.01	.36
4	2 LUND	.30	.51	.33	.46
5	PRAT	.34	.61	.22	.53
6	WRIC	.16	.04	.48	.26
7	OPST	.23	.37	.58	.52
8	WRMA	.39	.34	.33	.38
9	STEP 1	.88	.33	.24	.93
10	STEP 2	.65	.33	.37	.67
11	STEP 3	.76	.27	.44	.83
12	STEP 4	.73	.35	.36	.78
13	STEP 5	.72	.31	.37	.75
14	STAN WM	.44	.23	.75	.81
15	STAN PM	.42	.29	.72	.78

Finally, factor analyses for the postest data with the SES divisions are shown in Tables 22 through 25. First, the factor structure for the high SES, E postest group after training in problem solving showed the basic three factors, the same structure as for the SES-divided pretests and for the IQ-divided postests with factor I (reading) again showing a criterion loading value on 2 LUND (the variable of listening critically to propaganda). An appreciable correlation (-.50) was obtained between factor I and factor III (as was also the case for the high SES, E group on the pretest analysis where $r = -.61$). Also factors II and III were correlated (-.48) but only on the postests. Factor II (verbal abstract thinking) appeared more substantial, too, for the present high E SES analysis after training and was of interest because of the addition of reading variables to the factor: Stanford word meaning; paragraph meaning; and STEP subscore 5, criticizing. There appeared to be departures in structure from the post high IQ factors which had split into the two problem-solving variables. (See Table 22.)

For the factor structure on the low SES, E postests the outstanding feature was the strengthening of factor II (verbal abstract thinking) in relation to the pretest structure. A fourth factor (factor IV) also appeared which was formulated by the splitting of the Stanford reading test variables from the STEP subtests. In comparison with the postests from the low IQ, E group, the structure was basically the same but with less independence of relationship between factors. (See Table 23.)

The factor structure for the high SES, C on the postests showed the basic three factors. All of the reading variables were loaded on factor I; in addition the two abstract thinking variables, CHMA and WRMA, were unexpectedly loaded on it. Factor I was not as strong as in the experimental groups and was correlated (-.50) with factor III (problem solving). Factor III also appeared slighter by comparison with the experimental group; one of the problem-solving tests (WRIC) did not reach the criterion cutoff value. Surprisingly, not only were the Stanford reading variables located on factor III (problem solving) but also the STEP subscore, number 2 (translating and making inferences) was located on factor III. Factor III was also correlated with factor II (-.48). In comparing the structure at the beginning of the fifth grade, this group showed the same number of factors but instead, factor I and II were the correlated factors.

In comparison with the high IQ, C on the postests a similar weakness was shown in factors II and III, but there was no splitting of 2 LUND, listening critically to propaganda, and WRMA (an abstract variable) appeared on the problem-solving factor rather than the reading factor. (See Table 24.)

The structure for low SES, C on the postests consisted of four factors. Factor I (reading) contained a listening variable (listening critically to propaganda) as had been the case for the low IQ group. This shift had not occurred for the low E group. Factor II (verbal abstract thinking) was less substantial than in the case of E. Factor III (problem solving) was basically the same and the fourth factor (identified previously as factor VIII, CHMA) included one other variable that reached criterion value, 1 LUND (the test of listening critically to speaker's purpose.)

Table 22

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Postest, Experimental, High Socio-economic

Var. No.	Acronym	Factor No. I	II	III	$\underline{h}^2$
1	CHMA	.34	.53	.15	.42
2	CLSA	.29	.59	.18	.47
3	1 LUND	.32	.52	.06	.38
4	2 LUND	.40	.51	.12	.43
5	PRAT	.22	.62	-.05	.44
6	WRIC	.13	.06	.67	.47
7	OPST	.31	.38	.48	.48
8	WRMA	.11	.59	.29	.45
9	STEP 1	.63	.31	.17	.52
10	STEP 2	.71	.28	.45	.78
11	STEP 3	.68	.32	.14	.58
12	STEP 4	.79	.29	.16	.74
13	STEP 5	.71	.42	.14	.70
14	STAN WM	.46	.64	.22	.66
15	STAN PM	.44	.62	.31	.68

Table 23

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Postest, Experimental, Low Socio-economic

Var. No.	Acronym	Factor No. I	II	III	IV	$\underline{h}^2$
1	CHMA	.29	.55	-.02	.33	.50
2	CLSA	.40	.53	.22	.38	.64
3	1 LUND	.19	.57	.07	.01	.37
4	2 LUND	.25	.41	.28	.10	.31
5	PRAT	.23	.63	-.01	.30	.54
6	WRIC	.14	-.01	.77	.09	.62
7	OPST	.18	.30	.62	.17	.54
8	WRMA	.15	.53	.19	.17	.36
9	STEP 1	.79	.32	.22	.25	.83
10	STEP 2	.81	.27	.16	.13	.77
11	STEP 3	.72	.20	.21	.28	.69
12	STEP 4	.76	.21	.11	.26	.70
13	STEP 5	.74	.37	.11	.20	.74
14	STAN WM	.34	.31	.27	.75	.85
15	STAN PM	.35	.26	.16	.80	.85

Table 24

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Postest, Control, High Socio-economic

Var. No.	Acronym	Factor No. I	II	III	$\underline{h}^2$
1	CHMA	.41	.60	.21	.57
2	CLSA	.19	.49	.39	.43
3	1 LUND	.18	.85	-.07	.77
4	2 LUND	.24	.55	.23	.42
5	PRAT	.18	.56	.42	.52
6	WRIC	.07	.02	.17	.03
7	OPST	.14	.12	.52	.30
8	WRMA	.40	.33	.32	.37
9	STEP 1	.72	.34	.38	.78
10	STEP 2	.75	.22	.42	.79
11	STEP 3	.67	.21	.35	.61
12	STEP 4	.78	.30	.23	.75
13	STEP 5	.81	.22	.17	.74
14	STAN WM	.56	.31	.65	.83
15	STAN PM	.44	.27	.72	.79

This factor was correlated (-.48) with factor I (reading). Five variables appeared diffused and clustered on two or more factors: CLSA, 2 LUND, WRMA, STEP (subscore 2), and Stanford paragraph meaning. There was no fourth factor for the pretests for this group. The structure was similar to the one for the low IQ C postests, except that factor I correlated with the problem-solving factor rather than factor VIII, and the variable of general listening did not reach criterion value. (See Table 25.)

<u>Summary of the two levels of socio-economic status</u>. The highlights from the results of the structural changes for the experimental and control groups differentiated by levels of high and low socio-economic status from pretest to postest and as compared with the analyses for two IQ levels were: (1) the basic structure appeared to consist of the same three major factors: I--reading achievement, II--verbal abstract thinking, and III--problem solving. (2) Again, STEP and Stanford reading tests did not always appear on the same factor, especially in the case of the low experimental group on the postests where a separate factor was formed by the two Stanford reading subtests. The second STEP subscore, making inferences, was unstable and shifted to several other factors. The reading factor, however, was correlated almost consistently with the problem-solving factor with respect to socio-economic status split, not so with the IQ split. As was the previous case, the factor with the most fluctuation was factor II.

When the division was made on the basis of socio-economic level there appeared to be less splitting of the factors as compared to the division on the basis of IQ level. Again, at the beginning of the fifth grade the low SES group did not show the variable of writing an abstract meaning (WRMA) as reaching criterion cutoff value on the pretest. (3) As was found in previous analyses, there was a strengthening on the postest structure after training when compared to the control groups, especially for factor II (abstract thinking), factor III (problem solving), and even for factor I (reading).

<u>The comparison at the sixth-grade level</u>. The final inspection using factor analysis was to compare structures from the pretests given early in fifth grade to the retention tests given approximately seven months after the postests when the children were in the second month of the sixth grade. Only those children in the sixth grade were tested who were in the subsample and who had completed all pre- and postest measurement. As expected, there was additional attrition of the total sample size ($\underline{N}$ = 153). A comparison, however, had been made earlier of the attrition from the postest sample to the retention test sample in which no significant difference in IQ or any other bias could be uncovered. The size of the experimental group for this present analysis was 117. The control sample was too small for appropriate use in factor analysis. Similarly, this sample was too small to make divisions for levels of IQ and socio-economic status.

Moreover, it had been necessary to reduce the number of measures in the battery. One test was selected to represent the group of three measures of abstract thinking (CLSA); one for listening (2 LUND); and one for problem solving (OPST). The same measures of reading, the STEP subscores and

Table 25

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Postest, Control, Low Socio-economic

Var. No.	Acronym	Factor No. I	II	III	VIII	h^2
1	CHMA	.27	.07	.28	.70	.64
2	CLSA	.33	.40	.39	.39	.58
3	1 LUND	.25	.29	.05	.46	.36
4	2 LUND	.42	.67	.19	.09	.68
5	PRAT	.25	.52	.33	.38	.59
6	WRIC	.17	.06	.64	.17	.47
7	OPST	.23	.29	.78	.11	.76
8	WRMA	.55	.18	.35	.46	.67
9	STEP 1	.81	.34	.21	.19	.86
10	STEP 2	.67	.44	.09	.31	.75
11	STEP 3	.79	.37	.24	.19	.86
12	STEP 4	.70	.26	.25	.36	.75
13	STEP 5	.76	.22	.23	.26	.75
14	STAN WM	.65	.09	.38	.37	.71
15	STAN PM	.58	.16	.48	.37	.73

the Stanford reading subscores, completed the battery of ten variables for the analysis of the retention test scores as compared to the matching pretest scores.

First the pretest structure for the smaller battery and reduced sample at the beginning of fifth grade for both experimental (E) and control (C) groups combined is presented; next, for the experimental alone, then, the retention test structure at sixth grade level for both E and C, and then for E alone. In general there were consistently two factors and the structures described in previous sections continued to be identified.

For the experimental and control group combined on the pretests (ten variables), two factors were extracted, one of which was identified tentatively as factor I (reading) with loadings at criterion level or above for the five STEP subtests. The next factor appeared to be a general factor or a composite of three factors identified earlier; mainly factor IV (Stanford reading), next, factor III (problem solving, OPST only, of course) and last, factor IX, the abstract singlet (CLSA). The test of critical listening used failed to reach criterion level value in this pretest analysis. (See Table 26). Also two STEP subscores (4 and 5) reached criterion value on the composite or general factor. Factor I and the general factor were correlated (-.77). The factor structure on the pretests for the E group alone was basically the same. (See Table 27.)

The factor structure on the retention tests in the sixth grade was similar to the pretests when both E and C groups were combined. An exception was that the test of critical listening had now reached criterion value, appearing on both the reading factor and on the general factor. The two factors had approximately the same correlation (-.79). (See Table 28.)

It was interesting, however, to note the slight change in structure for the experimental groups alone on the retention test. On the retention test for the E group only, the structure for the usual factor I (reading achievement, STEP subscores) now included the abstract thinking variable and the critical listening variable. Perhaps for the second factor, problem solving was more clearly defined along with Stanford reading. The correlation was about the same (-.79). (See Table 29.)

Summary for the retention test analyses. In sum, even with a reduced sample and with a reduced number of variables the factor structure identified earlier still appeared to emerge on the retention tests given in the sixth grade. The two sets of reading variables continued to appear on separate factors though correlation between factors was high. On the retention test for the E group, the abstract variable appeared on factor I, STEP reading achievement, rather than on the general factor.

The selection of the retention tests to represent the larger group of tests appeared to be supported by the factor analysis results. That is, the three measures selected: abstract thinking (CLSA), listening (2 LUND), and problem solving (OPST) were the most consistent over all analyses in reaching criterion value and the consistency or changes they showed in loadings was of interest and value in giving insight into the effects of training.

Table 26

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Pretest, Experimental and Control Groups Combined[a]

Var. No.	Acronym	Factor	
		I	General Factor
1	CLSA	.29	.44
2	2 LUND	.37	.35
3	OPST	.30	.56
4	STEP 1	.80	.34
5	STEP 2	.76	.35
6	STEP 3	.73	.39
7	STEP 4	.76	.41
8	STEP 5	.75	.40
9	STAN WM	.37	.84
10	STAN PM	.37	.85

[a] This sample matched the sample completing the retention test given in sixth grade.

Table 27

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Pretest, Experimental Group

Var. No.	Acronym	Factor	
		I	General Factor
1	CLSA	.31	.48
2	2 LUND	.37	.41
3	OPST	.26	.61
4	STEP 1	.77	.37
5	STEP 2	.79	.39
6	STEP 3	.74	.38
7	STEP 4	.79	.35
8	STEP 5	.77	.38
9	STAN WM	.39	.81
10	STAN PM	.38	.84

Table 28

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Retention Tests, Sixth Grade, Experimental and Control Groups Combined

Var. No.	Acronym	Factor	
		I	General Factor
1	CLSA	.37	.41
2	2 LUND	.49	.41
3	OPST	.37	.45
4	STEP 1	.82	.33
5	STEP 2	.75	.34
6	STEP 3	.73	.40
7	STEP 4	.75	.42
8	STEP 5	.74	.42
9	STAN WM	.36	.84
10	STAN PM	.36	.86

Table 29

F-MATRIX (NORMALIZED VARIMAX ORTHOGONAL FACTORS)

Retention Tests, Sixth Grade, Experimental Group

Var. No.	Acronym	Factor	
		I	General Factor
1	CLSA	.40	.36
2	2 LUND	.47	.42
3	OPST	.36	.46
4	STEP 1	.80	.34
5	STEP 2	.79	.36
6	STEP 3	.75	.39
7	STEP 4	.76	.39
8	STEP 5	.76	.41
9	STAN WM	.37	.86
10	Stan PM	.37	.85

CONCLUSIONS AND IMPLICATIONS

Conclusions. The present investigation attempted to assess by factor analysis the strength and importance of 15 variables of language/thinking achievement with a focus on creative problem solving. Three stable factors appeared across the beginning of the fifth grade, and to the end of the fifth grade, across high and low IQ, across ranges of socio-economic status, across a treatment which included training in problem solving and a treatment which did not, and were even identified at the sixth grade level with a smaller battery and sample. The most erratic variables were general listening ability and paragraph meaning. Only the STEP reading subtests appeared to cluster almost consistently and invariably on the same factor.

It was anticipated that a few variables would fit so consistently with the total combination of scores for abstract thinking and listening that one of the three might be used in the future to represent a larger number of tests. This anticipation was not exactly fulfilled. The measure with the largest semantic and syntactic units (CLSA) appeared to be the strongest or most consistent measure of the abstract variables. The structured measure (OPST) appeared to be the most substantial of the two problem solving measures for both high and low IQ levels. The only measure of listening that formed a singlet factor was the test of listening critically to propaganda.

More specifically, highlights in the findings with regard to variables, factors, and classifications of pupils were the following. (1) There was a basic structure of three major factors identified as I--reading achievement, II--verbal abstract thinking, and III--problem solving. (2) The subscores from the two different reading tests did not cluster together consistently. (3) The least stable factor was II (verbal abstract thinking) which contained the three abstract and the three listening variables. (4) Factor III (problem solving) appeared much better defined, more consistent, with higher loadings, and was more independent of other factors for trained groups than for untrained groups at both IQ levels. (5) In some analyses the two problem-solving measures were differentiated, i.e., did not cluster together. (6) Moreover, the variable of listening critically to propaganda appeared to split off in some groups from other factors to form a singlet factor. (7) Measures of listening were almost consistent in clustering together with measures of abstract thinking rather than with measures of reading, as might have been expected from past speculations and correlational studies. (8) Subtests for each of the two reading batteries did not split off and distribute themselves with other factors but tended to cluster according to the test to which they belonged, most consistently in the case of STEP. Possibly the results from STEP subscores suggest redundancy of measurement. (9) Paragraph reading from the Stanford test appeared to cluster frequently with problem-solving variables, especially and more consistently if the group of pupils under inspection was untrained.

A comparison of the results for the division into high and low IQ with the division for high and low socio-economic status revealed:

(10) The basic structure persisted, but the reading variables behaved somewhat differently. For example, the second STEP subscore (making inferences) was associated with other factors besides reading factor I for the two socio-economic breakdowns on the postests. Subscore 2 was found on factor III for the two high SES control groups on factor III and subscore 5 was found on factor II for the high SES experimental group. Reading achievement factor I was correlated almost consistently with problem-solving factor III for the division into levels of socio-economic status; such was not the case for the breakdown into IQ levels. (11) The structure for groupings based on socio-economic status showed less splitting and fewer factors than the division based on IQ level. (12) Although at the beginning of fifth grade the low socio-economic groups did not show the variable of writing an abstract meaning, WRMA, as reaching criterion value on factor II for the pretest, they did show the variables of writing a problem oriented composition, OPST, on factor III; such was not the case for the low IQ group. (13) For both divisions of the sample--socio-economic status and IQ--there appeared to be a strengthening of the factor structure at the end of the fifth grade for the experimental group that was trained in problem solving compared to the control group, which was not.

The results of an earlier factor analysis at the sixth-grade level (Lundsteen and Michael, 1966) using some of the same variables tended to be in agreement, but there was less distinction between the abstract variables and the listening variables in the present study than in the earlier study and less association between the reading variables and the abstract thinking variables. In the earlier factor analysis using sixth grade pupils, it appeared that children who tended to prefer abstract qualities of concept formation did well on tests of critical listening STEP reading and in scholastic achievement as measured by SCAT.

Implications. Chapman (1969) has presented an analysis of three "theories" of the relationships among reading comprehension skills which may be applicable to the present study. These "theories" were: (1) Independent Skills Theory, (2) Global Skills Theory, and (3) Hierarchical Skills Theory. On the one hand the results of the present factor analysis did not appear to support a global skills theory for reading tests, tests of abstract thinking, listening, or problem solving. On the other hand, the independent skills theory was not substantiated and variables which were labeled alike did tend to cluster and a general factor was found for the retention tests when the pupils had progressed to the sixth grade. The strength of the relation between abstract thinking, reading, and problem solving may be the basis for testable hypotheses concerning cause-effect and hierarchical relationships, i.e., the undertaking of some basic research.

From the standpoint of practice, the present test battery might be used by teachers for locating groups of pupils along a continuum of language and thought proficiency, replacing more subjective methods of teacher evaluation. Teachers using the present battery claimed that by examining the results of the battery they learned a great deal about the quality of their pupils' abilities to think abstractly, to listen in a test situation, and to express themselves including their values and techniques with regard to "people problems."

The cross sectional look at the structure of development from the beginning of the fifth grade to the end of the fifth grade (and in a limited way in the second month of the sixth grade) indicated some notable changes for both trained and untrained, high and low groups. No cluster of variables appeared consistently and more closely associated with the low IQ than with the high IQ group, however.

There did not appear to be any consistent pattern for the groups studied so that a certain structure at the beginning would predict a certain structure at the end of fifth grade or the beginning of the sixth grade. It appeared, however, that a group which received training produced a more clear-cut structure at the end of training.

The products of measurement had been constructed prior to this study, and results of the factor analysis appeared to give no particular enhancement or clarification which was not already known from the inspecition of earlier correlation matrices. Further research with the measurement (which needs further revision) should be made with other populations of children and with larger groups that can be delineated more clearly than in the present sample as high and low, or better yet, high, medium, and low.

Finally, in addition to the suggested effect of training, the most interesting results and implications may have to do with the comparison of the analyses based on IQ with those based on socio-economic status. The evidence was that the reading variables behaved somewhat differently for the division based on socio-economic status and the division based on IQ. Also the analyses showed that the reading variables were more related to the problem-solving factor than to other factors, again when the basis for division was socio-economic level; these results were provocative. These tentative findings are presented with the suggestion of the need for follow-up research which may demonstrate that socio-economic status, possibly more so than IQ, is a crucial influence on reading performance.

REFERENCES

Bronfenbrenner, U. The split level American family. Saturday Review, October 1967, 60-66.

Chapman, C. A. An analysis of three theories of the relationships among reading comprehension skills. Paper presented at the meeting of the International Reading Association, Kansas City, 1969. (mimeo)

French, J. W. The description of aptitude and achievement tests in terms of rotated factors. Psychometric Monographs, Psychometric Society, University of Chicago Press, No. 5, 1951.

Fruchter, B. Program SCORBLIQ. The University of Texas at Austin, May 1968. (dittoed)

Gallup International. Parents reactions to educational innovations. (POS 634) Princeton, New Jersey, May 10, 1966.

Jensen, A. R. How much can we boost IQ and scholastic achievement. Harvard Educational Review, 1969, 39 (1), 1-123.

Levi, A. Remedial techniques in disorders of concept formation. Journal of Special Education, 1966, 1 (1), 3-8.

Lundsteen, S. W. Teaching abilities in critical listening in the fifth and sixth grades. Unpublished doctoral dissertation, University of California, Berkeley, 1963.

Lundsteen, S. W. Improving the abstract quality within creative problem solving. The Journal of Special Education, 1968, 2 (2), 177-183.

Lundsteen, S. W. Critical listening research and development: listening tests, curriculum, and results for the thinking improvement project. Highlights of the 1968 IRA Preconvention Institute II: Critical Reading and Listening, Exemplary Center for Reading Instruction: Salt Lake City, Utah, 1969, in press. (a)

Lundsteen, S. W. Promoting growth in problem solving in an integrated program of language skills for fifth grade. Journal of Educational Psychology, 1969, in press. (b)

Lundsteen, S. W. Research in critical listening and thinking. Journal of Research and Development in Education, 3 (1), 1969, in press. (c)

Lundsteen, S. W. Manipulating abstract thinking as a subability to problem solving in a program for integrated language skills. American Educational Research Journal, 1970, in press.

REFERENCES (Con't)

Lundsteen, S. W. Working with teachers to promote problem-solving skills within the context of language arts. Prospects in Education, UNESCO, Plac de Founterey 75, Paris 7e, France, in press.

Lundsteen, S. W. & Michael, W. B. Validation of three tests of cognitive style in verbalization for the third and sixth grades. Educational and Psychological Measurement, 1966, 26, 449-461.

Russell, D. H. Children's thinking. Boston: Ginn and Co., 1956.

Seligman, D. A special kind of rebellion. Fortune, 79 (1), 66-69, 173-174.

Voyat, G. IQ: God-given or man-made?" Saturday Review, May 17, 1969, 73-75, 86, 87.

APPENDICES

Appendix A

PALO ALTO UNIFIED SCHOOL DISTRICT
RESEARCH DEPARTMENT

SUGGESTED 9-POINT SCALE OF OCCUPATIONAL-SOCIAL STATUS CATEGORIES

Scale	In General	
9	Executives or owners of large concerns Major professionals	Presidents (vice-presidents), superintendents, directors Doctors, lawyers, professors, architects, consulting technicians, artists, Lt. Col.
8	Managers or owners of medium size concerns of large farms Minor professions (Large private incomes)	Retail store owners, branch managers, principals, teachers, coulists, veterinarians, officers (armed service), Major
7	Major administrators Independent small businessmen Skilled sales (Modest private incomes)	Section or department heads, automobiles, shops, theatres, real estate, insurance, stocks, Captain
6	Owners of small farms Minor sales (independent) Semiprofessionals	Parts, supplies, appliances, business machines, services, barbers, nurse aide, Sergeant
5	Skilled clerical Major foremen Civil inspectors Minor officials	Steno, private secretary, accountant, librarian, hairdresser
4	Minor clerical Minor supervisors, foremen	File clerk, PBX, bookkeeper, hostess, typist
3	Skilled laborer	Carpenter, mason, plumber, electrician, typographer, TV
2	Semi-skilled laborer	Custodian, waitress, truck-driver, service station, gardener, apprentice
1	Unskilled laborer	Fruit picker, road mender, day laborer, hod carrier
X	Unknown, not stated	

Note: If wife states no present or former occupation, she should be assigned to husband's category. 'Students' should be classified by major field or aspiration; if not known, use parental class.

Appendix B

ANALYSIS OF DIFFICULTY LEVEL OF TWELVE QUESTION TYPES FROM THE PROBLEM-SOLVING MEASURE, OPST FOR PRETEST AND POSTEST EXPERIMENTAL GROUP ONLY

Low IQ N = 60
High IQ N = 65

IQ Group	Question No.	$Pretest_1$ M	$Postest_2$ M	$Rank_1$	$Rank_2$
Low	1	20.13[a]	25.28[a]	1	1
	2	17.97	25.18	3	2
	3	15.33	18.53	5	10
	4	14.93	21.80	6	5
	5	18.43	24.36	2	4
	6	14.37	19.74	9	7
	7	11.97[b]	16.79[b]	12	12
	8	14.87	21.67	8	6
	9	13.53	17.90	10	11
	10	14.93	19.64	7	8
	11	12.70	19.21	11	9
	12	16.43	24.92	4	3
High	1	24.19	37.28	2	3
	2	23.72	37.16	3	4
	3	19.65	28.53	7	10
	4	20.12	33.47	5	5
	5	23.51	38.94	4	2
	6	19.42	33.38	8	7
	7	14.95[b]	21.94[b]	12	12
	8	20.03	33.41	6	6
	9	17.45	27.19	11	11
	10	18.95	31.44	9	9
	11	18.34	32.84	10	8
	12	24.55[a]	43.66[a]	1	1

[a] The questions for the problem-solving measure (OPST) were ranked from highest to lowest according to the mean score that high IQ and low IQ pupils in the experimental group were able to achieve. For pupils in the low IQ division, the highest mean score was made on question 1 (constructing a main problem) on both the pretest and the postest. For pupils in the high IQ division, however, the highest mean was made on question 12 (planned evaluation of hypotheses) on both the pretest and postest. See Appendix C for a description of the 12 question types. Comparison of pre- and postest ranking of all 12 question types, from highest mean score to lowest mean score for the low IQ group, yielded a rank-difference coefficient of correlation of .84, and for the high IQ group, .93.

[b] For pupils in the low IQ division and in the high IQ division the lowest mean score was made on question 7 (classification of facts and conditions) on both the pretest and the postest.

Appendix C

TWELVE STEPS OR QUESTION TYPES USED IN THE TESTS FOR CREATIVE PROBLEM SOLVING

1. Main Problem. The pupil constructs a problem.

2. Subproblems. The pupil names or constructs subproblems that go with the main problem or are a part of it.

3. Definition. The pupil defines (describes) key terms in the problem situation which he constructed and/or clarifies these terms.

4. Type of problem. The pupil identifies (distinguishes) the problem as to type or kind.

5. Hypotheses. The pupil constructs hypotheses.

6. Facts and conditions. The pupil names, describes, and distinguishes facts and conditions in the situation which he constructs that might be helpful when seeking a solution to the problem.

7. Classification of facts and conditions. The pupil distinguishes, groups or classes and names the class(es) under which the various facts and conditions might be categorized.

8. Missing data. The pupil names and/or describes and/or distinguishes missing information that is needed to solve the problem.

9. Search strategy. The pupil constructs a method(s) for finding the information that is missing.

10. Statement of principle. The pupil states a principle for solving a problem of the type he indicated.

11. Application of principle. The pupil applies the principle to the problem situation, describing the application.

12. Planned evaluation of hypothesis. The pupil identifies one of his constructed hypotheses for solving the problem and constructs an evaluation by supporting his choice with reasons in regard to confidence in probability and/or consequences.