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ABSTRACT

Content and task dimensions of social studies items were studied using factor analytic techniques. These items were developed to measure concept attainment using a completely crossed design with 30 concepts and 12 tasks. Conventional factor analyses were performed, separately for boys and girls, for concept scores and for task scores. Three-mode factor analyses were performed. The main conclusions drawn from the results of the conventional factor analyses are that all 30 of the concepts are measures of a single functional relationship existing among the concepts and that all 12 tasks are measures of a single underlying ability or latent trait. The three-mode results indicate that there are no important concept-task interactions for the idealized persons; thus it is reasonable to regard the concepts and the tasks as being two independent modes. (Author)

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CENTER FOR
COGNITIVE LEARNING

Technical Report No. 194

AN ANALYSIS OF CONTENT AND TASK DIMENSIONS OF SOCIAL STUDIES ITEMS DESIGNED TO MEASURE LEVEL OF CONCEPT ATTAINMENT

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Report from the Project on
A Structure of Concept Attainment Abilities
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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 that 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

Content and task dimensions of social studies items were studied using factor analytic techniques. These items were developed to measure concept attainment using a completely crossed design with 30 concepts and 12 tasks. Conventional factor analyses were performed, separately for boys and girls, for concept scores and for task scores. Three-mode factor analyses were performed.

The main conclusions drawn from the results of the conventional factor analyses are that all 30 of the concepts are measures of a single functional relationship existing among the concepts, and that all 12 tasks are measures of a single underlying ability or latent trait. The three-mode results indicate that there are no important concept-task interactions for the idealized persons; thus it is reasonable to regard the concepts and the tasks as being two independent modes.

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.

This paper contains a report of the factor analytic study of the content and task dimensions of the social studies items that were developed as one aspect of Step 2. This study is a necessary intermediate step between Step 2 and Step 4; some reduction in the number of concepts for each subject matter field from the 30 selected ones for which tests were developed is mandatory in order to be able to carry out Step 4.

Nature of Social Studies Items

Concepts may be defined in one or more of four ways: (a) structurally, in terms of perceptible or readily specifiable properties or attributes; (b) semantically, in terms of synonyms or antonyms; (c) operationally, in terms of the procedures employed to distinguish the concept from other concepts; or (d) axiomatically, in terms of logical or numerical relationships (Klausmeier, Harris, Davis, Schwenn, & Frayer, 1968). "A concept exists whenever two or more distinguishable objects or events have been grouped or classified together and set apart from objects on the basis of some common feature or property of each" (Bourne, 1966, p. 1). The concept of Bourne's definition might be called a classificatory one and seems to be the same as the structural type discussed by Klausmeier et al. (1968). This is the type of concept with which this project is concerned, and such a definition of a concept served as the basis for selection and analysis of subject matter concepts.

Many different types of performance might be taken as the critical evidence that a student does or does not understand a given concept. Thus, as a part of this project it is necessary to have a schema for measuring understanding of concepts. Such a schema was developed by Frayer, Fredrick, and Klausmeier (1969) and was used by the CAA Project to assess concept attainment. The "Schema for Testing the Level of Concept Mastery" consists of 13 types of questions, each involving a different task required of the examinee. The schema also allows for selection of an answer (multiple-choice type questions) or for production of an answer (completion type questions). It was decided to use the first 12 tasks and a multiple-choice format for this project. The 12 tasks of the schema which were used are:

1. Given the name of an attribute, select an example of the attribute.

2. Given an example of an attribute, select the name of the attribute.

3. Given the name of a concept, select an example of the concept.

4. Given the name of a concept, select a nonexample of the concept.

5. Given an example of a concept, select the name of the concept.

6. Given the name of a concept, select the relevant attribute.

7. Given the name of a concept, select the irrelevant attribute.

8. Given the definition of a concept, select the name of the concept.

9. Given the name of a concept, select the definition of the concept.

10. Given the name of a concept, select the supraordinate concept.

11. Given the name of a concept, select the subordinate concept.

12. Given the names of two concepts, select the relationship between them.

Single- or compound-word classificatory concepts (those that are defined by attributes) in social studies subject matter at the fourth grade level were identified. This task was subdivided into four steps:

1. Identification of the major areas within the subject matter of social studies,

2. Selection of three of these major areas to be studied,

3. Identification of classificatory concepts within each of these three major areas, and

4. Random sampling of ten concepts from those identified for each of the three selected major areas.

This yielded a total of 30 social studies concepts to be studied by the project. A list is given in Table 1, by area, of the concepts identified and randomly selected for study. The areas are Geographic Region, Man and Society, and Map and Globe Study. A description of the procedures used to identify these concepts can be found in "Selection and Analysis of Social Studies Concepts for Inclusion in Tests of Concept Attainment" (Tabachnick, Weible, & Frayer, 1970).

The researchers of Project 101, Situational Variables and Efficiency of Concept Learning, developed a system for analyzing a concept in preparation for developing items to measure the level of attainment of that concept (Frayer, Fredrick, & Klausmeier, 1969). Since the publication of that paper they, in cooperation with the researchers of the CAA Project, have refined their thinking and advanced this system. The refinements are discussed in "A Structure of Concept Attainment Abilities: The Problem and Strategies for Attacking It" (Harris, Harris, Frayer, & Quilling, in press). Briefly, a concept may be described in many ways: in terms of its criterial, relevant, and irrelevant attributes; its examples and nonexamples; its supraordinate, coordinate, and subordinate hierarchical relationships (theoretically determined); and its lawful or other types of relationships to other concepts. Knowledge of each of these kinds of information may be tested to determine a student's level of attainment of a concept. An analysis, along these lines, of each of the 30 sampled social studies concepts which are being studied can be found in "Selection and Analysis of Social Studies Concepts for Inclusion in Tests of Concept Attainment" (Tabachnick, Weible, & Frayer, 1970).

Thus, using the analysis of a concept as the basis for appropriate content and the 12 tasks of the schema as the basis for appropriate tasks, 12 items, one for each of the 12 tasks, could be developed for each of the 30 concepts making a total of 360 social studies items. Actually, only 359 items were developed for the purpose of measuring and assessing concept attainment in social studies, as no subordinate concept was identified for the concept Tropical Region; thus, there is no Task 11 item for this concept. A description of the procedures used in the development of these items, along with item and total score statistics (for concepts and for tasks) obtained for them for fifth grade boys and girls, can be found in "Measuring Social Studies Concept Attainment: Boys and Girls" (Harris & Tabachnick, in press). The items can be found in "Items to Test Level of Attainment of Social Studies Concepts by Intermediate-Grade Children" (Tabachnick, Weible, & Livermore, 1970).

The following sections contain a discussion of the study of the dimensionality of the two modes, concepts (content) and tasks, of this completely crossed design used to develop items to measure concept attainment in social studies.

Table 1
Social Studies Concepts Categorized by Area

Geographic Region	Man and Society	Map and Globe Study
Bay	Agriculture	Area (square miles)
Canal	*Airway	Axis
Climate	Basic Needs	Boundary
*Coastline	*City	Continent
*Delta	Commerce (trade)	*Country
*Desert	*Countryside	Day
Elevation	*Democracy	*Distance
Geography	Economy	Earth
*Gulf	Educational Institution	*East-West (lines of latitude)
Harbor	*Exchange	Equator
Highland	Family	*Globe
Hills	Farming	Gravity
Island	Fishing	Hemispheres
Isthmus	Forestry	Legend
Lake	*Government	Map
Location	Industry	*Map Directions
Mountain	Institutions	*Map Measurement
Mountain Pass	International	*Map Scale
Mountain Peak	*Land Routes	Meridians
*Mountain Region	Man	Model
Ocean Currents	Man as a member of a group	Night
Ocean Tides	Man as an individual	*North-South (lines of longitude)
Peninsula	Manufacturing	Ocean
Plain	Market	Orientation
Prairie	Nation	Parallels
Precipitation	Nature	*Physical Feature Map
Ridge	*News	Planet
Region	*Organization	Political Map (of nations, countries)
*River	President	Revolution
*River Mouth	Republic	Rotation
River Source	Service Organization	Sea Level-Below Sea Level
*Strait	Society	Seasons
Subtropical Region	State	Solar System
Swamp	Suburban	*Symbol Map
Temperature	Transportation	Topographical Map (map of land forms)
Topography	Urban	
Transitional Region	Village	
*Tributary	*Waterway	
*Tropical Region		
Valley		
Waterway		
Weather		

*Concepts randomly selected to be tested.

Hypothesized Factor Structures

Alternative sets of factors were postulated for the social studies concepts and for the tasks using social studies content by viewing the concepts and tasks as two independent modes. Viewing them in this way is essentially hypothesizing that no important interactions exist between the two modes.

Concepts

The most general hypothesis is that just one common factor underlies the selected social studies concepts. Next in the order of generality to specificity is that three common factors are present, one for each of the three major areas selected for study: Geographic Region, Man and Society, and Map and Globe Study. A more specific hypothesis is that there may be two or more common factors for each of the three areas. A structure of the concepts within each of the three areas was not hypothesized. Instead, it was preferred to randomly sample concepts from each area and and see what functional relationships exist among those sampled concepts. It was felt that this would eliminate bias in the picture of the dimensionality of the concepts imposed by theoretical relationships that may or may not exist in actuality. If attainment of concepts is highly specific, this approach may be detrimental as there may not be at least two measures (concepts) of a concept dimension included. There are some indications that the concepts are not this specific. For example, fairly reliable task scores obtained by totalling across the 30 concepts for a single task were obtained. This indicates some degree of homogeneity among the concepts.

Tasks

The most general hypothesis is that just one common factor or ability underlies the 12 tasks. A more specific hypothesis is that there are five underlying abilities: an ability dealing with attributes (Tasks 1 and 2); one dealing with examples of a concept (Tasks 3, 4, and 5); one related to the definition of a concept (Tasks 6, 7, 8, and 9); one related to hierarchical relationships (Tasks 10 and 11); and one for a relationship of a concept with another concept (Task 12). A slightly more specific hypothesis is that there are six abilities: The five just listed, with the exception that the ability related to the definition of a concept may be further specific to those tasks dealing with relevant and irrelevant attributes (Tasks 6 and 7) and those tasks dealing directly with a definition (Tasks 8 and 9).

These alternative sets of factors represent an a priori analysis of the social studies concepts and the tasks when using social studies content. A major question to be answered in this study is the extent to which the obtained factors parallel such hypothesized analyses. Note that, as discussed, several levels of specificity are postulated. Another question to be answered in this study is the extent to which the concepts and the tasks are independent as hypothesized.

II
Procedures

Subjects

Pilot studies revealed that the concepts selected were very difficult for fourth graders. Thus, the decision was made to test fifth grade students with the concepts identified and sampled from the fourth grade textbooks. The social studies items were administered during early summer, 1970, to 196 girls who had just completed the fifth grade and to 195 boys who were just beginning the sixth grade during the fall of 1970 in the public school system of Madison, Wisconsin. The students were randomly selected from the population of all such girls and from the population of all such boys. The Madison Public School System made available the information concerning the populations and used their computing facilities to designate the random sample for the girls.

Initially, a random sample of 300 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 two yes responses and 25 no responses were obtained from the cards returned. Those parents who had not returned the card by a specified date were phoned. An additional 46 yes and 61 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 150 girls was drawn at random. From this sample, 56 yes and 30 no responses were obtained by card. Thus, of the total sample of 450 students, 203 yes and 116 no responses were received; seven students did not complete the testing, which resulted in a total of 196 girls tested. These students were paid $7.50 for participating.

A random sample of 756 boys was drawn and letters were sent. By mail, 420 yes and 87 no responses were obtained. Thirty-eight of the subjects did not complete the testing, resulting in 382 boys tested. Of this total, 195 boys completed the mathematics and social studies items; the others responded to language arts and science items. As with the girls, the boys who completed the testing program were paid $7.50.

Since the participation of all students comprising the random sample was impossible to attain, test score and IQ data were obtained from the files of the Madison 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 public school system of the city of Madson during the school year 1969-1970, and for the boys and the girls who comprised the tested samples for the social studies items. 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 on fathers' occupations were collected from the students using the Master Occupational Code of the United States Bureau of the Census. These data were tabulated and are presented in Table 3.

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 five 2-hour daily sessions for one week.

Table 2
Test Data for Population and Samples

Test		Population	Boys	Girls
Lorge-Thorndike Intelligence Test	$\bar{X}$	106.60	105.95	112.02
	s		14.74	12.15
	N	2605	169	191
Iowa Basic Skills				
Vocabulary	$\bar{X}$	5.53	5.60	5.75
	s		1.39	1.34
	N	2520	181	187
Reading Comprehension	$\bar{X}$	5.44	5.43	5.84
	s		1.60	1.46
	N	2520	181	187
Language Skills	$\bar{X}$	5.24	5.07	5.74
	s		1.43	1.29
	N	2520	181	187
Work-Study Skills	$\bar{X}$	5.46	5.50	5.70
	s		1.31	1.13
	N	2520	181	187
Arithmetic Skills	$\bar{X}$	5.05	5.08	5.24
	s		1.04	.97
	N	2520	179	187
Composite	$\bar{X}$	5.35	5.34	5.65
	s		1.22	1.10
	N	2520	179	185

Subjects could choose the week and the school in which they wanted to report for testing. A one-week session was held at Hawthorne School from June 22 to June 26, and a one-week session was held at Hoyt School from July 13 to July 17. Each 2-hour session consisted of a 72-item "test" composed of social studies items, a 72-item "test" composed of mathematics items, and an activity break between the two of approximately 1/2 hour. The social studies and the mathematics items were given first on alternate days.

The data for the boys were collected in a similar manner from mid-October to mid-November. Ninety of the boys who were attending Middle School for sixth grade were tested after school for five consecutive days at Schenk (October 19-23), Sennett (October 26-30), and Orchard Ridge (November 2-6) schools; those 105 elementary school boys who completed the testing were tested on three consecutive Saturday mornings (October 10, 17, and 24) at Franklin, Longfellow, and Randall schools.

The social studies items were arranged in one 71-item and four 72-item "tests." The order of the items was assigned randomly over the 359 items. Two different random orders were used to collect the data: one for each school for the girls and one for each type of school for the boys. The items were arranged in five test booklets according to the random order. The students responded to the items by marking their chosen response directly on an answer sheet. 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.

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

Table 3
Distribution of Fathers' Occupations

Occupation	Boys	Girls
PROFESSIONAL, TECHNICAL, AND KINDRED WORKERS		
00. Accountant	2	2
01. Architect	1	1
02. Dentist	--	--
03. Engineer	5	8
04. Lawyer, Judge	4	3
05. Clergyman	--	--
06. Doctor	7	4
07. Nurse	--	--
08. Teacher, Professor	18	21
09. Other Professional	16	22
FARMER		
11. Farmer	--	--
MANAGERS, OFFICIALS, PROPRIETORS, EXCEPT FARM		
21. Owner of Business	2	--
22. Manager, Official	12	11
CLERICAL AND KINDRED WORKERS		
31. Bookkeeper	--	--
32. Receptionist	--	--
39. Other Clerical and Kindred Workers	3	5
SALES WORKERS		
49. Salesman	20	15
CRAFTSMEN, FOREMEN, AND KINDRED WORKERS (SKILLED WORKERS)		
51. Craftsman, Skilled Worker	31	17
52. Foreman	2	4
53. Armed Services - Officer	1	1
54. Armed Services - Enlisted Man	1	--
OPERATIVES AND KINDRED WORKERS (SEMI-SKILLED WORKERS)		
61. Truck Driver	10	5
62. Operative in Factory	9	8
69. Other Operative and Kindred Workers	18	23
PRIVATE HOUSEHOLD AND SERVICE WORKERS		
71. Fireman	1	3
72. Policeman	1	--
73. Other Protective Service Worker	--	1
74. Practical Nurse, Nurse's Aide	2	--
75. Private Household Worker	1	--
79. Other Service Workers	14	13
81. Non-Farm Laborer	--	--
82. Farm Laborer	--	--
91. Not presently in labor force	4	8
99. Not ascertained	13	22

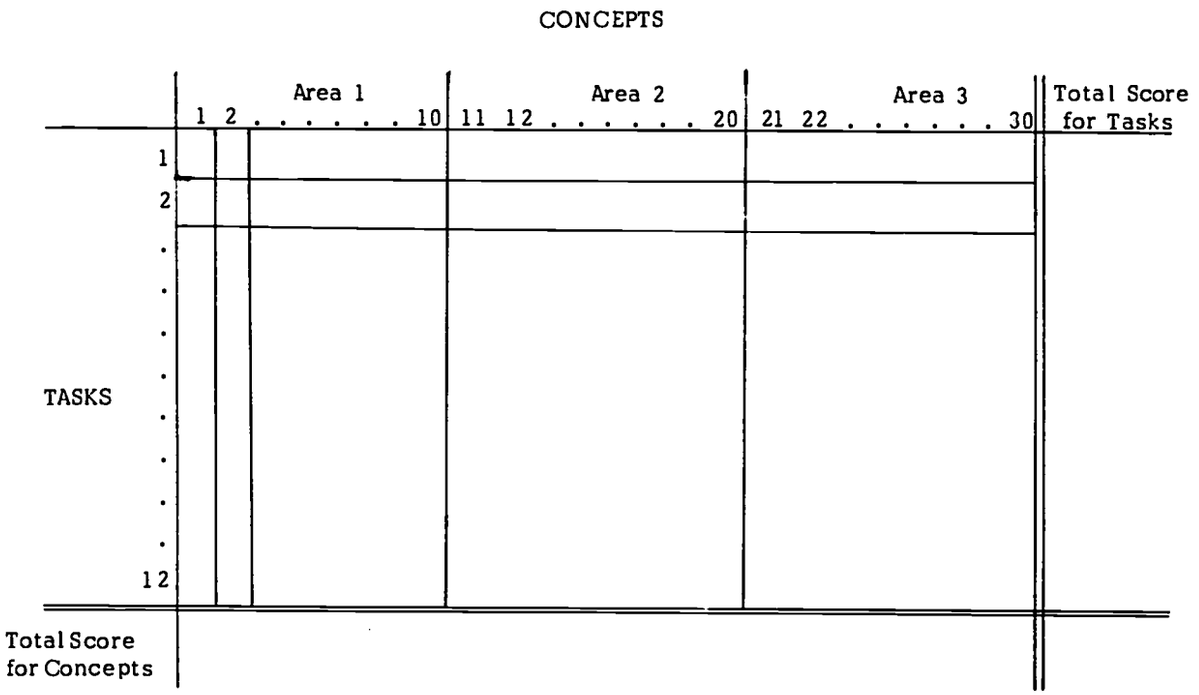

Fig. 1. Item matrix for each individual.

for each of the 30 concept scores and each of the 12 task scores for each group studied. Means and standard deviations for each of the scores were also computed.

Factor Analyses

Developing one item for each of the 12 tasks for each of the 30 selected concepts yields a 12 (tasks) by 30 (concepts) matrix consisting of the score for each of the 360 items, one for each cell of the matrix, for each individual to whom the items are administered. A completely crossed design exists and two types of total scores can be secured from this matrix: a total score for each of the 30 concepts (totalled across tasks) and a total score for each of the 12 tasks (totalled across concepts). Figure 1 is an illustration of such a matrix. Using this design to test concept attainment yields data of a three-dimensional type, if more than one concept and more than one task are included. The three dimensions are concepts, tasks, and individuals. The application of conventional factor analysis procedures to such data presents certain problems. As it has been used in the past, the researcher commonly collapses one dimension of the data, thereby losing information that is possibly very important. For example, common practice would be to use mean scores over the set of individuals to create a two-dimensional concept by task matrix which is then "factored."

Tucker's (1966a, 1966b) three-mode factor analysis has made it possible to factor analyze three-dimensional data without the potential loss of information involved in collapsing a dimension. There are some problems, however, in applying the analysis to data collected using the concept by task design with one item per cell. First, the data for a three-mode system are 0-1 data with a single item per cell; thus, there is a reliability problem with single item variables. Second, the common factors in the system are of major interest and the program to which there is access is for a component type analysis. Third, as in ordinary factor analysis, the question of the number of factors (components) to extract is a difficult question to answer, and this information has to be input into the three-mode program. For these reasons the procedures outlined here were used for factor analyzing the social studies data collected using the

schema for testing level of concept attainment.

Briefly, the strategy consists of performing conventional factor analyses separately for the concepts and for the tasks to gain some insight into the interrelationships among the variables of a single mode. Tucker's three-mode factor analysis was then used to determine if there are any important concept-task interactions for the idealized persons (person factors).

Conventional Factor Analyses. The original plans called for determining the comparable common factors, separately for the concepts and for the tasks, by using a strategy suggested by Harris & Harris (1970). This strategy is a way to determine those factors that are robust with respect to method--factors which tend to include the same variables across methods. Analyses were obtained using three initial factor methods: Alpha (Kaiser & Caffrey, 1965), Harris R-S^2 (Harris, 1962), and Unrestricted Maximum Likelihood Factor Analysis (UMLFA) (Jöreskog, 1967). These three methods provide a factor solution with a statistical basis with the number of factors determined by a statistical test (UMLFA), and two factor solutions 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). All three of the methods are independent of the scale of the variables. Derived orthogonal solutions were obtained for each of the three initial solutions using the Kaiser normal varimax procedure (Kaiser, 1958), and derived oblique solutions were obtained using the Harris-Kaiser independent cluster solution (Harris & Kaiser, 1964).

The "right number of factors" question is one for which there is still no definitive answer. For matrices which yield about the same number of factors when different methods are used, Harris & Harris (1970) suggest taking the comparable common factors as the substantive results. Doing this, the number of factors can be more or fewer than the number of factors for any single solution. This idea does not seem to be appropriate when the number of common factors obtained using different methods varies considerably, as is the case, for example, with the factoring of the social studies concepts: for boys and girls respectively, 1 and 2 for Alpha, 7 and 8 for Harris R-S^2, and 3 and 6 for UMLFA for the derived orthogonal solutions; the derived oblique solutions yielded 1 and 2 for Alpha, 7 and 8 for Harris R-S^2, and 3 and 4 for UMLFA for boys and girls respectively. These results will be presented more explicitly and discussed in the next section.

Alpha sometimes underfactors, and underfactoring is, according to Kaiser, "an unforgivable sin." Harris R-S^2 extracts a relatively large number of factors (Kaiser calls it deliberate overfactoring); but this is no problem since derived orthogonal common factors retain the important things, get rid of the "garbage," and are in no way substantially affected by doing so (Kaiser, 1970). As an example, for the social studies concepts, Harris R-S^2 extracted 18 factors initially for the girls but the derived orthogonal solution trimmed these to 8 common factors. Kaiser (1970) advocates this "deliberate overfactoring" but says he wishes oblique transformations were robust to it, which they are not. This problem was "solved" by not submitting the initial raw factor matrix to oblique rotation. Instead, the common factors of the derived orthogonal solution were taken as F and used to build R*. The Q obtained from a principal axes decomposition of R* then was submitted for oblique transformation. Thus: derived orthogonal common factors = F; FF' = R*; R* = QD^{2}Q'; and then this Q is transformed to give an oblique solution. It may be pointed out here that getting derived oblique factors from the initial raw factor matrix or from the Q obtained from R* will not make any difference if the number of initial factors and the number of derived orthogonal common factors is the same; this is the case for the factors obtained for the social studies concepts and tasks using both Alpha and UMLFA. Incidentally, Kaiser (1970) in the same paper advocates obtaining "Harris factors" as they are model-free. What is named Harris R-S^2 is one of the set of "Harris factors."

This discussion of the number of factors is an important one for this paper since it is necessary to input the number of factors for concepts and the number of factors for tasks into the three-mode program. For these social studies data the number of factors used was the number of Harris R-S^2 derived oblique common factors. There are several reasons for this: (a) Harris R-S^2 gives as many or more common factors as Alpha or UMLFA and greater specificity should allow any concept-task interactions to be more demonstrable, (b) the Harris R-S^2 solutions "look" better in terms of simple structure and lack of bipolarity, and (c) Henry Kaiser (1970) now advocates that it is the best method.

Three-Mode Factor Analyses. As was mentioned earlier in the paper, three-mode factor analyses (Tucker, 1966a, 1966b) were performed to determine if there are any impor-

tant concept-task interactions for the idealized persons. Three problems were mentioned at that time. Two of them were "solved" by doing the conventional factor analyses. The common factors in each of the two modes, concepts and tasks, were obtained and the number of factors (components) to input into the three-mode program for the two modes other than individuals was determined. The third problem still remains--the reliability problem with single item variables consisting of 0-1 type data. Also, a fourth problem exists which should perhaps be pointed out at this time. There are some missing data as can be seen in Table 4; instead of 360 items, there are only 359 for boys and 357 for girls. And empty cells cannot be tolerated in a three-mode factor analysis. To alleviate the latter two problems mentioned, single item unreliability and missing data, a three-mode analysis was performed on two different forms of the same data in an attempt to gain insight into the existence of any important concept-task interactions. It might also be pointed out that the existing program has the capacity to handle only a product of 120 for the two modes other than individuals. Thus, we could not analyze our 30 concepts by 12 tasks, as this gives a product of 360. It would have been possible to expand the program's capacity to some extent but it would have been very difficult, if not impossible, to expand it to handle a product of 360.

Conceptually, the 30 concepts were organized by subject matter experts into three areas within the subject matter field. A three-mode analysis was conducted using only three variables for concepts. Each of these variables is a composite of the items for a single task across the ten concepts within a single area. Thus, the input data for this analysis consisted of a 3 (concepts) by 12 (tasks) matrix of 36 entries for each individual. Each entry consisted of the total number correct of ten items (or fewer in the cases of missing data). The number of factors (components) for concepts input for this analysis was taken as three. The number of factors (components) for tasks input for this analysis was the number of derived oblique factors obtained for the Harris R-S^2 method--two for boys and four for girls. This analysis will be referred to as Type I three-mode analysis. Such an analysis should permit any task interactions to be clearly evident, as each task is a separate entry; actually, each task comprises three separate entries, one for each composite concept variable.

A second three-mode analysis, to be referred to as Type II, was conducted using all 30 of the concepts but only two task variables for boys and four for girls. The task variables are composites of the items for a single concept for given tasks. The composites formed for boys are:

Task Variable A - Tasks 1, 2, 3, 4, 5, 8, and 10
Task Variable B - Tasks 6, 7, 9, 11, and 12

The composites formed for girls are:

Task Variable A - Tasks 1, 2, 8, and 10
Task Variable B - Tasks 3 and 11
Task Variable C - Tasks 4, 5, 9, and 12
Task Variable D - Tasks 6 and 7

The formation of the composites was based on the derived oblique factors obtained for the Harris R-S^2 method. A task was assigned to a composite on the basis of its highest factor coefficient. It is realized that this is essentially forming factor scores using a rather undesirable method, but it was felt that since the intercorrelations of the task factors are very high (in fact so high that a reasonable interpretation is that the 12 tasks are all measures of the same latent ability), it would not be too detrimental. Also, it provided a way of forming composites based on experimental results rather than theoretical considerations to allow for greater specificity; an alternative would have been to input only one variable for tasks which would consist of a composite for all 12 of the tasks. Thus, the input data for this Type II three-mode analysis consisted of a 30 (concepts) by 2 or 4 (tasks) matrix of 60 or 120 entries for each individual. The two tasks, and thus 60 entries, are for the analysis of the boys'data and the four tasks and 120 entries are for the girls'. Each entry for the boys consisted of the total number correct of seven or five items (or fewer in the cases of missing data) and each entry for the girls consisted of the total number answered correctly of four or two items (or fewer in the cases of missing data). The number of factors (components) for tasks input for this analysis was taken as two for boys and four for girls. The number of factors (components) for concepts input for this analysis was the number of derived oblique factors obtained for the Harris R-S^2 method--seven for boys and eight for girls. Such an analysis should permit any concept interactions to be clearly evident since each concept is a separate entry; actually, each concept comprises two or four

separate entries, one for each composite task variable. There still may be somewhat of an unreliability problem in this analysis, as some of the entries consist of the total score for just two items.

The results of treating the data in these various ways are presented and discussed in the following section.

III
Results and Discussion

The means, standard deviations, and Hoyt reliability estimates obtained for the data collected during summer and fall of 1970 using the social studies items developed are presented, separately for boys and girls, for total concept and total task scores. The intercorrelations and factor results for this data are presented and discussed, once again separately for boys and girls.

Reliability Estimates and Test Statistics

Tables 4 and 5 contain the means, standard deviations, and Hoyt reliability estimates obtained for the data collected during summer and fall, 1970, using the revised items for total concept and total task scores. The data were analyzed separately for the 195 boys and the 196 girls. In general, the concept scores consist of 12 items each, and the task scores of 30 items each. Exceptions to this are noted in the footnotes.

The mean scores for boys are generally lower than are the mean scores for girls. No conclusions can be drawn from this, however, as the data for the girls were collected in early summer shortly after the school year of their fifth grade had ended and the data for the boys were collected in the fall shortly after the school year of their sixth grade had begun. Thus, it cannot be determined what, if any, of this difference is due to a sex difference and what is due to a time difference and possible forgetting factor. It should also be noted that the scores for the concepts Physical Feature Map and Delta are based on one more item for boys than they are for girls; Physical Feature Map and Delta have 12 items each for boys and 11 items for girls. The scores for Tasks 4 and 7 are made up of 30 items for boys but only 29 for girls. The standard deviations are generally bigger for boys than they are for girls.

The reliability estimates are comparable for boys and girls. The reliability estimates for the task scores are generally a few points higher for boys than they are for girls, and the estimates for just over half of the concepts are slightly higher for boys with the remaining ones being higher for the girls.

The reliability estimates are sufficiently high to warrant study of the dimensionality of these selected social studies concepts and the tasks when using social studies content. This is a major objective of the CAA Project and is the main purpose for developing these items to measure social studies concept attainment.

As was mentioned earlier, the subject matter specialists categorized the identified social studies concepts into three major areas: Geographic Region, Man and Society, and Map and Globe Study. This was done on a theoretical basis. The data could be, and were, analyzed by area for task scores. Instead of a single total task score consisting of the score for that task type item for each of the 30 concepts, three different task scores were obtained for each of the 12 tasks, consisting of the score for that task type item for each of the 10 concepts within a single area. The mean, standard deviation, and Hoyt reliability estimate for each of these 36 scores, 3 areas by 12 tasks, were obtained. Table 6 contains the reliability estimates obtained for task scores by area and for the total across all 30 of the concepts. Spearman-Brown estimates for tripled test lengths (some are given at the bottom of Table 6 for comparison purposes) indicate that the area distinctions are not important ones; the reliability estimates for the total task scores are about what would be expected from tripling the length of the test when the single area reliability estimates are of the magnitude that were obtained. Also,

Table 4
Means, Standard Deviations, and Reliability Estimates for
Social Studies Concept Scores: Boys and Girls[a]

Concept	Mean		Standard Deviation		Hoyt Reliability	
	Boys[b]	Girls[c]	Boys	Girls	Boys	Girls
1	8.71	9.22	2.53	2.34	.72	.70
2	6.93	5.97+	2.71	2.55	.71	.68
3	8.18	9.16	2.09	1.76	.54	.48
4	8.49	8.36	2.28	2.19	.63	.61
5	8.93	9.99	2.28	1.97	.65	.65
6	8.31	9.01	2.54	2.30	.69	.70
7	6.80	6.74	2.47	2.55	.62	.66
8	7.60	7.95	2.72	2.55	.71	.70
9	7.80	8.29	2.86	2.60	.75	.70
10	7.71+	7.85+	2.55	2.39	.73	.72
11	8.45	9.43	2.59	2.21	.69	.66
12	8.41	9.42	2.54	1.88	.70	.53
13	8.32	9.97	2.62	1.95	.72	.65
14	6.64	7.46	2.72	2.72	.67	.70
15	7.61	8.85	2.73	2.54	.70	.74
16	6.93	7.98	2.91	2.41	.74	.68
17	8.19	8.97	2.68	2.36	.73	.69
18	7.36	8.40	2.68	2.14	.71	.61
19	8.33	9.70	2.71	2.33	.73	.74
20	8.29	9.14	2.47	2.29	.67	.70
21	6.82	7.04	2.39	2.27	.59	.59
22	8.07	9.21	2.57	2.39	.68	.71
23	7.21	8.02	2.92	2.90	.74	.76
24	8.82	9.73	2.13	1.62	.62	.51
25	6.49	7.20	2.12	2.09	.48	.56
26	6.20	7.16	2.43	2.23	.57	.54
27	6.77	7.52	2.44	2.44	.59	.64
28	6.63	7.30	2.37	2.39	.60	.65
29	6.28	6.55+	2.80	2.52	.72	.70
30	7.04	8.16	2.50	2.13	.65	.60

[a] Scores consist of 12 items each except those marked by + which have 11 items each.

[b] $N = 195$

[c] $N = 196$

Table 5
Means, Standard Deviations, and Reliability Estimates
for Social Studies Task Scores: Boys and Girls[a]

	Mean		Standard Deviation		Hoyt Reliability	
Task No.	Boys[b]	Girls[c]	Boys	Girls	Boys	Girls
1	22.54	24.40	5.23	4.29	.84	.81
2	21.30	23.16	5.33	4.46	.83	.80
3	22.14	24.28	5.41	4.43	.84	.81
4	22.32	23.03+	4.76	3.82	.81	.77
5	21.30	22.54	5.63	5.15	.85	.84
6	16.55	15.15	5.90	5.35	.82	.80
7	14.24	14.63+	5.60	4.78	.80	.74
8	19.29	22.14	6.55	5.67	.88	.86
9	18.61	21.34	6.44	5.71	.87	.86
10	19.25	21.90	5.49	5.26	.82	.84
11	17.04+	18.29+	4.99	4.52	.78	.76
12	13.71	15.58	5.98	5.69	.83	.82

[a] Scores consist of 30 items each except those marked by + which have 29 items each.

[b] $N = 195$

[c] $N = 196$

Key for Tasks:

1 Given name of attribute, select example.
2 Given example of attribute, select name.
3 Given name of concept, select example.
4 Given name of concept, select nonexample.
5 Given example of concept, select name.
6 Given concept, select relevant attribute.
7 Given concept, select irrelevant attribute.
8 Given definition of concept, select name.
9 Given name of concept, select definition.
10 Given concept, select supraordinate concept.
11 Given concept, select subordinate concept.
12 Given two concepts, select relationship.

Table 6
Reliability Estimates for Task Scores by Area and Total for Girls

Task	Area: Geographic Region[a]	Area: Man and Society[a]	Area: Map and Globe Study[a]	Total[b]
1	.50	.66	.59	.81
2	.51	.56	.62	.80
3	.50	.64	.58	.81
4	.47+	.60	.53	.77++
5	.63	.63	.68	.84
6	.63	.62	.46	.80
7	.60	.54	.36+	.74++
8	.67	.63	.70	.86
9	.68	.69	.66	.86
10	.64	.75	.60	.84
11	.53+	.62	.40	.76++
12	.63	.58	.56	.81

[a] Scores consist of 10 items each except those marked by + which have 9 items each.

[b] Scores consist of 30 items each except those marked by ++ which have 29 items each.

For comparison, these are the Spearman-Brown estimates for tripled test length:

Original	Estimated
.40	.67
.50	.75
.60	.82
.65	.85
.70	.88

the factor results, which will be discussed later, indicate that the area distinctions are not important functional ones.

Factor Analysis

The correlation matrices for the concept scores upon which the factor analyses were based are given in Table 7 for boys and Table 8 for girls. The intercorrelations of the task scores are given in Table 9 for boys and Table 10 for girls.

The intercorrelations of the concept scores are quite consistent in magnitude within the matrix for both boys and girls. The correlations for boys are typically in the .50s to mid .70s and for girls they are typically in the .40s to low .70s. The reliability estimates obtained for the concept scores are typically in the .50s to mid .70s for both boys and girls. Thus, if the correlations were corrected for attenuation they would all be quite high. The lower correlations obtained are almost wholly associated with the concept scores which have low reliability estimates.

The intercorrelations of the task scores are quite consistent in magnitude for boys and girls. They are in the .70s and .80s for both boys and girls with the exception that the correlations for Task 7 for girls are mainly in the .60s. Once again, it is interesting to look at the reliability estimates for the task scores. They are typically in the .80s for both boys and girls with one for boys and

Table 7
Intercorrelations of Concept Scores for Boys[a]

Concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
2	62																												
3	66	59																											
4	69	63	63																										
5	66	58	62	69																									
6	75	68	65	70	61																								
7	57	70	53	65	52	56																							
8	66	61	55	66	58	67	58																						
9	66	69	63	71	65	71	61	65																					
10	71	62	66	72	68	69	58	65	68																				
11	72	59	68	71	67	70	55	61	67	67																			
12	71	61	58	68	69	69	51	60	61	66	73																		
13	67	57	62	66	66	67	51	58	66	72	65	72																	
14	62	57	56	60	63	61	50	53	57	56	64	64	59																
15	67	64	68	68	67	68	56	65	66	69	65	67	67	65															
16	68	66	66	72	70	71	60	64	66	72	64	69	68	62	74														
17	65	60	58	67	64	70	52	61	63	67	67	64	56	56	67	62													
18	66	61	60	69	67	69	56	63	65	70	69	74	72	61	67	72	65												
19	67	59	62	64	63	69	49	57	67	68	67	70	68	56	68	71	68	68											
20	67	60	61	66	65	66	58	63	61	68	63	67	63	58	68	68	68	66	66										
21	60	61	57	53	55	60	54	54	57	59	62	58	52	54	61	58	57	58	55	56									
22	67	63	56	65	61	66	56	66	65	64	66	63	64	56	62	68	64	70	61	60	55								
23	66	65	62	69	64	70	60	66	67	69	64	63	65	61	75	68	68	63	63	57	57	65							
24	63	52	62	60	65	66	47	56	62	70	64	61	66	49	62	62	63	64	62	59	54	59	60						
25	57	46	54	53	57	48	45	56	54	52	54	56	57	57	60	57	56	61	57	55	48	54	58	53					
26	60	56	55	64	64	62	52	58	60	61	64	59	62	61	62	67	65	62	65	62	53	62	64	61	57				
27	62	62	57	60	57	61	54	64	61	59	63	58	59	60	64	63	52	65	53	67	58	61	59	54	61	58			
28	61	64	59	61	69	67	59	61	62	66	63	62	62	56	62	68	56	65	54	56	54	60	69	59	51	58	58		
29	61	67	59	66	59	63	57	63	63	64	65	61	60	60	70	70	58	62	63	66	55	66	69	50	61	65	65	61	
30	60	59	67	70	63	67	57	61	68	68	66	62	64	55	70	68	65	64	59	67	55	62	66	65	54	60	63	57	62

[a] All decimals have been omitted.

Table 8
Intercorrelations of Concept Scores for Girls[a]

Concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
2	62																												
3	50	50																											
4	66	55	41																										
5	71	59	50	57																									
6	71	54	44	62	63																								
7	54	58	44	51	54	52																							
8	61	58	39	59	61	57	52																						
9	60	68	47	62	58	62	53	63																					
10	67	60	50	59	63	68	55	57	65																				
11	70	55	51	61	64	68	52	55	56	64																			
12	65	54	48	45	66	59	51	60	59	55	54																		
13	56	48	58	45	67	57	45	46	47	55	59	59																	
14	65	55	45	64	60	63	51	52	57	52	59	55	50																
15	70	50	49	56	64	63	51	54	52	64	66	57	60	59															
16	73	55	54	62	65	68	51	57	56	62	70	55	65	64	72														
17	69	55	49	56	71	68	59	58	58	65	70	62	62	59	67	62													
18	69	56	48	58	66	68	50	58	59	65	62	57	56	51	69	72	62												
19	70	51	48	56	65	69	45	54	59	64	64	65	63	57	72	69	68	68											
20	70	52	59	65	65	62	51	66	64	60	65	56	59	60	62	65	63	67	64										
21	62	50	43	59	52	54	42	53	60	51	52	48	48	54	52	57	52	59	58	59									
22	65	55	53	58	69	64	51	54	59	63	64	58	67	59	69	70	67	65	63	65	50								
23	63	58	50	65	62	62	54	64	58	62	64	53	51	60	60	62	62	58	63	59	58	59							
24	54	45	47	52	63	61	45	49	49	59	56	51	50	49	51	49	59	55	55	56	44	51	58						
25	54	46	30	46	51	48	39	48	41	41	45	48	49	47	55	52	43	55	45	52	46	53	46	37					
26	64	47	41	58	57	53	42	59	48	54	56	50	54	56	59	59	56	55	50	58	51	62	58	47	47				
27	67	54	51	61	55	62	52	60	57	60	58	51	46	58	59	63	61	63	56	65	52	64	69	57	52	65			
28	65	52	38	56	53	66	51	56	58	59	51	47	45	55	53	60	54	57	52	55	50	55	63	45	48	54	62		
29	62	56	46	57	62	61	45	64	61	54	59	56	57	66	62	67	59	65	60	65	55	63	62	55	53	60	63	60	
30	57	54	49	59	58	54	42	45	56	55	51	49	52	55	55	56	51	57	62	62	52	58	55	51	52	47	57	53	58

[a] All decimals have been omitted.

Table 9
Intercorrelations of Task Scores for Boys[a]

Task	1	2	3	4	5	6	7	8	9	10	11
2	82										
3	83	84									
4	81	77	83								
5	84	82	87	82							
6	80	78	78	78	78						
7	73	75	71	71	77	81					
8	84	81	84	84	86	86	80				
9	83	83	82	79	84	85	83	89			
10	82	82	82	79	86	84	78	86	87		
11	76	78	81	74	78	80	76	80	82	83	
12	72	73	72	69	73	82	82	78	83	79	75

[a] All decimals have been omitted.

Table 10
Intercorrelations of Task Scores for Girls[a]

Task	1	2	3	4	5	6	7	8	9	10	11
2	8[illegible]										
3	80	81									
4	76	73	81								
5	80	81	84	79							
6	74	80	77	73	78						
7	67	69	70	68	69	76					
8	83	85	84	78	83	84	75				
9	81	78	78	79	80	82	69	84			
10	79	82	79	76	80	80	69	86	81		
11	70	75	79	73	80	78	64	81	76	76	
12	76	76	75	77	79	81	74	81	83	79	71

[a] All decimals have been omitted.

three for girls in the .70s. Thus, as with the concepts, if the correlations were corrected for attenuation, they would almost all be extremely high. The uncorrected correlations are all quite high.

Conventional Factor Analyses

The numbers of factors obtained for the initial solutions and for the derived solutions, orthogonal and oblique, are given in Tables 11 and 12 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 co-

Table 11
Numbers of Initial and Derived Factors for Concept Scores: Boys and Girls

Factor Method	Initial Factors		Derived Orthogonal Factors						Derived Oblique Factors					
			Common		Specific		Null		Common		Specific		Null	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Alpha	1	2	1	2	0	0	0	0	1	2	0	0	0	0
Harris R-S^2	17	18	7	8	2	2	8	8	7	8	0	0	0	0
UMLFA	3	6	3	6	0	0	0	0	3	4	0	2	0	0

Table 12
Numbers of Initial and Derived Factors for Task Scores: Boys and Girls

Factor Method	Initial Factors		Derived Orthogonal Factors						Derived Oblique Factors					
			Common		Specific		Null		Common		Specific		Null	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Alpha	1	1	1	1	0	0	0	0	1	1	0	0	0	0
Harris R-S^2	6	5	2	4	4	0	0	1	2	4	0	0	0	0
UMLFA	2	4	2	4	0	0	0	0	2	4	0	0	0	0

efficients greater than .300 (absolute).

The derived orthogonal common factor results can be found in Appendices B-E; the derived oblique common factor results are presented in Tables 13-16. Only coefficients greater than .30 (absolute) are included. The order of the factors for each solution is arbitrary. The intercorrelations of the factors are included in the tables for the oblique solutions.

Interpretation of Factor Results for Concept Scores. The factor results for the concepts can be interpreted at two levels. One level is a general one. The most reasonable interpretation is that all 30 of the concepts are measures of a single functional relationship existing among the concepts; this holds for both boys and girls. At least four things lead to such an interpretation. First, the intercorrelations of the 30 concepts are all quite uniform. They would probably fit a Spearman pattern fairly well; this indicates a single common factor. The correlations, if corrected for attenuation, would all be quite high. The eigenvalues of the correlation matrices obtained for both boys and girls are characterized by the first one being very large followed by a great drop in magnitude to the next ones which diminish very gradually. Finally, the oblique factor intercorrelations are uniformly extremely high, indicating only one second order factor. Such an interpretation is reasonable in terms of past studies, also. In the literature for factor studies that include measures of achievement, the results typically indicate that achievement measures are found on a single factor. We have here achievement measures for a single subject matter field which, conceptually at least, should be even more closely related than achievement measures from several different areas of study.

The other level at which the factor results can be interpreted is a more specific one. The derived orthogonal factors are not very meaningful; they are not very interpretable psychologically. As can be seen from Tables 13 and 14, the oblique factors are very highly correlated; thus, imposing the restriction of orthogonality on the factors for these sets of data gives results that are not very meaningful. Many of the variables are of complexity 2, 3, and even higher in the orthogonal solutions. For example, for the two factors of the Alpha solution for the girls, all but one of the concepts have coefficients greater than .30 on both of the factors; for the UMLFA solutions, most of the variables are of complexity 3 for the three factors obtained for boys and many are of complexity 3

Table 13
Oblique Common Factor Results for Social Studies Concepts: Boys[a]

Concepts	Alpha	Harris R-S[2]							UMLFA		
	A-1	H-1	H-2	H-3	H-4	H-5	H-6	H-7	U-1	U-2	U-3
Area: Geographic Region											
1 Coastline	83				56		33		87		
2 Delta	78		99							101	
3 Desert	77						87		71		
4 Gulf	83		33						63		
5 Mountain Region	80	34			34				81		
6 River	84			-39	38				91	32	-38
7 River Mouth	70		108							100	
8 Strait	77		39							44	
9 Tributary	81	39	52						53	48	
10 Tropical Region	83	69							99		
Area: Man and Society											
11 Airway	83				51		61		84		
12 City	81				124				95		
13 Countryside	80	59			63	35			96		
14 Democracy	74	-50			57						60
15 Exchange	84							70	37		39
16 Government	85				36			35	50		
17 Land Route	79					82			80		
18 News	83	32			71				73		
19 Organization	79				53				94		
20 Waterway	79					31			61		
Area: Map and Globe Study											
21 Country	71		35				53		31	36	
22 Distance	79		38						36		
23 E-W Lines of Lat.	82							96		39	
24 Globe	75	89							123		
25 Map Directions	69			98							105
26 Map Measurement	77			40		31			37		46
27 Map Scale	75		33	69							65
28 N-S Lines of Long.	76		32					49	33	44	
29 Physical Feature Map	79	-34		40				39		40	72
30 Symbol Map	80	53			45		33		59		
Intercorrelations of factors 2		87							91		
3		85	86						92	88	
4		93	89	90							
5		87	84	83	86						
6	91	91	89	87	92	87					
7		90	92	90	90	86	90				

[a] Includes those variables which have coefficients greater than .30 (absolute). Decimals have been omitted.

Table 14
Oblique Common Factor Results for Social Studies Concepts: Girls[a]

Concepts	Alpha		Harris R-S[2]								UMLFA			
	A-1	A-2	H-1	H-2	H-3	H-4	H-5	H-6	H-7	H-8	U-1	U-2	U-3	U-4
Area: Geographic Region														
1 Coastline	60			61								42		48
2 Delta	79				91						56	-33		
3 Desert		65				80								
4 Gulf	114	-38	70										-37	77
5 Mountain Region		74		46					39				96	
6 River	52	31		55						51		66		33
7 River Mouth	58				76							-33	40	53
8 Strait	100				44		48					-45	35	63
9 Tributary	89		57		64						100			
10 Tropical Region	47	32		46								36		
Area: Man and Society														
11 Airway		56		77								45		38
12 City		62		47	35								79	
13 Countryside	-52	128		60		42							86	-40
14 Democracy	71													46
15 Exchange		74		110								73		
16 Government		59		78					-32			71		
17 Land Route		68		78									66	
18 News	38	44		58								66		
19 Organization		81	35	102			-31					110		-40
20 Waterway	46	37	51											
Area: Map and Globe Study														
21 Country	73		85								36	44		
22 Distance		71		56									49	
23 E-W Lines of Lat.	92						38							89
24 Globe		42							92				34	42
25 Map Directions	47							75						
26 Map Measurement	64						90							95
27 Map Scale	93						62							119
28 N-S Lines of Long.	97									83				92
29 Physical Feature Map	61						34							31
30 Symbol Map	49		48					36				40		
Intercorrelations of factors:														
2	92		88								81			
3			86	85							81	92		
4			74	82	74						86	91	89	
5			87	87	84	72								
6			79	81	72	71	80							
7			84	88	84	77	83	70						
8			86	86	84	65	86	73	82					

[a] Includes those variables which have coefficients greater than .30 (absolute).

Decimals have been omitted.

Table 15
Oblique Common Factor Results for Social Studies Tasks: Boys[a]

Task	Alpha	Harris R-S[2]		UMLFA	
	A-1	H-1	H-2	U-1	U-2
1 Given name of attribute, select example.	89	93		92	
2 Given example of attribute, select name.	89	83		84	
3 Given name of concept, select example.	90	115		118	
4 Given name of concept, select nonexample.	87	103		102	
5 Given example of concept, select name.	91	101		101	
6 Given concept, select relevant attribute.	90		78		76
7 Given concept, select irrelevant attribute.	86		104		103
8 Given definition of concept, select name.	94	61	34	62	33
9 Given name of concept, select definition.	94	32	64	33	62
10 Given concept, select supraordinate concept.	92	52	41	54	39
11 Given concept, select subordinate concept.	87	42	45	47	41
12 Given two concepts, select relationship.	85		111		113
Intercorrelations of factors: 2		94		93	

[a] Includes those variables which have coefficients greater than .30 (absolute). Decimals have been omitted.

Table 16
Oblique Common Factor Results for Social Studies Tasks: Girls[a]

Tasks	Alpha	Harris R-S[2]				UMLFA			
	A-1	H-1	H-2	H-3	H-4	U-1	U-2	U-3	U-4
1	88	112				116			
2	89	104	-34			71	-40	33	
3	90				63				91
4	85		91				77	-42	52
5	90		35						65
6	89			82				106	
7	79			87				74	
8	94	59				33		43	35
9	90		72				55		
10	90	62				33		39	
11	85				101	-35			105
12	88		75	48			77	45	-36
Intercorrelations of Factors: 2		96				92			
3		94	94			93	93		
4		96	95	92		92	93	94	

[a] Includes those variables which have coefficients greater than .30 (absolute). Decimals have been omitted.

and 4, and in one case, 5, for the six factors obtained for the girls. Even for the greater number of factors for the Harris R-S^2 solutions, there are still a large number of concept variables of complexity 2, 3, 4, and even 5. Thus, at a more specific level, the only solutions which it makes any sense to interpret are the oblique ones. It must be remembered, however, that the correlations of these factors are all extremely high.

For matrices which yield about the same number of factors when different methods are used, Harris & Harris (1970) suggest taking the comparable common factors, those that are robust over method, as the substantive results. This idea does not seem to be appropriate when the number of common factors obtained using different methods varies considerably, as is the case with the factoring of these social studies concepts: for boys and girls respectively, 1 and 2 for Alpha, 7 and 8 for Harris R-S^2, and 3 and 4 for UMLFA. Thus, it seems the only appropriate thing is to look at the results for each method individually.

The results for the boys are given in Table 13. For these social studies concepts, Alpha yielded just one common factor. The coefficients on this factor are all quite uniform for the 30 concepts.

The UMLFA method gives somewhat the same results even though it yielded three factors. One of these, U-1, is a very general common factor including many of the concepts from all three areas. U-2 is essentially a doublet for the concepts Delta and River Mouth; a delta is formed at the mouth of some rivers. All of the other bodies of water studied except Gulf appeared on this factor but with much smaller coefficients. There are also some Map and Globe Study concepts with small coefficients. U-3 appears to be comprised essentially of map reading concepts with the exception that Symbol Map is not included. The appearance of Democracy and, to a lesser extent, Exchange is unexplainable.

The Harris R-S^2 solution is, in general, much more difficult to interpret than the others. There is no apparent rationale for the appearance of Globe, Tropical Region, Countryside, Symbol Map, etc. on H-1. H-2 is essentially the same factor as U-2; it is primarily a doublet for the two concepts Delta and River Mouth. All of the other bodies of water studied appear on H-2 except River. There are some Map and Globe Study concepts with small coefficients. H-3 is the same as U-3 including the map reading concepts with the exception of Symbol Map. Unlike U-3, Democracy does not appear on H-3. The main variables on H-4 are seven of the ten concepts from the area Man and Society. Others are Coastline, Mountain Region, River, and Symbol Map. H-5 is comprised primarily of two of the three travel routes, Land Route and Waterway. Countryside and Map Measurement appear with small coefficients. The third travel route studied, Airway, appears on H-6. Other concepts on H-6 are Desert, Country, Coastline, and Symbol Map. It appears from these two factors that fifth grade boys have some sort of functional relationship linking land and water routes with traveling over the countryside while they view air travel as being much more global. The concepts which appear on H-7, except for Physical Feature Map, tend to be abstract concepts—Exchange, Government, E-W Lines of Latitude, and N-S Lines of Longitude (the lines of latitude and longitude appear on maps and globes but they are not visible in the real world).

The results for the girls which will be interpreted here are given in Table 14. The Alpha results are the easiest to interpret. Alpha yielded two factors for girls as contrasted with only one for boys. A-1 includes most of the Area 1 and Area 3, Geographic Region and Map and Globe Study, concepts as well as Democracy from the area Man and Society. A-2 includes the Man and Society concepts except for Democracy. A few other concepts appear on A-2; the main ones are Mountain Region, Desert, Distance, and Globe.

The UMLFA method yielded four factors for girls as compared to three for boys. It is a rather difficult solution to interpret. For example, 11 of the 30 concepts are of complexity 2 or 3. U-1 is essentially a doublet for Tributary and Delta. A possible interpretation would be having to do with less familiar bodies of water and attributes of bodies of water. There is no apparent interpretation for U-2. Some of the main concepts on this factor are abstract ones—Organization, News, Exchange, and Government—but River also has a quite large coefficient and it certainly is not an abstract concept. A possible interpretation for U-3 is that it includes concepts that involve some notion of travel on land. The concepts with the largest coefficients are Mountain Region, Countryside, City, Land Route, and Distance. U-4 includes the map and globe reading concepts except for Symbol Map, as well as concepts for bodies of water, e.g. Gulf and Strait, and attributes of bodies of water, e.g. Coastline and River Mouth. The exceptions are Delta and Tributary which appear on U-1 as a doublet.

As with the boys, Harris R-S^2 results are much more difficult to interpret than the others. There seems to be no rationale for interpreting

H-1. Gulf, Tributary, and Waterway have some obvious relationships but River and Strait do not appear on H-1. Other concepts on H-1 are Country, Symbol Map, and Organization. H-2 is the broadest factor obtained for the Harris R-S^2 solution. It includes all of the Man and Society concepts except Democracy and Waterway. It also includes Coastline, Mountain Region, River, Tropical Region, and Distance. H-3 may be interpreted as including concepts that deal with less familiar types of bodies of water and attributes of bodies of water. The four main concepts appearing on H-3 are Delta, River Mouth, Strait, and Tributary. H-4 is a doublet for Desert and Countryside. H-5 and H-6 include the map and globe reading skills that are a major part of U-4. Map Measurement and Map Scale are found on H-5, while Map Directions and Symbol Map are on H-6. H-7 is essentially a specific for the concept Globe. H-8 is a doublet for the two concepts N-S Lines of Longitude and River. It seems from this that fifth grade girls have some notion that rivers run north and south. This may be peculiar to the subjects' living in Wisconsin near the Mississippi River, a major river that runs almost directly north and south.

In general, the factors are slightly less correlated for girls than they are for boys. This is also evidenced by Alpha yielding two factors for girls but only one for boys. The most general factor of the Harris R-S^2 solution is the most highly correlated with the remaining factors of that solution of any of the Harris R-S^2 factors.

It is evident from the factor results that the three area distinctions are not functional distinctions; thus, the hypothesis that social studies concepts are functionally related according to the three conceptually-determined major content areas must be rejected.

A word of caution. Too much emphasis should not be placed on the distinctions just discussed, as the intercorrelations of the factors are extremely high. The two factors of the Alpha solution for girls are correlated .92. There are only six concepts that are of complexity 2. Of these, two are bipolar. As one would expect, as the results become more specific (more factors) the factors are less correlated. However, for the seven and eight factors of the Harris R-S^2 solution, the correlations are in the .70s and .80s for girls and the .80s to low .90s for boys; these correlations are very high, especially considering that there are very few variables on many of the factors.

It may be well to insert a reminder here that the orthogonal solutions are not very meaningful psychologically, since the complexity is greater than 1 for most of the concepts; most of the concepts appear on more than one factor.

The most interesting aspect of studying these social studies concepts is yet to come: the study of the relationships of selected social studies concepts with selected concepts from the other three subject matter fields being studied (language arts, mathematics, and science). This is Step 4 of the objectives of the CAA Project as stated on page 1.

Interpretation of Factor Results for Task Scores. As with the concepts, the factor results for the tasks can be interpreted at two levels. One level is a general one; all 12 of the tasks are measures of a single underlying ability or latent trait. This seems to be the most reasonable interpretation for the tasks since the intercorrelations of the oblique factors are extremely high when more than one factor is yielded. All of the reasons for a general interpretation for the concepts apply for the interpretation of the tasks: (a) the intercorrelations are all quite high and quite uniform—they would fit a Spearman pattern fairly well, (b) the correlations corrected for attenuation would all be extremely high, (c) the eigenvalues of the correlation matrices are characterized by the first one being very large followed by a great drop in magnitude to the next ones, and (d) the factor intercorrelations are uniformly very high, indicating only one second order factor.

At a more specific level, only the oblique factor results are psychologically meaningful. These results are given in Table 15 for boys and Table 16 for girls.

For the boys, Alpha yielded only one common factor. Both Harris R-S^2 and UMLFA yielded two factors, but they are correlated .94 and .93 respectively. H-1 and U-1 are almost identical. The main variables on these factors are Tasks 1 through 5. All of these tasks deal with examples of concepts. Tasks 3, 4, and 5 deal with examples of the given concept and Tasks 1 and 2 with examples of an attribute of the given concept which is, in itself, a concept. H-2 and U-2 are also practically identical. The main variables on these two factors are Tasks 6, 7, and 12. All three of these tasks go beyond the characteristics of the concept itself and involve relationships with other concepts. Task 12 does this directly; Tasks 6 and 7 require that the student distinguish between attributes that are necessary for an exemplar to be identified as an exemplar of that particular concept (relevant attribute)

and those that are an attribute of the concept but are not necessary to identify it as an exemplar of that particular concept (irrelevant attributes). For example, both map and globe are representations of the earth. The relevant attribute that distinguishes these two concepts from each other is shape—a globe is round and a map is flat. Exemplars of both of these concepts have a size but the size does not alter the concept; size is an irrelevant attribute. Shape is an irrelevant attribute of the concept, representation of the earth. Irrelevant attributes often identify concepts that are conceptually subordinate to a given concept. In this sense, Tasks 6 and 7 involve relationships with other concepts. Task 6 is essentially the reverse of Task 7. Task 6 requires selecting a relevant attribute from irrelevant ones while Task 7 requires selecting an irrelevant attribute from relevant ones.

For the girls, Alpha yielded just one factor while both Harris R-S^2 and UMLFA yielded four factors. The Harris R-S^2 and UMLFA solutions are not identical for the girls as they were for the boys, but they give essentially the same results for the girls. The intercorrelations of these four factors are in the mid .90s for both solutions. The main variables on H-1 and U-1 are Tasks 1 and 2. They deal with examples of an attribute of the tested concept. Tasks 8 and 10 also have fairly high coefficients on H-1. The main variables on H-2 and U-2 are Tasks 4, 9, and 12. This is unexplainable. The main variables on H-3 and U-3 are Tasks 6 and 7. Tasks 3 and 11 are the main variables on H-4 and U-4; there is no apparent explanation for this. Harris R-S^2 gives a cleaner solution than does UMLFA. In the UMLFA solution, four variables are of complexity 3 and two are of complexity 2; for Harris R-S^2, only two are of complexity 2.

It must be remembered that the correlations of these task factors, when more than one is yielded, are in the mid .90s for both boys and girls. Thus, little emphasis should be placed on these distinctions just discussed. The most defensible interpretation is that there is a single latent trait for these 12 tasks.

As with the concepts, the most interesting aspect of studying these tasks using social studies content will be to see the relationships to these same tasks when language arts, mathematics, and science concepts are used as content.

Three-Mode Factor Analyses

As was discussed earlier, a three-mode factor analysis was performed on two different forms of the same data to gain insight into the existence of any important concept-task interactions for the idealized persons. Performing conventional factor analyses on the two modes, concepts and tasks, separately is essentially hypothesizing that there are no interactions. The three-mode analyses were performed to determine whether this hypothesis is a tenable one.

The Type I three-mode analysis is the analysis of the 12 tasks and the three composite concept variables; Type II is the analysis of the two (boys) or four (girls) composite task variables and the 30 concepts. Type I was performed to permit maximum task interactions to be evident; Type II to permit maximum concept interactions.

The core matrix obtained for each analysis is the only piece of the three-mode analysis of interest here since it contains the idealized person components by task components by concept components. Hence, it is in this matrix that any interactions are seen. The core matrices obtained for Type I and Type II analyses are presented in Table 17 for boys and in Table 18 for girls. Only those idealized person (core) components that have one or more coefficients greater than .50 (absolute) are included in the tables; the number of core components obtained in each of the analyses was equal to the product of the number of components for the two modes other than individuals. The variables comprising the task components are given in footnotes on each of the tables. The variables comprising the Type I concept components are the ten concepts in each of the three areas. The concept components for the Type II analyses bear some resemblance to the Harris R-S^2 factors which were the basis for the number of components to be extracted but they are much more specific. Most of them have only two or three variables with coefficients greater than .30 (absolute).

Both Type I and Type II analyses for the boys indicate that there is only one idealized person type—there is just one major core component. As indicated by the Type I analysis, persons respond similarly to the concepts of the three different areas for each of the two task components; the Type II analysis indicates some slight differentiation among the concepts. This analysis indicates that a person who scores well tends to do less well on the tasks comprising task component 2. A person with low scores for core component 1 would tend to perform better on the tasks comprising task component 2 than on the remaining tasks. In the Type I analysis there

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Table 17
Three-Mode Core Results: Boys

Idealized Persons	Task Components[a]	Type I Concept Components Area 1	Area 2	Area 3
1	1	2.02	1.99	1.75
	2	1.91	1.76	1.95
2	1	.65	.29	.22
	2	.28	.73	.18

Idealized Persons	Task Components[a]	Type II Concept Components 1	2	3	4	5	6	7
1	1	2.72	1.62	3.25	1.50	1.52	.99	1.29
	2	.09	-.09	.16	.24	.25	.22	.10
2	1	.52	-.11	.03	-.53	-.37	-.18	-.08
	2	.59	.26	.50	.55	.07	.07	.08
3	1	-.26	.78	-.13	-.21	.31	.10	-.35
	2	.28	.13	-.05	.11	.13	.06	-.10

[a] Variables comprising task components:

Type I: Component 1 - Tasks 1, 2, 3, 4, 5, and 8
Component 2 - Tasks 6, 7, 9, 10, 11, and 12

Type II: Component 1 - Tasks 1, 2, 3, 4, 5, 8, and 10
Component 2 - Tasks 6, 7, 9, 11, and 12

Table 18
Three-Mode Core Results: Girls

Idealized Persons	Task Components[a]	Type I Concept Components Area 1	Area 2	Area 3
1	1	1.94	1.83	1.89
	2	1.13	1.01	1.23
	3	1.08	1.34	1.29
	4	.77	.56	.67
2	1	-.04	-.11	-.33
	2	.12	.11	-.18
	3	.54	-.30	-.14
	4	-.02	.25	-.11

Idealized Persons	Task Components[a]	Type II Concept Components 1	2	3	4	5	6	7	8
1	1	1.84	1.56	.51	1.81	1.20	.49	.20	.86
	2	1.51	1.19	.25	1.24	.88	.22	.11	.29
	3	1.73	1.48	.55	1.75	1.12	.41	.40	.72
	4	1.53	.63	.37	1.32	.68	-.06	.32	.49
2	1	.42	.19	-.42	-.05	.12	.06	-.02	.01
	2	-.50	.25	.43	.59	-.04	.05	.13	.01
	3	.45	-.08	-.51	-.34	-.29	.02	-.20	.26
	4	.10	-.36	-.12	.01	-.21	-.03	.06	.06
3	1	.11	.07	-.09	.22	-.17	-.22	.23	.27
	2	.05	.16	-.01	.23	-.14	-.30	.00	.13
	3	.09	.04	-.05	.23	.32	.44	-.11	-.17
	4	.21	-.02	.30	-.11	-.54	-.27	.10	-.17

[a] Variables comprising task components:

Type I: 1 - Tasks 1, 2, 6, 9, 10, 12
2 - Tasks 8, 11
3 - Tasks 3, 4, 5
4 - Task 7

Type II: 1 - Tasks 1, 2, 8, 10
2 - Tasks 3, 11
3 - Tasks 4, 5, 9, 12
4 - Tasks 6, 7

are no other coefficients greater than .75 (absolute). Minor variations in response patterns for the idealized persons can be seen in Table 17. In the Type II analysis there is just one other coefficient that is greater than .75 (absolute). Idealized person type 3 tends to do better than average on concept component 2 which is comprised primarily of the two concepts, Delta and River Mouth. These are the two main variables on the factor, H-2. Minor variations in response patterns for the idealized persons for the Type II analysis can be seen in Table 17.

The three-mode results for the girls are essentially the same as for the boys; there is just one major core component indicating just one idealized person type. As with the boys, the Type I analysis indicates that girls respond similarly to the concepts of the three different areas; they do less well on Task 7 than they do on the other tasks. Of the total of 32 idealized person components from the Type II analysis, only three of them have any coefficients greater than .50 and only the one has any coefficients greater than .75. This analysis indicates that girls with high scores on this component tend to do less well on concept components 3, 6, 7, and 8. These concept components correspond to the factors H-3, H-6, Symbol Map and Strait, and H-4 and H-7 combined respectively. There are no other coefficients greater than .75 for either of the analyses for girls. Minor variations in response patterns for the idealized persons can be seen in Table 18.

The results of the three-mode factor analyses support the hypothesis that there are no important concept-task interactions for the idealized persons. Thus it is reasonable to regard these two modes as being independent.

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. This paper contains a report of the factor analytic study of the content and task dimensions of the social studies items.

Social studies items to measure concept attainment were developed using a completely crossed design utilizing 30 concepts and 12 tasks. These social studies items were administered during the summer of 1970 to 196 girls who had just completed the fifth grade and during the fall of 1970 to 195 boys who had just begun the sixth grade.

Two types of total scores were secured from the students' responses to the social studies items—a total score for each of the 30 concepts (totalled across tasks) and a total score for each of the 12 tasks (totalled across concepts). Means, standard deviations, and Hoyt reliability estimates were obtained for each of the 30 concept scores and each of the 12 task scores for each of the groups studied.

Conventional factor analyses were performed separately on the intercorrelation matrices obtained for the concepts and for the tasks for the boys and the girls. Analyses were obtained using three initial factor methods: Alpha (Kaiser & Caffrey, 1965), Harris R-S^2 (Harris, 1962), and Unrestricted Maximum Likelihood Factor Analysis (Jöreskog, 1967). Derived orthogonal solutions were obtained for each of the three initial solutions using the Kaiser normal varimax procedure (Kaiser, 1958), and derived oblique solutions were obtained using the Harris-Kaiser independent cluster solution (Harris & Kaiser, 1964).

Three-mode factor analysis (Tucker, 1966a, 1966b) was performed on two different forms of the same data to determine whether there are any important concept-task interactions for the idealized persons.

The conventional factor results for the concepts yielded one or more orthogonal factors for the various methods. The concept variables are almost all of complexity 2, 3, and even greater on these factors, however. The oblique results tend to yield simple structures but the oblique factors are very highly correlated; thus, the main conclusion is that all 30 of the concepts are measures of a single functional relationship existing among the concepts. This holds for both boys and girls.

As with the concepts, the most reasonable interpretation for the tasks is that all 12 of the tasks are measures of a single underlying ability or latent trait. The intercorrelations of the oblique factors are extremely high when more than one factor is yielded.

The results of the three-mode factor analyses support the hypothesis that there are no important concept-task interactions for the idealized persons. Thus, it is reasonable to regard these two modes as being independent.

The most interesting aspect of studying these social studies items will be to see how they are related to concepts from three other subject matter fields (language arts, mathematics, and science) and to general cognitive abilities. The data for such a study will be collected during summer, 1971. Even though the most reasonable interpretation is that there is only a single common factor for the 30 concepts, the most specific results obtained were used to determine the social studies concepts to be included in the summer, 1971, study. This should permit maximal demonstration of relationships with concepts from other subject matter fields. The two concepts with the highest coefficients on each of the Harris R-S^2 factors for both the boys and girls were selected. On this basis a total of 20 social studies concepts were selected for further study. These concepts are: Delta, Desert, Gulf, River, River Mouth, Tropical Region, Airway, City, Countryside, Exchange, Land

Route, News, Organization, Country, E-W Lines of Latitude, Globe, Map Directions, Map Measurement, Map Scale, and N-S Lines of Longitude. Even though the most reasonable interpretation for the tasks is that there is a single common factor, all 12 of the tasks will be included in the summer, 1971, study in order to have a reliable concept score (totalled across the 12 tasks for a single concept).

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Appendix A
Key for Concepts in Numerical Order

1 Coastline
2 Delta
3 Desert
4 Gulf
5 Mountain Region
6 River
7 River Mouth
8 Strait
9 Tributary
10 Tropical Region
11 Airway
12 City
13 Countryside
14 Democracy
15 Exchange
16 Government
17 Land Route
18 News
19 Organization
20 Waterway
21 Country
22 Distance
23 E-W Lines of Latitude
24 Globe
25 Map Directions
26 Map Measurement
27 Map Scale
28 N-S Lines of Longitude
29 Physical Feature Map
30 Symbol Map

Appendix B
Orthogonal Common Factor Results for Social Studies Concepts: Boys[a]

Concept	Alpha	Harris R-S[2]							UMLFA		
	A-1	H-1	H-2	H-3	H-4	H-5	H-6	H-7	U-1	U-2	U-3
Area: Geographic Region											
1 Coastline	83	37	33	46					63	43	34
2 Delta	78	69							33	72	
3 Desert	77	33	47				35		56	41	34
4 Gulf	83	46	37	37					56	51	34
5 Mountain Region	80		42	42	36				60	32	43
6 River	84	44	37	40					63	53	
7 River Mouth	70	68								67	
8 Strait	77	47			38				43	53	39
9 Tributary	81	52	41						52	57	
10 Tropical Region	83	40	54	36					66	45	
Area: Man and Society											
11 Airway	83	34	34	46	31		34		62	39	38
12 City	81			64					65	32	42
13 Countryside	80		47	50	33				64	32	40
14 Democracy	74	32		39	44				42	35	52
15 Exchange	84	36	36		41			33	51	45	50
16 Government	85	42	37	39	33				55	47	45
17 Land Route	79	33	35	31		52			59	41	34
18 News	83	36	37	52	38				60	37	46
19 Organization	79		36	45					64	32	39
20 Waterway	79	36	33	36	31	31			55	40	41
Area: Map and Globe Study											
21 Country	71	44							42	47	32
22 Distance	79	43		35	36				48	47	42
23 E-W Lines of Lat.	82	46	35		36			40	47	54	42
24 Globe	75		60	32					68	31	
25 Map Directions	69				63				35		65
26 Map Measurement	77	31	32		42				48	36	49
27 Map Scale	75	43			52				34	47	53
28 N-S Lines of Long.	76	50	35	33					46	53	34
29 Physical Feature Map	79	46			47				33	52	57
30 Symbol Map	80	38	50		32				54	46	37

[a] Includes those variables which have coefficients greater than .30 (absolute).

Decimals have been omitted.

Appendix C
Orthogonal Common Factor Results for Social Studies Concepts: Girls[a]

Concept	Alpha		Harris R-S[2]								UMLFA					
	A-1	A-2	H-1	H-2	H-3	H-4	H-5	H-6	H-7	H-8	U-1	U-2	U-3	U-4	U-5	U-6
Area: Geographic Region																
1 Coastline	63	57	52	33	35	31						39		47	34	40
2 Delta	61	40		62								32	53	33		
3 Desert	34	54					61				90					
4 Gulf	73	33		34	37	47							39	53		
5 Mountain Region	48	68	47	35					33			61			38	
6 River	59	55	52	31						32		40		44		47
7 River Mouth	52	41		55								40	34	40		
8 Strait	68	36		45	44							32	44	44	35	
9 Tributary	66	40		55		42							72			
10 Tropical Region	56	54	47	44								42	37	41		37
Area: Man and Society																
11 Airway	51	61	55	31								44		42		39
12 City	44	60	42	36								52	36		33	
13 Countryside		78	49				46				32	53			44	
14 Democracy	61	45	33			32							31	41	38	
15 Exchange	46	67	64									41		32	41	46
16 Government	52	64	57		31							32		37	45	46
17 Land Route	48	66	56	37								61		38		31
18 News	55	59	51					36				32		33	41	44
19 Organization	44	69	62			34						43			31	58
20 Waterway	57	57	35		31	40	37				31		34	36	40	32
Area: Map and Globe Study																
21 Country	58	39				50							40	31	34	34
22 Distance	47	67	50		34		33					44		32	41	46
23 E-W Lines of Lat.	68	42	31	36	43								31	56		
24 Globe	45	51	32						54			42		38		
25 Map Directions	47	41						57							56	
26 Map Measurement	57	44	32		58									50	46	
27 Map Scale	68	41			53									62	35	
28 N-S Lines of Long.	66	34		33	36					42				55		
29 Physical Feature Map	60	50	32		38			34					34	35	52	
30 Symbol Map	53	48				38	31	36					34		40	32

[a] Includes those variables which have coefficients greater than .30 (absolute).

Decimals have been omitted.

Appendix D
Orthogonal Common Factor Results for Social Studies Tasks: Boys[a]

Task	Alpha	Harris R-S[2]		UMLFA	
	A-1	H-1	H-2	U-1	U-2
1 Given name of attribute, select example.	89	74	51	75	51
2 Given example of attribute, select name.	89	71	53	72	53
3 Given name of concept, select example.	90	80	46	82	45
4 Given name of concept, select nonexample.	87	76	47	76	46
5 Given example of concept, select name.	91	77	51	78	50
6 Given concept, select relevant attribute.	90	56	72	56	72
7 Given concept, select irrelevant attribute.	86	46	77	46	77
8 Given definition of concept, select name.	94	69	63	70	63
9 Given name of concept, select definition.	94	62	71	62	71
10 Given concept, select supraordinate concept.	92	65	64	67	64
11 Given concept, select subordinate concept.	87	60	62	62	61
12 Given two concepts, select relationship.	85	43	78	43	79

[a] Includes those variables which have coefficients greater than .30 (absolute). Decimals have been omitted.

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Appendix E
Orthogonal Common Factor Results for Social Studies Tasks: Girls[a]

Task	Alpha	Harris R-S^2				UMLFA			
	A-1	H-1	H-2	H-3	H-4	U-1	U-2	U-3	U-4
1 Given name of attribute, select example.	88	40	37	59	42	68	38	34	39
2 Given example of attribute, select name.	89	47	45	58		59	48	46	
3 Given name of concept, select example.	90	40	58	45	36	44	38	62	36
4 Given name of concept, select nonexample.	85	39	48	36	50	36	36	50	54
5 Given example of concept, select name.	90	43	55	43	40	44	42	55	39
6 Given concept, select relevant attribute.	89	67	43	35		33	72	42	
7 Given concept, select irrelevant attribute.	78	64	32	32		33	60	34	
8 Given definition of concept, select name.	94	54	49	51		51	55	50	
9 Given name of concept, select definition.	90	54	39	40	47	42	57	37	45
10 Given concept, select supraordinate concept.	90	50	45	50	32	48	53	46	
11 Given concept, select subordinate concept.	85	44	62	33		31	47	64	
12 Given two concepts, select relationship.	88	61	34	35	46	36	62		49

[a] Includes those variables which have coefficients greater than .30 (absolute).

Decimals have been omitted.

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