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ABSTRACT

The original intent of this investigation was to evaluate the effectiveness of the Object Sorting Task (OST) as a predictor of learning outcomes, especially among minority children. The study results, however, have produced a subtle but significant shift of attention to the issue of possible differences in the cognitive organization of children from relatively diverse backgrounds. Specifically, the results showed a generally clear difference in how adequate performance on the OST was related to indices of learning and school achievement. For both white samples adequate divergent performance and verbalization exhibited moderately strong relationships with a number of learning-achievement measures. On the other hand, adequacy of convergent recognition and verbalization was found to have a generally low relationship with the same criterion measures. In contrast, for the Black sample, adequate convergent recognition and verbalization, but not divergent performance and verbalization, was shown to be related to the criterion variables. (Author)

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THE OBJECT SORTING TASK AS PREDICTOR OF LEARNING ABILITIES

By

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General Statement of the Problem

There is a considerable body of conflicting research dealing with the relationship between psychometric intelligence (IQ) and learning ability. Thus, Zeaman and House (1967) have noted in their review of a large number of studies that the expected positive relationship between IQ and learning is not always confirmed. From the standpoint of the present study, the work of Jensen and his associates has particular relevance to these conflicting findings. In his program of research, Jensen has used laboratory tasks (e.g., serial learning, paired associates, and free recall of word lists). Such tasks are assumed to be relatively uncontaminated by prior knowledge and established skills, and therefore, appropriate for assessing immediate learning abilities. The speed of learning such tasks has been related to both IQ as well as the social economic status (SES) of subjects (Ss). A brief review of some of the representative studies of Jensen and his associates is now appropriate.

In an early study (Jensen, 1961) a group of low SES Mexican-American and middle SES White fourth and fifth grade children were compared on a number of learning tasks consisting of free recall of familiar objects, serial, and paired associate learning of familiar and abstract objects. The range of IQ for the total sample was from 60 to 120. Mexican-American Ss of low IQ (Mean IQ=83) were found to be much faster learners on these tasks than white Ss of the same IQ level. On the other hand, when bright Mexican-American Ss (Mean IQ=117) were compared with a similar group of bright Anglo-American Ss, no difference in learning ability was noted.

Rohwer and Lynch (1968) presented a paired associate task of 24 pairs of pictures to Ss consisting of low and middle SES children from kindergarten to the sixth grade. About 90 percent of the low SES children were Black and all of the middle SES were white. Further, the low SES sample was on the average 15 to 20 IQ points below the middle SES sample. Despite such differences in measured intelligence, no significant differences were noted in learning rate on the associate task between lower and middle SES children across grade level.

In a recent study, Rohwer (1968) administered four paired associate tests to groups of low and middle class children (total N=288) in grades K, one, and three. Again, social class and race were confounded in this investigation. While clear IQ differences were noted of from 20 to 30 IQ points in favor of the middle SES sample, there were no significant differences in total learning score (except at grade K) between the two groups of children.

As a means of isolating the effects of social class from race, Rapier (1968) compared low and middle SES white children in learning serial and paired associate tasks. The range of IQ of these Ss was from 70 to 110 points. The results of this study somewhat paralleled the findings of Jensen's early study (1961) summarized above. That is, a significant IQ x SES interaction was found, such that within the middle class sample average IQ Ss were significantly superior in speed of learning to retarded Ss; in contrast, among children from a lower SES background, intellectual level (high versus low IQ) did not markedly differentiate performance on the same learning tasks. The average correlation between IQ and learning scores was .44 for the middle SES group and .14 for the low SES group.

Comparing a group of 100 low SES Black preschool Ss with a group of

100 middle SES white Ss, Jensen and Rohwer (1969) found a correlation of .49 between mental age and serial learning scores within the middle class sample; the similar correlation for the low SES sample was .27.

Finally, Rohwer, Lynch and Suzuki (1968) compared groups of first, third, and sixth graders (total n=432) who were divided between low and middle SES backgrounds. While the expected IQ differences favoring the middle SES samples were found, the learning scores on a variety of associative learning tasks showed no signs of significant difference between the lower and middle SES groups.

Summary. The findings of these studies may be summarized as follows: (1) when comparisons between lower and middle SES samples are made on learning ability involving associative tasks, no significant differences were noted despite the fact that IQ differences (presumably functioning as a predictor of learning ability) between such samples were found; (2) when IQ level and SES are used as joint independent variables, psychometric intelligence has been found to differentiate between normal and retarded Ss within a middle but not within a lower SES sample. From the latter conclusion, it would appear that IQ indices are probably measuring important psychological functions with middle class children. The fact that in some investigations, learning measures show negligible correlation with IQ in lower SES groups might be interpreted to mean that IQ indices are relatively poor predictors of learning ability for these children.

The relatively weak predictive potential of IQ indices for low SES samples with respect to associative and to perhaps higher order learning activities (e.g., concept formation) raises the possibility of considering alternative approaches to predicting learning abilities. In this respect, the present study aims to evaluate the extent to which Object Sorting Task (OST) may serve as a predictor of learning outcomes.

Briefly, the OST is a cognitive classification task which, based on prior research, has shown the following promising features: (1) the instrument yields a large number of diverse objectively derived scores; (2) the OST has demonstrated reasonably good predictive validity in relation to both classroom achievement and laboratory learning tasks; (3) available evidence suggests that the OST may be tapping relatively unique cognitive functions as reflected in its low correlation with measures of intelligence and paper and pencil tests of creativity. A detailed summary of these conclusions on the OST is presented below.

The Object Sorting Task

The OST is intended to assess both divergent and convergent thinking. As used by Guilford (1967) divergent thinking refers to the generation of multiple responses in relation to a fixed stimulus. Convergent thinking refers to the generation of a unique(or most appropriate) response to a given stimulus.

The OST requires S first to classify a group of plastic objects into two dichotomous piles (the divergent phase) in as many different ways as possible. After each sort, S is asked to verbalize a classification rationale which is subsequently rated against a scoring standard. The divergent phase is terminated when S reaches a specified failure criterion. At this point, the convergent phase of the OST is administered. In the convergent assessment, the examiner (E) sorts the blocks according to the dimensions not employed by S during the divergent phase. After each presentation, S is asked to explain to E why the particular classification was made. The convergent phase of the OST is terminated when the failure criterion is reached by S.

Specifically, the OST consists of six plastic objects which vary on as many dimensions as there are possible equal dichotomous groupings minus one. A photograph of the OST blocks is shown in Figure 1.

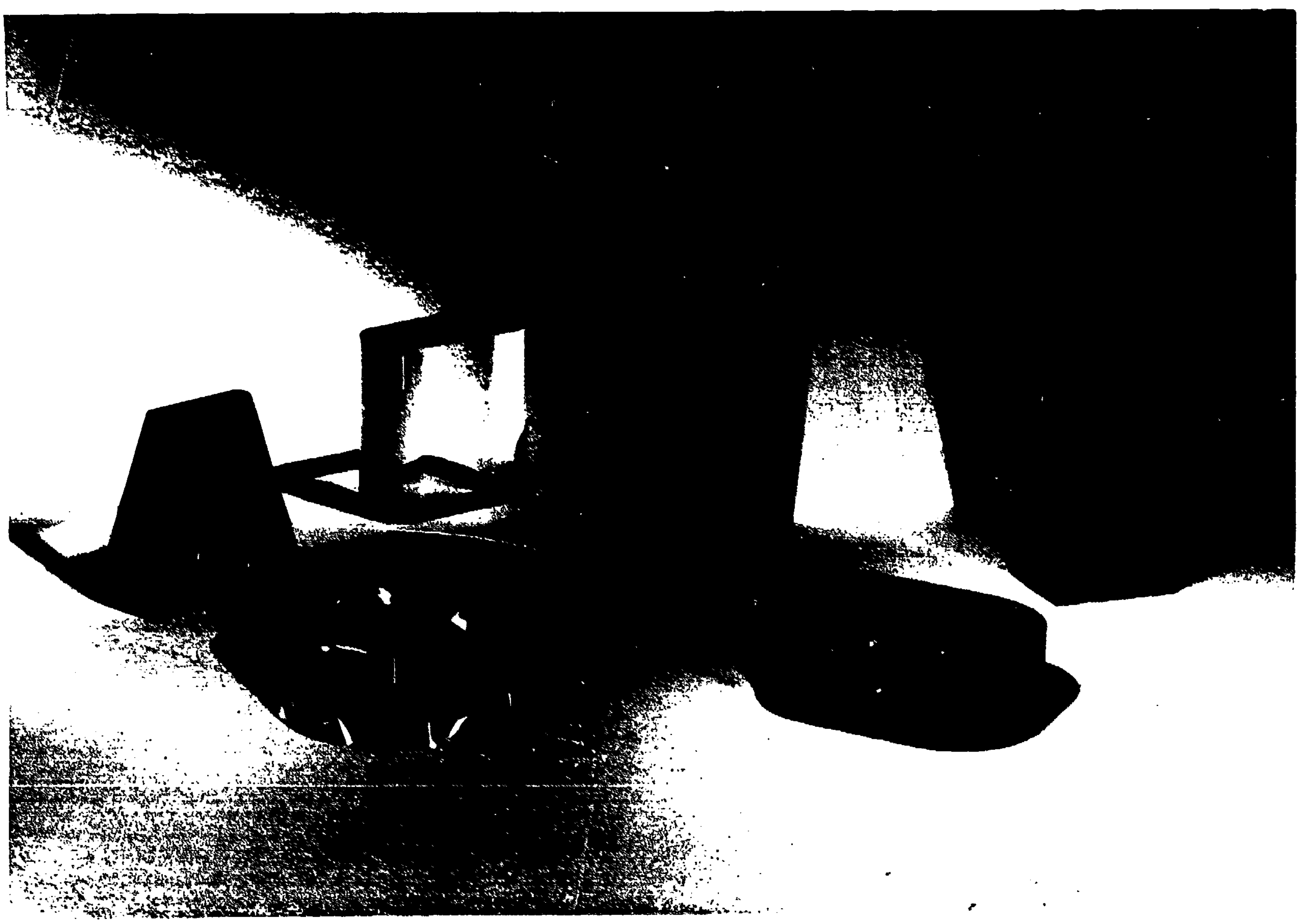

Figure 1. Photograph of OST objects; the objects have been grouped into the category of transparency versus opaqueness.

There are thus nine valid dichotomous combinations of six objects taken three at a time. The sorts, ranked in order of empirically determined difficulty are: curvilinearity, hue, transparency, height, perpendicularity of side, radial equality of base, color saturation, volume, and area of the base. These nine attributes contribute to three supraordinate attribute families of : color, unidimensional form, and dimensional relationships (e.g., volume).

The blocks used in the present version of the OST are precision milled from bulk plastic to tolerances of ± .05, vary in weight from 6 to 17 grams, in volume from 33 to 87 c.c., and are either dip dyed or painted.

One major direction of research with the OST has been directed at identifying its dimensional properties. Using the Guttman-Lingoes scaling procedure (Lingoes, 1968) three supraordinate concept families of color, form, and relational properties have been identified from performance data on the OST. Further, using a cluster analysis technique (McQuitty, 1957) three major scoring dimensions dealing with (a) divergent processes, (b) convergent recognition, and (c) erroneous classifications, have been identified. There are a number of field investigations of performance characteristics on the Object Sorting Task. These are described below.

Field Study I. The purpose of this initial investigation was to evaluate OST procedures, using a small sample of 18 subjects. The prototype sorting objects were made of wood and manufactured to only gross dimensional tolerances. In general, the test in this early form correlated highly with the WISC Full Scale IQ. Thus, the number of positive divergent sorts and the total verbalization score correlated .77 and .79, respectively, with IQ.

Field Study II. This was the first investigation in which the current

OST objects and procedures were used (Safford, 1967; Safford and Dunn, 1967). This study was based on a stratified random sample of ten boys and ten girls from grades one, two, three, four, and six. The results showed moderate correlations between divergent performance and IQ. Thus, total number of positive divergent sorts correlated .31 and .51 with the Stanford-Binet IQ and WISC vocabulary scores, respectively. Furtner, the ability to perform divergent sorts showed generally consistent increases as a function of age. Few sex differences in OST performance were noted.

The most interesting result was the strong relationship between the performance on the OST performance and academic achievement. In fact, the OST was a slightly better predictor of academic achievement, for this sample, than either Wechsler vocabulary or Stanford-Binet IQ scores. In particular, the correlation between total number of correct divergent sorts and achievement on the California Achievement Test Battery was .48. When mean speed and number of correct convergent sorts were also included, a multiple R of .55 was obtained. The most likely reason for the lower IQ achievement correlation was that Ss were bright (mean IQ=126) which therefore attenuated heterogenity at the upper level of intelligence.

Field Study III. The largest of the current investigations on the OST (Dunn, 1969) was based on groups of 21 boys and 21 girls drawn at random from kindergarten through the sixth grade from a middle class school district (total N=294). In addition to the OST scores, data were collected for grades 4-6 on the Iowa Test of Basic Skills, the California Test of Mental Maturity, and the Torrance Creativity scales. As one might expect, the number of valid divergent classifications increased as a function of age, and invalid or incorrect sorts decreased with the age of the child. The correlational analyses indicated that the sex of the subject was generally uncorrelated with the OST variables. In contrast, there was moderately strong sex biases especially for the Torrance scales and to a lesser extent for language achievement and IQ. Further noted were significant correlations of achievement with both divergent and convergent measures on the OST; the noncorrelation of OST scores with IQ (except for error scores which were significantly correlated negatively with IQ); and the noncorrelation of OST variables with the Torrance measures of creativity. For all practical purposes, the OST correlations with achievement were not attenuated when the effects of IQ were partialled out. The latter is not surprising in light of fact of the non-correlation of IQ-OST performance.

Clearly, the OST predicted variance in academic achievement, that was not accounted for by IQ scores or by the Torrance measures. Further, when a multiple correlation was computed using as the predictor variables the number of verbalized divergent sorts and number of convergent recognitions, the OST-achievement correlation increases to .44, a correlation slightly larger than that between IQ and total achievement (.41).

In addition to predicting to achievement, the OST has been useful in predicting to laboratory learning situations. Thus, Bloom (1969) found that Ss who demonstrated rapid mastery of the shift problems on either reversal or nonreversal concept tasks, performed significantly more divergent sorts or the OST than did those Ss who exhibited relatively slow mastery of a shift problem.

Finally, mention should be made of two studies in which the OST has been used to compare subjects of distinctively different psychological backgrounds. In one study by Safford (1967), the cognitive performance of groups of mentally retarded, emotionally disturbed, and normal elementary school pupils (matched on CA and MA) were compared on an array of OST variables. Generally consistent performance differences favoring normals, emotionally disturbed, and mentally retarded Ss (in that order) were noted on such OST variables as number of correct divergent sorts, quality of verbalization, and total number of correct divergent and convergent sorts performed. In the other study (Curcio, 1969) normals were compared to schizophrenic Ss in relation to a number of OST performance scores. Although matched for both MA and CA levels, normals consistently exceeded the schizophrenic Ss on OST convergent and divergent performance. Thus, for both the studies by Safford and Curcio, the performance indices of the OST can be used to differentiate among groups which have been previously clinically classified.

In summary, the Object Sorting Task appears to be technique different from anything reported elsewhere in the literature. While there are a number of concept classifications procedures (e.g., the Vigotsky and Goldstein-Scheerer Blocks), such tests yield relatively few objective scores and involve a very limited number of relatively simple dimensions (e.g., abstract versus concrete) by which the materials are classified. Further, the assessment of divergent behavior has been done almost exclusively on a verbal basis (e.g., Guilford, 1967). In contrast, the OST provides for an assessment of divergent thinking which varies in terms of difficulty and style of assessment - i.e., on a verbal and nonverbal basis. Because of such diversity, the OST is likely to be useful on subjects who vary widely in age and background. In addition, the OST has demonstrated reasonable face and construct validity and has shown promise in predicting to criterion performance and in differentiating among clinically identified groups. The fact that the available data shows that the correlations of OST performance scores and IQ are moderately low suggest that the sorting task yields measures which make a unique contribution to learning score variance.

Study Design. As earlier indicated, the intent of this study was to evaluate the effectiveness of the OST as a predictor of learning outcomes. Figure 2 summarizes the overall study design.

Predictors	Dependent Variables		
	(1)	(2)	(3)
OST Variables	Level I Learning	Level II Learning	School Achievement

Figure 2. Study designs

The independent or predictor variables consists of selected performance scores on the OST and the total IQ. The inclusion of an IQ index is intended to provide a base line against which the effectiveness of OST measures as predictors may be evaluated.

The dependent or criterion variables will mostly consist of two clusters of laboratory tasks which correspond to the distinction made by Jensen (1969) between levels I and II learning abilities. One group (level I) will consist of associative (i.e., serial and paired associative) learning. The other group (level II) will consist of conceptual learning activities as for example a nonreversal shift task. Finally, scores on a standardized achievement test will serve as an index of classroom learning. The inclusion of a diversity of measures within the criterion battery should help define the range or kinds of learning activities to which predictors such as IQ or OST performance are likely to evince relationships

METHODOLOGY

Subjects. The study sample consisted of 120 fifth grade children from a lower to lower middle class background. These children were enrolled in six classrooms in two elementary schools of the Middle Island School District, Long Island, New York. Table 1 summarizes by sex and race, data relevant to the age, IQ, Iowa achievement level, and the social class characteristics of the subjects (Ss).[1]

TABLE 1

Subject Characteristics

	White Males (N=61)	White Females (N=29)	Blacks (N=30)	Significance Level
Mean Chronological Age at time of testing	10.5	10.6	10.5	n.s.
Mean IQ	110	107	101	F=3.29, df=2/100, p .05
Mean Achievement Level	52	48	48	n.s.
Father's Educational Level (Mean)	12.0	10.80	10.96	n.s.

Table 1 indicates that with the exception of total IQ, the Ss were generally similar to each other. In the case of IQ, the Black sample differed significantly (t=2.49, df=75, p=.05) from the white male sample. It should be noted however, that all three samples, including the Black group,

[1]The study design, as outlined in the proposal submitted to the Office of Education called for a sample equally divided between lower and middle class students. However, because of the difficulties in gaining the cooperation of a school district in which such a sample could be obtained, it was necessary to deviate from the original expectations in order to accommodate to the sample made available to the investigator.

had mean IQ's which fell well within the normal range of intellectual performance.

Methods of data collection. The major data source for this investigation was the Object Sorting Task (OST), a research instrument designed to assess divergent and convergent behavior. In this task, S was asked to sort six plastic objects, which differ from each other along various dimensions, into two dichotomous categories in as many ways as possible. After each sort, S was asked to explain the basis for his sort.

There are nine valid ways by which the six OST objects may be sorted into sets of three. The last or tenth sort is a blank or meaningless classification. The nine possible valid classifications in the empirically determined order of difficulty (Dunn, 1969) are as follows: (1) angularity; (2) hue; (3) transparency; (4) height; (5) perpendicularity; (6) equality of the radial axis of the base; (7) color intensity; (8) volume; and (9) area of the base. The tenth or blank sort was used as a starting position after a sort was completed and before the next one is attempted. During the administration of the OST, the examiner (E) recorded both the sorts performed by S, his explanations of the sorts, and the time required to complete each sort.

To establish a proper performance set, a demonstration sorting task involving the classification of six pencils was used prior to the introduction of the OST. This demonstration task involved arranging the six pencils into two dichotomous groups according to three dimensions. The E first grouped the pencils on the basis of being sharpened or unsharpened and then explained to S the rationale for this classification. E repeated this procedure for second dimention -- whether the pencils had erasers or not. Immediately after performing the sort, E explained the basis for the classification. The S was then asked to perform on his own a third classification -- whether or not a clip was attached near the top of the pencil. After completing this sort, S was asked to provide an explanation of his classification. Most of the Ss were able to correctly respond to the demonstration task. For those few Ss who had difficulty with this task, part of or the entire procedure was repeated with the rules for classification reemphasized by the tester.

Overall, the goals of the demonstration task was to establish a set for: (1) grouping three objects into a pile; (2) learning to sort or classify on the basis of some common or shared property; and (3) recognizing that six objects may be grouped in more than one way.

Once the demonstration task was completed, the OST was administered. The OST is divided into two procedures, called the divergent and convergent procedures. In the former, S is asked to sort the objects into as many dichotomous groupings as possible. After each sort, S was asked to explain why he sorted in that particular fashion. When S indicated he was no longer able to perform additional sorts, exceeded 120 seconds in producing a further sort, performed nine duplicate or erroneous sorts, or performed a single sort five times, the divergent phase was terminated and the convergent phase initiated.

In the convergent phase, E presented each dichotomous sort, in order of difficulty, not correctly performed during the divergent phase. After E presented each convergent classification, S was asked to provide an explanation for the classification. The convergent or recognition phase was terminated after S failed to correctly respond to three successive classifications or required more than 120 seconds in identifying three successive sorts. On the average, the OST required about 20-25 minutes for its completion.

Using both the divergent and convergent procedures, S's performance on the OST blocks was quantified in terms of eighteen scoring variables. (Table 2 lists and describes these variables.) The directions given to S and the criteria for scoring S's verbalizations (i.e., sorting explanations for the divergent and convergent phases) are given in Appendix A.

Ss were also administered a series of learning tasks which served as covariables with the OST performance scores. The following are descriptions of these tasks.

Paired associates. This task consisted of ten pairs of pictures of common objects such as a chair and a candle. Upon being shown one member of a pair of objects, S's task was to correctly recall the other member of the pair. S was first shown on a simultaneous basis, both members of the ten pairs of pictures. During the trials, S was shown only one member of a pair and asked to recall the other member. After responding, S was shown the correct associate. The duration of each picture presentation was three seconds with approximately the same time interval between picture presentations. A trial was defined as one presentation of all of the ten pairs of pictures, with a randomized order of presentation between trials. The criterion for task termination was perfect recall for all ten pairs during one trial.

Nonreversal concept learning. This task consisted of a set of 12 solid objects, half of which were in the form of circles and half in the form of triangles. Each group of shapes was further dichotomized in terms of the following dimensions: size (large versus small) and color (light versus dark).

The objects were presented to S on a successive basis (i.e., one by one). The S was asked to indicate whether or not each object represented an example of the concept. Immediately after responding, S was informed by E regarding whether his response was correct.

A nonreversal concept task consists of two separate but successive problems. For this study, a criterion of ten successive correct responses on the first problem was required before S was shifted to the second concept problem. S was not informed of the shift from the first to the second problem. Again, the criterion of ten successive correct responses was required before the second problem was terminated.

Size and color served as the relevant dimensions for the nonreversal task, with the shape dimension functioning as an irrelevant property throughout concept acquisition. Color served as the relevant dimension for the first problem, and size for the second problem. The order of presentation of the concept objects was randomly varied across trials.

WISC subscales. The following scales of the WISC were administered to the Ss, using standardized testing procedures: vocabulary, information, and digit span. Rather than serving as an abbreviated index of IQ, the subscales were treated as measures of long term and immediate learning ability. Of particular importance for this research was the digit span scale which was used as a measure of serial learning of relatively meaningless stimulus materials.

The OST, paired associates, the nonreversal task, and the WISC subscales were administered to all Ss. However, the time schedule did not permit total data collection on four additional learning tasks that were selected for inclusion in this investigation. Accordingly, each of four randomly selected subgroups (N=30 for each group) from the total sample received one of the following four learning tasks.

Information. Ss (N=30) were presented with a tape recording of a factual paragraph dealing with the solar system. The tape lasted four and a half minutes during which period 425 words were spoken. Immediately after the tape was ended, S was presented with two picture puzzles from the WISC. The S was kept occupied with the puzzles for two minutes before a thirteen item multiple-choice test dealing with the content of the paragraph was presented.

Meaningful serial. This task consisted of ten pictures of familiar objects (e.g., a shoe, bell, and book). Each picture was presented for a duration of three seconds with the same interval between pictures. A trial on this task consisted of the presentation of all ten pictures. Ss (N=30) were required to anticipate each picture based on the cue of the preceeding picture. This task was terminated once S was able to correctly anticipate the ten pictures during a single trial.

Picture concept. This task consisted of fifty pictures of familiar animate and inanimate objects (e.g., comb, cat, nurse, and clock). Ss (N=30) were asked to indicate whether each picture (present one at a time) represented an example of the concept (inanimate objects). A trial on this task consisted of the two presentations of all the cards. After S attempted a categorization, he received feedback from E regarding the correctness of his response. The task was terminated once S was able to correctly categorize ten successive pictures.

Relative discrimination. This task consisted of a series of nine cards on which were drawn geometric forms. Each of the nine cards varied from one another in terms of the number (from one to seven), color (red, blue, and green) and shape of forms (squares, triangles, and stars). Further, each card contained a heterogeneous combination of color forms -- e.g., 3 forms divided between two red stars and one blue triangle. Ss (N=30) were required to learn the rule that a card was correct if it contained a larger number of geometric forms relative to the preceeding card. Color and form of the stimuli were thus irrelevant in learning this task.

As an example of the rule for learning this task, if two successive cards had four and six figures, respectively, the latter would be the correct choice on the one hand; if two successive cards had six and four figures, respectively, the latter would not have been a correct choice.

The stimulus cards were presented on a successive or one by one basis. The order of presentation of the cards was randomly varied from one trial to another. After responding to each card, S was informed regarding the correctness of his choice. This task was terminated once S was able to correctly respond to all nine cards successively.

Testing Administration. The administration of all tasks, including the OST, was carried out in special service rooms in the two schools in which the research was carried out. The study was conducted during the period from December 10, 1971 to June 5, 1972.[1]

Each S came by himself or was brought to the testing room by the examiner. Since each S was given five tasks, it was not possible to com-

[1]The directions used for all of the learning tasks are included in Appendix B.

plete his data collection within a single testing period. Usually four testing periods, each lasting 20-25 minutes, were required to complete testing. In most cases, testing for any given S was carried out over consecutive school days within a single week, except when this was not possible due to pupil absence or special scheduling problems. As a means of avoiding any systematic learning effects resulting from a fixed sequence of testing, the order in which the learning tasks and the OST were administered was randomly varied from subject to subject.

Prior to the start of testing, E attempted to establish rapport by assuring the Ss that they were to be involved in playing some interesting games, and that these activities had nothing to do with their school work. In general, the Ss showed enthusiasm in participating in the study.

In addition to the OST and learning data, the following subject information was collected: (A) educational attainment, by grade level, of the main wage earner of the household in which S is a member; (B) occupation of the main wage-earner of the household;[1] (C) the vocabulary, reading comprehension, language, arithmetic ability, work study skills, and composite achievement on the Iowa Test of Basic Skills; (D) the composite IQ derived from the Kuhlman-Anderson Test of Mental Abilities. Both the Iowa and Kuhlman-Anderson were administered approximately six months prior to the beginning of the present research project.

RESULTS

The major data analyses for this study involves comparison of white

[1]The occupation data was used as one basis for measuring socio-economic status, following the occupational prestige scale formulated by Reiss, 1961.

boys (N=61), white girls (N=29), and Black boys and girls (N=30) are with respect to the variables, identified in Table 2. Table 3 lists these variables' means and standard deviations by sub-sample.[1]

Table 3 shows that the three groups were generally similar to each other as evinced by the many non-significant differences between the group means. The exception to this pattern were the significant differences noted for: the number of positive convergent sorts (variable 7); total positive divergent and convergent sorts (variable 8); the number of duplicate sorts (variable 10); the information scale (variable 27); and the vocabulary scale (variable 28) of the WISC; and total IQ (variable 38). In the case of the significant OST variables (variables 7 and 8), the Black Ss exhibited significantly more positive convergent and total convergent and divergent sorts than the sample of white boys. On the other hand, white males showed a significantly higher performance level than either white females or Black Ss on the WISC vocabulary and information scales. Similarly, white males had a higher mean IQ level than the Black sample, although both white samples as well as the Black group fell well within the range of normal intelligence.

The remainder of the results section will be devoted to an analysis of the intercorrelations of the first forty study variables described in Table 2. This analysis will be divided into four parts: (a) the intercorrelations among OST variables; (b) the intercorrelations among the learning measures; (c) the intercorrelations between OST variables as predictors and the learning measures; (d) a similar examination of the intercorrelations between

[1]Since the information, meaningful serial, picture concept, and relative discrimination tasks are based on small partial samples, it was felt appropriate to exclude their data from the major results section. However, appendix C lists for the total sample, the correlations of these tasks with the remaining study variables.

TABLE 2

LIST AND DESCRIPTION OF VARIABLES[1]

Variable #	Title	Scoring
1	number of positive divergent sorts with verbalization	total number of positive sorts with nonzero verbal scores
2	number of positive sorts without verbalizations	total number of positive sorts with exceedingly poor or no verbalization
3	total number of adequate positive divergent sorts	sum of variables one and two
4	total number of all divergent sorts	total number of all sorts, adequate as well as erroneous - e.g., false positive sorts
5	mean speed of positive sorts	mean speed for nonzero verbalized divergent sorts
6	mean verbalization score-divergent phase	mean of verbalization scores associated positive divergent sorts
7	number of convergent positive sorts	number of convergent sorts with nonzero verbalization
8	total of positive divergent and convergent responses	total divergent and convergent nonzero verbalized sorts
9	number of false positive sorts (incorrect)	total number of positive divergent sorts with erroneous verbalizations
10	number of duplicate sorts (incorrect)	number of times a positive divergent sort is repeated
11	number of internal relational divergent sorts (incorrect)	2-1, 1-2 bases for sorts - e.g., these two are tall, this one is short
12	mean convergent verbalization score	mean of all convergent nonzero verbalization sorts
13	proportion of positive verbal divergent sorts	proportion of positive verbalized (nonzero) sorts to total of number of all divergent sorts
14	proportion of all positive divergent sorts	proportion of positive divergent sorts (verbalized or nonverbalized) to total number of all divergent sorts
15	OST flexibility score	number of shifts from one sorting dimention to another for all positive divergent sorts (variable 3)

[1]The first eighteen variables deal with OST measures.

TABLE 2 (Cont'd)

Variable #	Title	Scoring
16	number of categories employed in verbal justifications, including duplicates, false positives, and blank sorts	number of different valid explanations used on all positive and erroneous divergent sorts
17	number of blank sorts	number of times meaningless (sort 10) sort is performed
18	mean speed on convergent recognition	mean speed of nonzero verbalized convergent recognitions
	Title and Scoring	
19	number of errors to criterion on the paired associate picture task (administered to total sample)	
20	number of trials necessary to reach criterion	
21	number of errors to criterion on problem 1, nonreversal concept task (administered to total sample)	
22	number of trials to criterion on problem 1, nonreversal concept task (administered to total sample)	
23	number of errors to criterion on problem 2, nonreversal concept task (administered to total sample)	
24	number of trials to criterion on problem 2, nonreversal concept task (administered to total sample)	
25	total number of errors (problems 1 and 2), nonreversal concept task (administered to total sample)	
26	total number of trials (problems 1 and 2), nonreversal concept task (administered to total sample)	
27	number of correct responses on WISC information scale (administered to total sample)	
28	number of correct responses on WISC vocabulary scale (administered to total sample)	
29	number of digits forward on WISC digit span (administered to total sample)	
30	number of digits backward on WISC digit span (administered to total sample)	
31	total number of correct digits on WISC digit span (administered to total sample)	
32	vocabulary scale - Iowa Test of Basic Skills (obtained for total sample)	
33	reading comprehension - Iowa Test of Basic Skills (obtained for total sample)	
34	language skills - Iowa Test of Basic Skills (obtained for total sample)	
35	work study skills - Iowa Test of Basic Skills (obtained for total sample)	
36	arithmetic skills - Iowa Test of Basic Skills (obtained for total sample)	
37	total achievement score - Iowa Test of Basic Skills (obtained for total sample)	

TABLE 2 (Cont'd)

Variable #	Title and Scoring
38	IQ - From Kuhlman-Anderson Test of Mental Abilities (obtained for total sample)
39	Father's or main breadwinner's education (grade) level (obtained for total sample)
40	Father's or main breadwinner's occupation rated in terms of social prestige (obtained for total sample)
41	number of errors on picture concept sort (obtained on a partial sample)
42	number of trials to reach criterion (of ten successive correct classifications), picture concept sort (obtained on a partial sample)
43	number of errors on the picture serial task (obtained on a partial sample)
44	number of trials to criterion (of correctly anticipating all ten pictures successively), picture serial task (obtained on a partial sample)
45	number of errors on relative discrimination task (obtained on a partial sample)
46	number of trials to criterion (of correctly selecting all nine cards successively), relative discrimination task (obtained on a partial sample)
47	number of errors on information task (obtained on a partial sample)

TABLE 3

MEANS AND STANDARD DEVIATIONS BY SAMPLE[1]

Variables	Male White			Female White			Black			Significance
	N	M	SD	N	M	SD	N	M	SD	
(1) No.pos.div. verb. sorts	61	3.28	1.34	29	3.03	1.52	30	3.63	1.67	n.s.
(2) No.pos.div.sorts no verb.	61	.06	.31	29	0.0	0.0	30	.03	.18	n.s.
(3) Total all pos. div.sorts	61	3.34	1.29	29	3.03	1.52	30	3.67	1.67	n.s.
(4) Total all div. sorts	61	6.05	4.18	29	6.21	4.76	30	7.47	4.48	n.s.
(5) Mean speed, pos. div. sorts	61	23.98	16.88	29	21.45	11.48	30	20.83	11.30	n.s.
(6) Mean verbal score, div.	61	2.62	.68	29	2.52	.54	30	2.47	.62	n.s.
(7) No. of con. pos. sorts	61	.41	.61	29	.76	1.12	30	.93	1.20	$F=3.63$, $df=2/117$, $p < .05$
(8) Total con. and div.	61	3.69	1.43	29	3.79	1.32	30	4.57	1.78	$F=3.62$, $df=2/117$, $p < .05$
(9) No. false pos. sorts	61	.62	1.16	29	.93	1.77	30	.53	.82	n.s.
(10) No. of dup.div. sorts	61	1.69	2.57	29	1.55	2.23	30	3.07	3.18	$F=3.23$, $df=2/117$, $p < .05$
(11) No. of inter.rel. div.sorts	61	.36	.88	29	.55	1.62	30	.20	.55	n.s.
(12) Mean con.verb. score	61	.89	1.32	29	.98	1.29	30	1.23	1.31	n.s.
(13) Proport. pos.verb. sorts (div.)	61	.69	.31	29	.70	.33	30	.60	.29	n.s.
(14) Proport. all pos. sorts (div.)	61	.70	.30	29	.69	.33	30	.60	.28	n.s.
(15) OST flex. score	61	1.79	1.05	29	1.62	1.24	30	2.00	1.29	n.s.
(16) No.of categories employed	61	3.51	1.46	29	3.31	1.47	30	3.77	1.63	n.s.

[1]A complete description of the listed variables is given in appendix A; variables 41-48 are not included in the primary analysis since they are based on sub-samples. In some cases, the N for the variable will not be the same as the sample N. This is due to missing test data or inability to meet the mastery criterion of a task.

TABLE 3 (Cont'd)

Variables	Male White			Female White			Black			Significance
	N	M	SD	N	M	SD	N	M	SD	
(17) No.of blank sorts	61	.43	1.12	29	.69	1.56	30	.23	.63	n.s.
(18) Mean con. speed	61	8.03	20.00	29	8.10	15.78	30	14.40	21.99	n.s.
(19) No.of errors- paired assoc.	61	28.74	18.06	29	25.28	11.67	30	30.40	16.30	n.s.
(20) No. of trials paired assoc.	61	5.89	2.52	29	6.52	4.94	30	6.20	2.37	n.s.
(21) Errors Prob.1 nonreversal	61	9.98	13.67	29	8.55	11.95	30	11.27	16.28	n.s.
(22) No.of trials, Prob.1, nonreversal	61	18.82	30.06	29	16.55	26.19	30	21.83	34.44	n.s.
(23) Errors Prob.2 nonreversal	56	17.45	14.05	27	21.56	14.92	26	22.58	15.68	n.s.
(24) No.of trials, Prob.2 nonreversal	56	36.00	29.00	27	44.70	32.39	26	49.62	32.90	n.s.
(25) Total errors, nonreversal	61	26.01	16.24	29	28.45	14.47	30	30.87	16.05	n.s.
(26) Total trials, nonreversal	61	51.80	33.16	29	58.35	31.09	30	64.87	34.59	n.s.
(27) Information WISC	61	13.82	3.14	29	12.10	2.11	30	11.97	2.47	$F=6.46$, $df=2/117$, $p < .01$
(28) Vocabulary WISC	61	34.31	8.38	29	29.83	5.46	30	29.63	4.80	$F=6.46$, $df=2/117$, $p < .01$
(29) Digit Foreward WISC	61	5.43	1.09	29	5.41	.95	30	5.93	1.01	n.s.
(30) Digit Backward WISC	61	3.80	.91	29	3.79	.68	30	4.00	1.02	n.s.
(31) Total Digits WISC	61	9.23	1.60	29	9.21	1.35	30	9.93	1.44	n.s.
(32) Vocabulary - Iowa	57	53.61	13.92	29	48.97	11.07	29	47.59	10.45	n.s.
(33) Reading - Iowa	57	53.61	14.61	29	49.83	9.56	29	47.82	10.18	n.s.
(34) Language - Iowa	58	51.03	13.39	29	49.72	12.39	29	48.86	11.06	n.s.
(35) Study Skills - Iowa	57	53.07	12.29	29	51.00	9.67	29	47.93	8.40	n.s.
(36) Arithmetic - Iowa	58	50.03	9.46	29	47.79	7.64	29	47.07	7.60	n.s.

TABLE 3 (Cont'd)

Variables	Male White			Female White			Black			Significance
	N	M	SD	N	M	SD	N	M	SD	
(37) Total Iowa	57	52.39	11.29	29	48.97	8.12	29	47.90	8.53	n.s.
(38) IQ	52	110.15	15.48	26	107.46	13.57	25	100.96	14.32	$F=3.29$, $df=2/100$, $p < .05$.
(39) Father's Education	56	12.14	2.50	26	10.81	2.02	25	10.96	3.80	n.s.
(40) Occupational Status	61	4.54	1.50	29	5.41	1.21	29	5.00	1.73	n.s.

IQ as a predictor and the various learning measures.

A. Intercorrelations among OST variables. Table 4 lists the correlations among OST variables (1-19) for the total sample as a means of providing the reader with a global picture of the patterning of these relationships. These data first indicate considerable redundancy among certain of the OST variables as evinced by the number of extremely high correlations in the .80s and .90s as found for example between variables 1 and 3, 4 and 10, and 3 and 8. While there is measurement overlap, it should not be concluded that all aspects of OST performance correspond to a single psychometric dimension. Thus, there are a large number of low to moderate size correlations suggesting that differentiation does exist between OST variables. For example, the fact that only modest relationships are found between mean verbalization scores - divergent phase (variable 6) and the number of correct divergent sorts (variables 1 and 3) suggests that verbalization and classificatory skills on the OST involve relatively distinctive processes. Similarly, the generally small correlations between error scores (variables 9, 10, 11, and 17) and positive divergent sorts (variables 1 and 3) or convergent sorts (variable 7) indicates a differentiation exists between the production of performance errors and of adequate convergent or divergent classification.

B. Interrelations among learning and achievement variables. Table 5 lists the intercorrelations by sample among the various learning and achievement measures.[1] An overall examination of these correlations indicates there

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[1]It should be recalled that the white male sample had approximately twice as many subjects as either the white female or Black groups. Because of the larger N in the white male group, it follows that there were more degrees of freedom by which the statistical significance of the correlations for this sample was tested. Accordingly, there was a clear possibility, in comparison to the other two samples, that more of the correlations for the white male group would be judged significant. To adjust this statistical inequalities between the samples. the correlations for each sample will be tested against a criterion of 28 degrees of freedom, approximately the degrees of freedom available for the white female and Black samples.

Intercorrelations Among OST Variables[1]
N=120*

Var. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	--	-18	99	33	20	32	-30	79	-27	23	-18	-24	21	19	86	94	-21	-16
2		--	-02	21	-10	-34	-08	-18	21	25	-06	-08	-26	-20	-09	-16	-01	-09
3			--	37	18	27	-31	77	-24	27	-20	-25	17	16	86	93	-22	-17
4				--	-12	-15	-38	10	64	92	51	-41	-73	-74	26	49	52	-24
5					--	16	03	22	-27	-10	-19	08	29	27	24	14	-19	00
6						--	02	32	-34	-17	-14	06	43	42	25	28	-13	08
7							--	34	-27	-25	-19	74	27	26	-27	-36	-16	45
8								--	-43	08	-31	24	35	34	68	69	-30	13
9									--	49	78	-32	-67	-67	-23	-07	53	-16
10										--	31	-29	-73	-73	16	38	29	-15
11											--	-23	-48	-48	-16	-05	61	-17
12												--	34	33	-21	-31	-24	56
13													--	99	17	03	-57	18
14														--	17	02	-58	20
15															--	80	-20	-10
16																--	-10	-20
17																	--	-13
18																		--

[1]A description of each OST variable is provided in Table 2. Decimals are omitted from each correlation.

* Correlations exceeding .20 are significant at the .05 level, two sided test.

Note: Decimals are omitted from the correlations.

TABLE 5

Intercorrelations Among Learning-Achievement Variables[1]

Variable	19 WM	19 WF	19 B	20 WM	20 WF	20 B	21 WM	21 WF	21 B	22 WM	22 WF	22 B	23 WM	23 WF	23 B
19	--	--	--	88	04	91	52	07	-15	50	06	-18	17	-11	24
20				--	--	--	30	-03	-04	30	-02	-08	13	-19	11
21							--	--	--	99	99	99	-10	-36	-27
22										--	--	--	-12	-34	-24
23													--	--	--
24															
25															
26															
27															
28															
29															
30															
31															
32															
33															
34															
35															
36															
37															

[1]Table 2 provides descriptions of each variable; table 3 lists the N's, means and S.D.'s associated with each variable. Correlations equal or greater than .36 are significant at the .05 level, two-tailed test, for 28 degrees of freedom. WM=white males; WF=white females; B=Black group.

Note. - Decimals are omitted from the correlations.

TABLE 5 (Cont'd)

	Variables																	
		24			25			26			27			28			29	
Var.	WM	WF	B	WM	WF	B	WM	WF	B	WM	WF	B	WM	WF	B	WM	WF	B
19	22	01	22	39	-07	12	42	05	07	-17	-21	25	-50	-23	-14	-25	-11	22
20	20	13	12	24	14	07	31	10	04	-15	00	-33	-35	02	-22	-30	11	25
21	-18	-38	-20	55	32	48	57	33	47	-14	-10	-26	-22	-16	-19	-29	10	03
22	-19	-37	-16	53	33	47	57	34	49	-13	-12	-26	-20	-19	-15	-30	08	01
23	95	96	95	85	92	89	82	89	82	09	-01	-04	-31	-04	27	-20	02	12
24	--	--	--	77	87	87	83	93	90	04	-17	-11	-33	-11	23	-20	03	18
25				--	--	--	95	96	95	01	-09	-19	-32	-12	05	-32	03	17
26							--	--	--	-04	-24	-23	-34	-20	05	-35	03	19
27										--	--	--	44	62	74	38	-04	-25
28													--	--	--	28	33	-20
29																--	--	--
30																		
31																		
32																		
33																		
34																		
35																		
36																		
37																		

TABLE 5 (Cont'd)

Var.	30 WM	30 WF	30 B	31 WM	31 WF	31 B	32 WM	32 WF	32 B	33 WM	33 WF	33 B	34 WM	34 WF	34 B	35 WM	35 WF	35 B
19	-19	-05	-14	-28	-10	06	-32	-09	14	-14	-20	-22	-11	-20	-15	-18	-27	-27
20	-11	03	-09	-27	09	13	-31	00	-23	-11	-09	-16	-10	-03	-20	-17	-28	-22
21	-29	29	11	-36	21	10	-11	-01	-16	-15	-27	-22	-04	-21	-18	-14	-25	-26
22	-26	26	10	-35	19	08	-09	-02	-10	-15	-31	-20	-04	-21	-17	-15	-27	-24
23	00	-22	-39	-14	-10	-20	-16	-16	30	-16	13	03	-33	46	-02	-30	24	-02
24	03	-21	-44	-12	-08	-19	-22	-27	31	-20	06	12	-31	37	00	-31	16	04
25	-19	-09	-29	-32	-02	-08	-16	-18	10	-22	-04	13	-30	33	-15	-33	10	-19
26	-15	-08	-33	-32	-02	-09	-21	-28	16	-26	-12	-03	-31	24	-13	-36	01	-11
27	25	04	19	40	-01	-05	65	70	42	51	66	39	35	51	52	34	75	52
28	12	25	-09	26	36	-21	57	63	55	48	52	50	30	51	53	36	66	58
29	29	36	-06	84	88	71	48	09	00	47	19	07	52	03	06	50	11	00
30	--	--	--	76	76	66	24	02	24	31	16	28	13	02	41	06	06	35
31				--	--	--	46	07	17	50	22	25	43	03	34	37	10	25
32							--	--	--	78	66	77	58	53	74	68	50	70
33										--	--	--	70	54	79	78	69	89
34													--	--	--	83	65	70
35																--	--	--
36																		
37																		

TABLE 5 (Cont'd)

36			37			
WM	WF	B	WM	WF	B	Variable
-10	-22	-08	-20	-25	-20	19
-04	-16	-11	-17	-11	-21	20
-12	-15	-32	-13	-20	-25	21
-11	-18	-32	-12	-22	-22	22
-34	29	15	-27	29	07	23
-39	23	18	-30	18	11	24
-35	25	-08	-29	17	-12	25
-39	17	-04	-33	06	-05	26
41	35	61	53	69	55	27
36	59	60	48	69	60	28
43	19	20	54	17	07	29
25	-03	09	22	04	32	30
42	12	21	50	14	29	31
59	43	60	84	76	86	32
70	53	67	91	80	93	33
74	64	71	87	86	90	34
76	51	71	91	81	90	35
--	--	--	84	76	81	36
			--	--	--	37

are generally low relationships between the various learning and achievement tasks. However, exceptions to this pattern are evident. First, correlations among variables within a task tended to be substantial in comparison to correlations between tasks. Note, for example, the presence of moderate to high correlations between certain of the variables (21-26) within the nonreversal tasks, and for selected WISC variables (particularly variables 27 and 28) within each of the three study samples. Such relationships perhaps reflect measurement redundancy as well as the assessment of a unitary learning property which operates during various aspects of a given task. Second, across all samples, the WISC variables especially information (variable 27) and vocabulary (variable 28), and backward digit span (variable 30), tended to show moderately high relationship with the various Iowa achievement sub-scales (variables 32-37). Third, in comparison to the white female and especially the Black sample, the white male group tended to present a moderately cohesive pattern of relationships between various learning assessments. Thus, the white male sample exhibited the only significant set of correlations between paired associate and the nonreversal measures (i.e., variables 19, 21, and 22). Similarly, the white male sample exhibited, in contrast to the non-significant correlations found in the Black sample, significant relations between the nonreversal variables (24 and 26) and the Iowa Arithmetic sub-scale (variable 36).

C. Intercorrelations between OST and learning-achievement variables. Table 6 lists the correlations between OST and learning achievement variables, by sample. Similarities as well as differences in the pattern of relationships may be noted between these correlation matrices. First, with respect to similarities, all three samples showed inverse relationships between a

TABLE 6

Intercorrelations Between OST Variables and Learning-Achievement Measures[1]

Dependent Variables	1 WM	1 WF	1 B	2 WM	2 WF	2 B	3 WM	3 WF	3 B	4 WM	4 WF	4 B	5 WM	5 WF	5 B	6 WM	6 WF	6 B
	OST VARIABLES																	
19	-25	-10	32	28	--	08	-19	-10	33	12	-21	30	02	07	-11	-48	-24	-07
20	-13	-38	17	33	--	22	-06	-38	19	17	-24	22	-01	18	-07	-36	-34	00
21	-10	-25	-11	34	--	53	-02	-25	-05	13	-05	08	00	-02	20	-54	-05	-18
22	-07	-26	-11	35	--	43	01	-26	-06	18	-02	04	02	-03	26	-52	-07	-16
23	-24	-24	05	-08	--	00	-25	-24	04	-09	25	-33	14	-12	-27	01	-01	15
24	-27	-26	-02	-12	--	00	-28	-26	-02	-02	27	-42	05	-08	-15	00	03	14
25	-21	-32	-02	16	--	31	-18	-32	01	-01	22	-17	17	-10	-13	-29	01	01
26	-21	-36	-08	16	--	20	-18	-36	-06	08	25	-28	11	-08	03	-31	02	03
27	30	20	16	-16	--	-15	28	20	15	-00	-46	11	10	-11	-04	20	27	15
28	49	10	15	-12	--	-18	49	10	13	10	-48	-07	05	00	01	38	44	-05
29	27	24	29	-23	--	01	23	24	29	-20	-03	28	03	24	00	25	13	32
30	25	01	02	-19	--	00	22	01	02	-15	-40	02	06	18	02	21	03	14
31	33	17	23	-27	--	01	28	17	24	-22	-22	22	06	26	01	29	11	34
32	45	23	12	-21	--	-25	42	23	10	-13	-52	-41	07	-06	16	29	48	13
33	33	27	-06	-25	--	-11	28	27	-07	-16	-37	-41	-10	-09	14	25	41	11
34	26	09	09	-24	--	-10	21	09	08	-15	-28	17	-19	-13	00	19	56	03
35	26	12	-01	-23	--	-16	22	12	-02	-17	-23	-37	-24	-39	12	23	42	02
36	44	15	21	-09	--	-18	44	15	19	-07	-18	-12	-02	-01	13	25	57	10
37	39	19	08	-24	--	-18	35	19	07	-14	38	-33	10	-19	11	27	62	07
(IQ) 38	42	33	07	-41	--	00	33	33	07	-32	-19	-25	03	-24	32	40	59	26
SES 39	20	-02	34	-21	--	-27	16	-02	31	-16	32	24	23	-47	-12	21	29	02
SES 40	07	-19	06	17	--	22	11	-18	-04	26	-01	01	-27	-11	-11	-13	-37	-14

[1] Table 2 lists and describes the variables; Table 3 lists the N's, means, and S.D.'s of these variables. WM=White males; WF=White females; B=Black group. Decimals have been omitted from the correlations. Correlations equal or greater than .36 are significant at the .05 level, two tailed test, for 28 degrees of freedom.

TABLE 6 (Cont'd)

OST Variables

(Dependent Variables)

	7			8			9			10			11			12		
	WM	WF	B	WM	WF	B	WM	WF	B	WM	WF	B	WM	WF	B	WM	WF	B
19	16	03	-20	-25	-11	16	30	-13	-16	08	-20	32	16	-10	-12	-13	01	-06
20	-03	55	-18	-07	03	04	29	-06	-18	13	-18	29	16	-05	-14	-04	11	02
21	-16	04	-04	-15	-25	-13	18	05	06	06	07	16	-08	-16	-13	-16	06	-17
22	-16	05	01	-11	-26	-10	23	08	05	10	11	11	-05	-17	-15	-15	07	-12
23	15	17	09	-16	-13	10	15	24	-31	-10	15	-39	13	41	-24	10	03	10
24	17	11	07	-18	-20	03	25	25	-31	-05	17	-47	25	43	-18	10	-03	18
25	04	17	-02	-17	-23	-04	17	25	-15	-06	20	-15	03	32	-28	01	00	-08
26	05	13	01	-17	-31	-07	30	27	-15	01	24	-27	16	33	-24	00	00	03
27	-05	21	-01	22	41	15	-17	-47	-03	09	-43	04	-22	-41	01	01	32	-06
28	-01	34	24	44	41	30	-18	-54	-21	14	-39	-14	-15	-37	04	-02	44	23
29	-07	-04	-08	23	24	22	-36	-09	04	-12	08	25	-23	03	-21	-06	-08	-01
30	-06	03	06	18	03	06	-18	-40	00	-21	-40	01	-20	-25	-12	-05	-03	-01
31	-08	-01	-02	26	19	21	-35	-26	-03	-20	-25	20	-27	-10	-24	-07	-07	-01
32	01	22	40	44	45	38	-42	-56	-36	-08	-43	-51	-43	-53	25	03	41	48
33	04	03	32	35	29	16	-38	-46	-28	-08	-46	-44	-39	-24	-18	04	09	54
34	-14	30	42	18	35	36	-32	-42	-28	-12	-24	-22	-26	-22	-22	-05	30	42
35	04	10	25	28	22	16	-39	-28	-19	-10	-21	-43	-33	-17	-15	07	22	42
36	-10	07	26	40	24	37	-34	-30	-40	-04	-18	-16	-35	-07	-24	-02	23	42
37	-04	21	37	37	40	33	-41	-48	-32	-07	-36	-39	-39	-30	-23	01	34	50
(IQ) 38	03	11	45	35	48	38	-43	-39	-51	-31	-22	29	-32	-19	-17	12	04	52
SES 39	09	-07	-09	27	-08	24	-45	22	-03	-04	30	16	-35	22	15	09	03	03
SES 40	-03	00	-15	07	-21	-16	24	08	05	18	10	07	19	-08	-07	-02	-09	-36

TABLE 6 (Cont'd)

Dependent Variables	13 WM	13 WF	13 B	14 WM	14 WF	14 B	15 WM	15 WF	15 B	16 WM	16 WF	16 B	17 WM	17 WF	17 B	18 WM	18 WF	18 B
	QST Variables																	
19	-29	23	-20	-26	23	-20	-12	-03	29	-19	-12	31	16	-11	-14	-04	10	-11
20	-22	18	-21	-19	18	-20	-07	-37	11	-08	-42	17	07	-04	-15	-03	32	-03
21	-21	-21	-17	-20	-21	-13	16	-23	-12	-12	-28	11	18	-06	-19	-12	35	-25
22	-22	-24	-11	-21	-24	-07	19	-24	-11	-08	-27	-11	19	-06	-20	-12	36	-25
23	04	-23	38	03	-23	38	-24	-33	13	-21	-21	00	08	51	-21	05	-12	-12
24	-04	-23	45	05	-23	45	-23	-29	06	-21	-23	-07	15	53	-27	11	-12	-06
25	-07	-30	14	-07	-30	16	-06	-41	-01	-21	-29	-04	13	43	-31	-03	04	-29
26	-15	-32	26	-15	-32	28	02	-38	-06	-18	-31	-10	20	45	-36	01	05	-22
27	17	51	11	16	51	10	25	06	13	24	04	24	-31	-46	36	06	-02	08
28	23	43	24	23	43	23	37	01	14	45	-10	16	-28	-40	20	20	20	13
29	22	11	-04	19	11	-03	18	23	15	15	06	30	-34	-10	02	-10	11	01
30	23	24	03	21	24	03	06	07	-05	20	-15	02	-11	-20	00	-09	-02	05
31	28	20	-01	24	20	-01	16	20	08	21	-03	24	-30	-17	02	-12	07	05
32	37	51	56	33	51	54	41	15	15	38	-01	07	-36	-57	-13	08	-02	25
33	28	45	45	25	45	45	19	16	-09	34	05	-11	-36	-20	00	04	-24	42
34	20	32	25	17	32	24	30	-08	02	21	-10	07	-22	-11	12	-04	-09	40
35	20	27	43	18	27	42	19	-01	02	26	02	-01	-28	-19	-11	11	-12	32
36	25	23	30	24	23	29	32	02	24	41	02	20	-35	-09	-04	-02	-09	45
37	29	42	43	25	42	42	32	03	07	37	-03	06	-35	-27	-03	03	-11	40
(IQ) 38	48	39	51	44	39	51	15	05	02	32	15	04	-39	-23	06	02	-07	28
SES 39	28	-31	06	26	-31	03	15	-10	32	18	02	36	-23	29	25	07	04	-02
SES 40	-26	-22	-12	-28	-22	10	01	-18	-06	15	-10	-06	21	08	-39	-03	14	-27

number of the OST variables dealing with erroneous classification (i.e., variables 9, 10, 11, and 17) and many of the scores on the various WISC, Iowa measures, and total IQ (variables 26-38). Thus, for example, tendencies of S to produce errors in divergent categorizations is modestly predictive of low performance on the WISC sub-scales. Of the three samples, white females exhibited the most consistent and strongest inverse correlational pattern involving the OST error variables and performance measures.

A second similarity found <u>only</u> in the white male and female samples involved the positive relationships between the number of positive divergent sorts (variables 1 and 3), quality of verbalization-divergent phase (variable 6) and various performance measures. In the case of the white male group, adequate divergent behavior was thus positively related to a number of WISC measures (variables 27-31), Iowa scales (variables 32-37), and total IQ (variable 38). For the female group, adequate divergent performance exhibited a somewhat more restricted positive relationship, involving significant relationships only with the paired associate (variable 20) and nonreversal learning (variable 26). Divergent verbalization (variable 6) was positively related to all of the Iowa sub-scales and to total IQ for the white female sample. For the white male sample, divergent verbalization (variable 6) was significantly related to IQ, paired associates (variables 19-20), and the first nonreversal task (variables 21-22). Overall, adequate divergent sorting behavior exhibited stronger relationships with performance measures for the white male than for the female sample. In contrast, positive relationships involving divergent verbalizations and performance measures were more robust for the white female than for the male sample. It should also be noted that for both white samples significant correlations were also found between total number of adequate convergent and divergent sorts (variable 8) and a number of the WISC and Iowa sub-scales (variables 27-37). For the Black sample, only four significant correlations emerged between variables 8 and learning achievement indices.

A somewhat contrasting pattern of correlations between the White and Black samples involved variables 13 and 14. Both of these variables may be viewed as measures of efficiency of S in performing positive sorts relative to the total number of sorts produced. For the white samples, there were relatively few significant correlations between variables 13 and 14 and variables corresponding to IQ, WISC measures, and the Iowa sub-scales. For the Black sample, there were a number of significant correlations between OST efficiency measures (variables 13 and 14) and a variety of criterion measures, including the Iowa and WISC sub-scales and errors produced on the second problem of the nonreversal task (variables 23-24).

A marked contrast between the white and Black samples was noted with respect to adequate convergent performance. Within the Black sample, adequate convergent recognitions (variable 7) and convergent verbalization (variable 12) showed moderately strong positive relationship with selected (variables 27-31) WISC and Iowa (variables 32-37), and IQ measures. Within the white male sample, there were no significant correlations between the convergent variables and the learning achievement measures; in the white female frou, the convergent variables (7 and 12) exhibited only three significant correlations involving paired associate learning (variable 20) the WISC, and Iowa sub-scales. In summary, significant relationships involving divergent processes characterizes both white samples while relationships involving convergent processes typifies the Black sample.

A further interesting comparison between the white and Black samples involved the two speed variables (5 and 18) dealing with the average latency in sorting or recognizing, respectively, the OST objects. In the case of the female white group, where the only significant correlation was noted, variable 5 (mean divergent speed) was found to be inversely related to one of the Iowa sub-scales. For the Black sample, mean convergent speed (variable 18) was found to be significantly related to four of the Iowa measures. It should be recalled that for the Black Ss, the convergent dimension (variables 7 and 12) was shown to be the only basis by which positive performance on the OST was related to learning achievement measures.

D. Relationship of socio-economic variables and OST performance. Two measures of socio-economic status (SES) were obtained in this study. These SES variables were the father's educational level (variable 39) and the rated prestige of the father's occupation (variable 40). Of particular interest is the relationship between these SES measures and OST indices which directly deal with positive divergent and convergent performance (variables 1, 2, 3, 6, 7, and 12). As may be seen from Table 6, there was only two such significant correlations, involving white females and Blacks. These were the relationships between occupational status and mean divergent verbalization (variable 6 - white females), and occupational status and convergent verbalization (variable 12 - Blacks). As a matter of fact, for all three samples, there were few significant relationships involving any of the other OST variables and the two SES indices. As a comparison, the white male and female samples exhibited significant correlations of .41 and .46, respectively, between the SES index of father's education level and IQ. For the Black sample, IQ was significantly correlated (.39) with rated occupational status of the father.

E. Relationship between IQ and OST variables. As may be further seen from Table 6, the extent to which IQ is related to adequate OST performance varies from sample to sample. In the case of the white male and female samples, IQ was found to be significantly related to positive divergent performance (white males, variable 1) and divergent verbalization (both white samples, variable 6). In the case of the Black sample, IQ was found to be related to positive convergent recognition (variable 7) and convergent verbalization (variable 12). Further, though there were significant correlations between IQ and OST indices, the relationships are generally modest in magnitude, suggesting that IQ and adequate OST performance are not substantially tapping a common variance pool.

F. Relationship between IQ and learning-achievement variables. A final analysis focuses on the relationship between IQ (variable 38) and the various learning and achievement variables. As shown in Table 7, the most consistent pattern apparent across all three samples were the substantial (and not surprising) relations between IQ and the various Iowa scales. However, there were relatively striking differences (between the three samples) in the extensity of the relationship involving the IQ variable. Clearly, the white male sample exhibited the highest frequency of significant correlations between IQ and a variety of measures including nonreversal

TABLE 7

Correlations Between IQ and Learning-Achievement Variables By Sample[1]

IQ And Variable	White Males	White Females	Black Group
19	-36	-38	-19
20	-29	15	-16
21	-43	-08	-14
22	-43	-11	-11
23	-28	15	09
24	-33	01	19
25	-43	15	02
26	-50	-02	11
27	52	67	38
28	41	53	58
29	51	18	17
30	53	-07	12
31	62	09	22
32	68	62	63
33	69	64	74
34	62	66	55
35	69	63	71
36	70	60	58
37	76	78	70

[1]Table 2 describes the listed variables; Table 3 lists the N's, means, and SD's for these variables. Correlations equal or larger than .36 are significant at the .05 level, two tailed test, for 28 degrees of freedom.

Note. - Decimals have been omitted from correlations.

learning, the WISC scales, and, of course, the Iowa sub-tests. In contrast, both the white female and Black samples exhibited a considerably less coherent pattern of relationships between IQ and the various dependent measures, except as noted above, the significant correlations between IQ and the Iowa measures.

It is somewhat difficult to compare the relative capacity of the OST instrument versus the intellectual assessment (IQ) to predict to the learning-achievement variables. This is because there are a large number of OST variables and only a single intellectual variable. It would follow that since there is an array of OST indices, the changes are enhanced, in comparison to a single intellectual assessment, that at least a few correlations involving OST variables would exhibit significance. Keeping this qualification in mind, it is evident across samples, that there are a diversity of OST measures which exhibit moderately strong predictive relationships with the learning-achievement variables. However, there is no single OST indices which clearly showed marked superiority to the IQ in producing consistently stronger relationships with the learning-achievement measures. Rather, both IQ and OST performance exhibit about equal predictive capacity, but utilizing different psychometric approaches to such prediction.

DISCUSSION

The original intent of this investigation was to evaluate the effectiveness of the OST as a predictor of learning outcomes, especially among minority children. The study results, however, have produced a subtle but significant shift of attention to the issue of possible differences in the cognitive organization of children from relatively diverse backgrounds. Specifically, the results showed a generally clear difference in how adequate performance on the OST was related to indices of learning and school achievement. For both white samples adequate divergent performance and verbalization exhibited moderately strong relationships with a number of learning-achievement measures. On the other hand, adequacy of convergent recognition and verbalization was found to have a generally low relationship with the same criterion measures. In contrast, for the Black sample, adequate convergent recognition and verbalization, but <u>not</u> divergent performance and verbalization, was shown to be related to the criterion variables.

Further evidence of group differences in cognitive organization comes from the finding that the white samples, especially white males, exhibited greater internal cohesiveness between OST indices and the learning-achievement measures, between IQ and OST indices, and between various learning-achievement measures. This tendency was manifested, as shown in Figure 3, by the greater number of significant linkages (correlations) found for the white sample than for the Black group involving the above clusters of variables. This finding is very reminiscent of those reported for example, by Jensen and Rohwer (1969), namely the presence of significant correlations

White Female

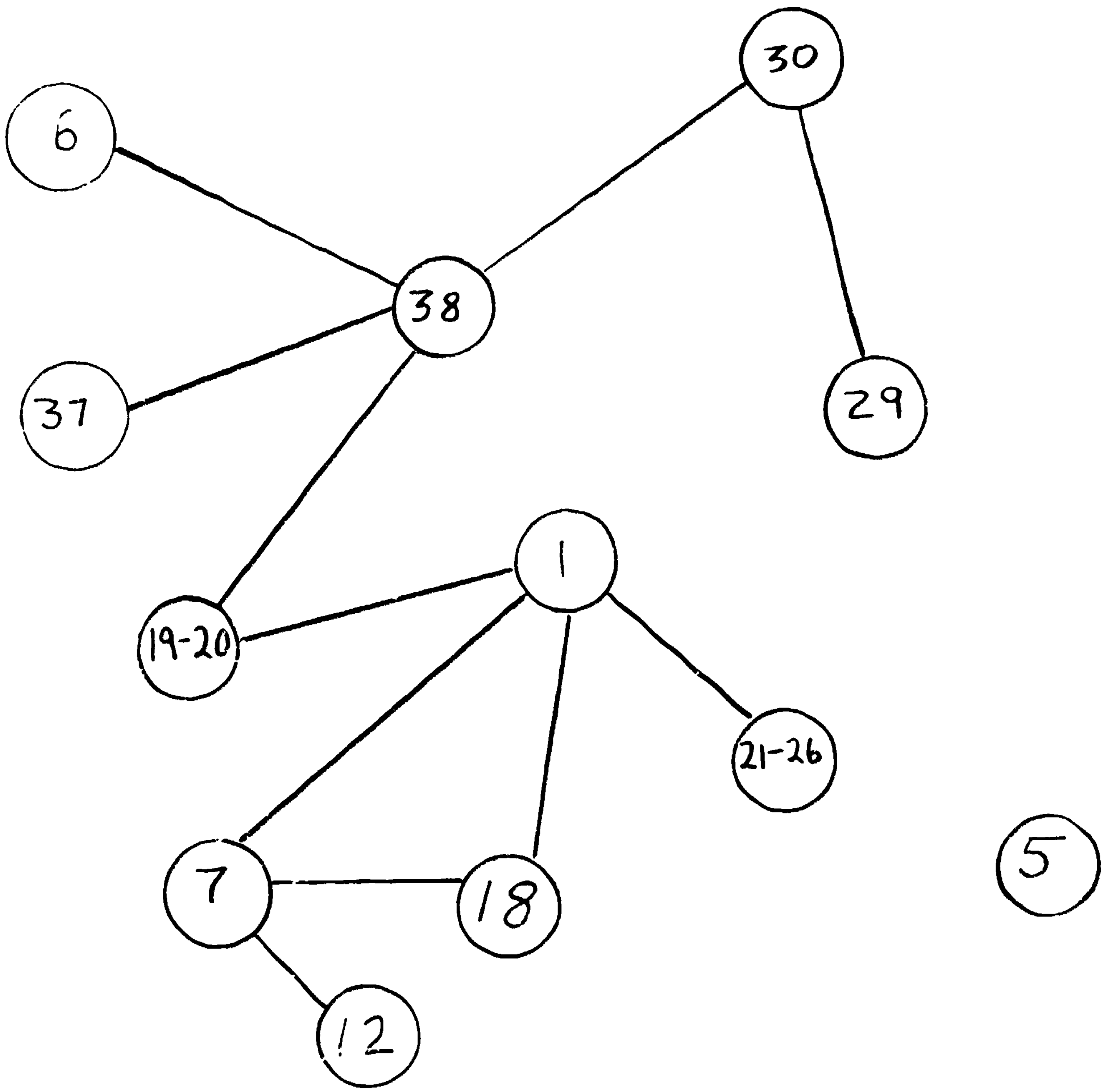


Figure 3. Linkages (significant correlations equal or greater than .36) among selected predictor and criterion variables.

Note: When variables are grouped together (e.g., 21-26), a significant linkage may refer to correlations involving one or more than one of the grouped variables.

Key:

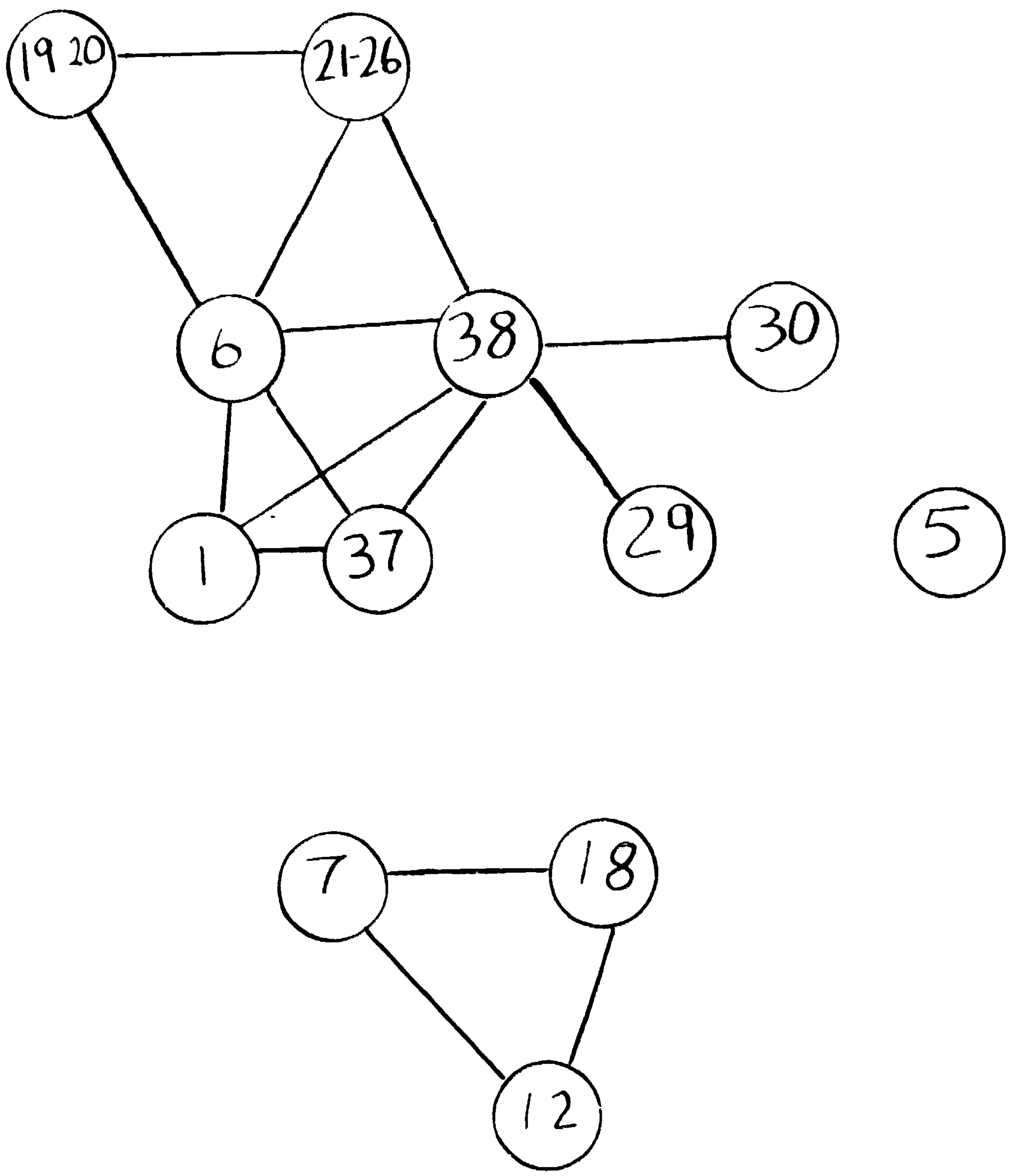
Predictor Variables

1 No.Pos.Diver.Verb.Sorts
5 Mean Diver.speed
6 Diver.verbal scores
7 No.pos.conver.responses
12 Mean conver.verbal scores
18 Mean conver.speed
38 IQ

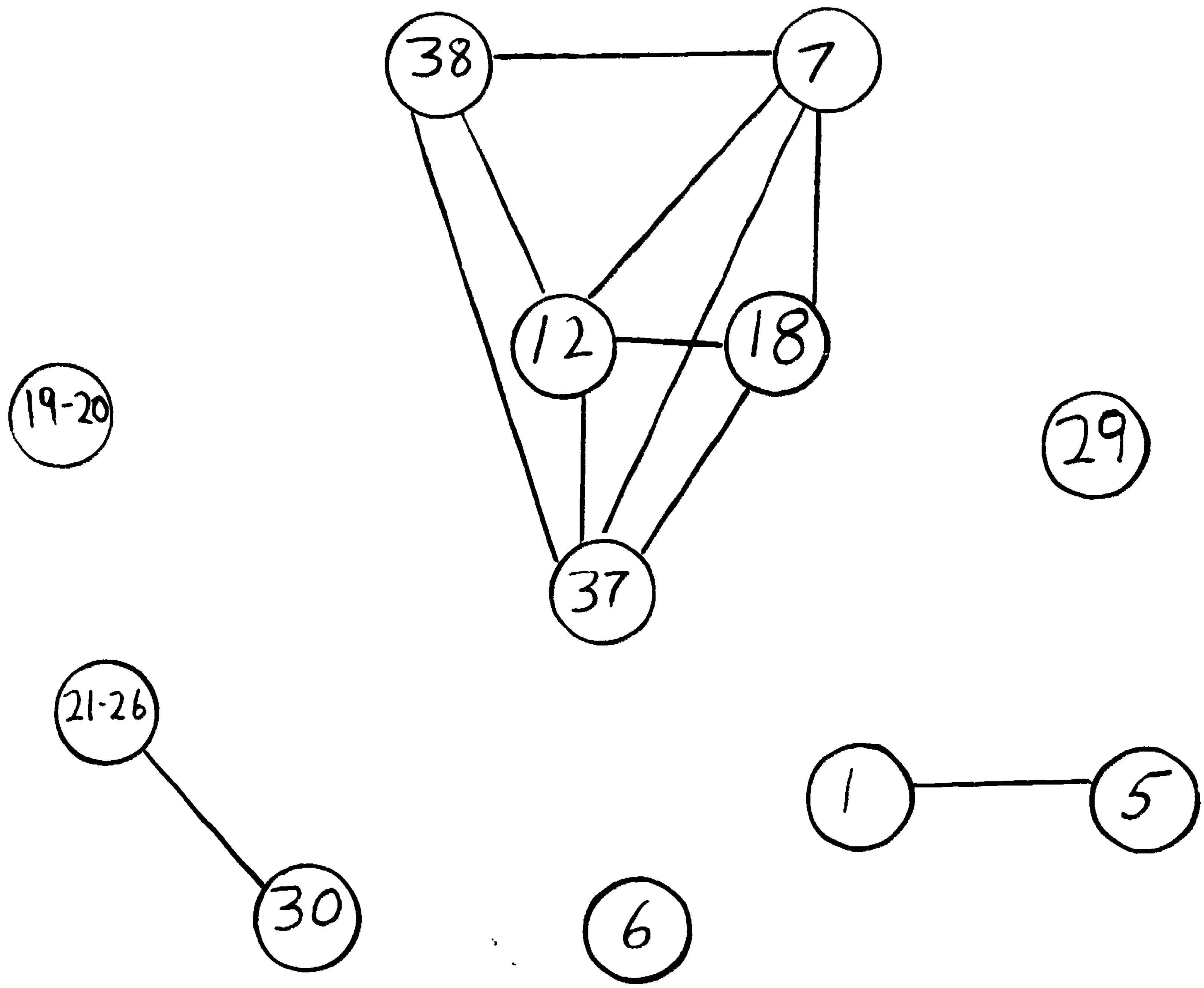
Criterion Variables

19-20 Paired associate scores
21-26 Nonreversal concept scores
29 WISC forward digit span
30 WISC backward span
37 Total Iowa score

White Males



Blacks



between IQ and performance scores on various associative learning tasks for white middle class samples of children and the absence of such correlations among samples of Black children.

In interpreting these observed group differences, attention can be directed to Anastasi (1958) who proposed that social-class and ethnic groups "differ in their relative standing on different (cognitive) functions. Each (group) fosters the development of different patterns of abilities." Thus, being a member of a particular ethnic group or falling within a social-class grouping as defined by the father's education or occupation, may have significant implications for the patterning of cognitive functions. The causal process between such group membership and cognitive organization, which is postulated as operating in this study, cannot at this point be explicated. Undoubtedly, it must involve an extremely complicated network of interacting factors.

Relevant to this proposition are some data reported by Stodalsky and Lesser (1967). Their findings involved a comparison between four ethnic groups: Chinese, Black, Jewish, and Puerto Rican children with respect to psychometric assessments of verbal, reasoning, number, and special abilities. Perhaps the most striking finding reported by Stoldasky and Lesser was that each group had an ability profile which was patterned differently (in terms of mean level) from each of the other samples. As with their results, the current findings were also strongly suggestive of the relationship with ethnic membership appears to hold to the patterning of cognitive learning functions.

One of the interesting aspects of the current study was that relatively few mean performance differences were noted between Black and white children. As has been reported in numerous studies and reviews (e.g., Dreger and Miller, 1960) Black children have typically performed at a lower average level than white children on standardized tests of intelligence. Such racial differences in IQ are maintained even when social class level is controlled (Deutsch and Brown, 1964). In this study, only one OST variable (number of duplicate erroneous sorts - Variable 10) showed the expected cognitive difference, with both white males and females producing significantly fewer duplicate sorts than the Black sample. In fact, the Black S's exhibited significantly superior performance to white males on two OST variables dealing with adequate convergent recognition (variable 7) and total number of adequate convergent and divergent sorts (variable 8). Contrasting findings were noted with respect to variables intended to assess IQ. Thus, two of the WISC sub-scales (information, variable 27, and vocabulary, variable 28) and total IQ (variable 38) showed the expected intellectual difference in favor of white subjects.

Further, since racial difference in intellectual performance are often confounded with social class, it was not surprising to find IQ (variable 38) positively related to a socio-economic index. Such cognitive differences, as functions of social class, were not strongly evident with respect to OST performance. The absence of consistent relationships between social class and OST performance is suggestive that the sorting task may be tapping cognitive functions which are not directly responsive to cultural or environmental factors.

Similar to general absence of group differences in OST performance, paired associate learning (variables 19 and 20), nonreversal concept learning (variables 21-26), and WISC forward and backward digit span (variables 29-31) did not produce significant differences between black and white children. These results are consistent with those reported by others (e.g., Rohwer and Lynch, 1968; Rohwer, 1968) namely that minority and middle-class white children function in a very similar fashion on associative learning tasks. The current results tentatively extend this generalization to a higher learning activity in that no significant racial differences were found with respect to learning scores on the nonreversal conceptual task.

The data from this investigation are strongly suggestive of the importance of examining a variety of performance criteria related to school achievement. It should be recalled that depending upon the particular group involved -- Black versus white children -- convergent or divergent performance was found to be related to school achievement. This trend was in addition to the fact that IQ was found to be an equally effective predictor for all groups of children. It may well be that there is some optimal combination of cognitive abilities or skills that result in superior school achievement, and that this combination varies from one defineable group (e.g., in terms of ethnicity) of children to another. Thus, the fact that convergent performance was predictive of school achievement for black Ss is suggestive that such a cognitive skill, in conjunction with other abilities (as for example those measured in a standard IQ test), might be predictive of successful school achievement within a disadvantaged population of children. This discussion suggests the following research questions:

(1) Within a disadvantaged population such as Blacks and Puerto Ricans, what combination of cognitive skills are associated with normal or superior academic performance in a group which has typically exhibited school learning deficits? How can knowledge concerning the patterning of cognitive skills, as they are related to school achievement, be integrated into decisions regarding the content, sequencing, and timing of instruction? (2) If there are optimal combinations of cognitive skills necessary for successful school achievement, what possibilities are there for supporting (reinforcing) these skills such that this ideal configuration of abilities may be produced for the student?

There are clear limitations to the present data, especially in terms of the samples which were available for this investigation. In particular, the Black sample should not be viewed as typifying a population of disadvantaged school children who are characteristically from a lower SES background. It should be recalled that the sampling characteristics placed both white and Black Ss within the lower middle-class. Accordingly, it would be highly desirable to cross validate the present correlational findings using a Black sample which includes both children from a lower as well as middle-class background.

APPENDIX A

OST Procedures and Directions

OBJECT SORTING TASK (OST)

ADMINISTRATION PROCEDURES

I want to see how many ways you can think of to put things into two groups. All of the things in a group must be the same in some way. I will show you what I mean.

(PLACE PENCILS BETWEEN THE CIRCLES ON THE ADMINISTRATION BOARD WITH THE ERASER ENDS POINTING TOWARD THE EXAMINER.)

See these pencils? They are all mixed up. (MIX UP.)

Now, suppose I asked you to put three pencils in this circle (POINT) and three pencils over here in this circle (POINT) so that all of the pencils here in this circle (POINT) are all the same in some way and all the pencils over here (POINT) are the same in some way. You could do this. (SORT PENCILS.)

See these pencils? (POINT LEFT.) They are all the same because they are all new. They have never been sharpened. (POINT TOWARD UNSHARPENED END OF PENCILS.)

These pencils are the same (POINT RIGHT) because they are not new (POINT TO POINTS). They have been sharpened.

Now I'll mix them up again (MIX UP AND PUT BETWEEN CIRCLES AGAIN.)

Suppose I asked you to sort the pencils <u>again</u>, except this time in a <u>different</u> way. You could do it like this. (SORT PENCILS.)

See, these are all the same because they all have erasers (POINT) and these are the same because they don't have erasers (POINT).

Always sort them into two groups. Always three things here (POINT LEFT) and three things here (POINT RIGHT).

(MIX UP PENCILS AND PUT IN CENTER.)

Now, can you see still another way to divide up the pencils into two groups? A way that we haven't tried yet?

(IF SUCCESSFUL, SAY:) Fine. Why did you put them that way? That's right: "These are the same because they all have pocket clips (POINT) and these are all the same because they don't have pocket clips (POINT).

(IF THE CHILD IS UNSUCCESSFUL, SORT THE PENCILS WITH THE POINTS TOWARD HIM AND SAY:) See, here is another way. These are the same because they all have pocket clips (POINT) and these are all the same because they don't have pocket clips (POINT).

Do you get the idea? Do you understand what it is that we are going to do? (IF THE CHILD SAYS "NO," PARAPHRASE THE INSTRUCTIONS AGAIN.)

(IF THE CHILD SAYS "YES," SAY:) O.K., then, we can start, except this time, instead of pencils, (REMOVE PENCILS FROM SIGHT), we will use blocks.

(TAKE BLOCKS FROM STORAGE AREA AND PLACE ON THE X'S ON THE ADMINIS-

TRATION BOARD.)

Can you see a way to divide up these blocks so that the three you put here (POINT) are all alike and the three you put here (POINT) are all alike? Go ahead and try it.

(BEGIN TIMING. RECORD TIME REQUIRED TO COMPLETE THE SORT.)

Why did you put them like that?

(WRITE RESPONSE ON PROTOCOL, THEN RETURN BLOCKS TO THE X'S AND SAY:) O.K., now let's see if you can find another way to sort the blocks. (INDICATE FOR THE CHILD TO TRY AGAIN.)

Why did you sort them that way?

(WRITE RESPONSE ON PROTOCOL, THEN RETURN BLOCKS TO X'S.) Can you see still another way to do it? (INDICATE FOR THE CHILD TO SORT THE BLOCKS AGAIN.)

(CONTINUE UNTIL THE CHILD INDICATES HE CAN FIND NO MORE WAYS TO SORT THE BLOCKS, EXCEEDS 120 SECONDS IN PERFORMING A SINGLE SORT, PERFORMS NINE DUPLICATE OR ERRONEOUS SORTS, OR PERFORMS A SINGLE SORT FIVE TIMES. THE FIRST TIME A CHILD SAYS HE CAN SEE NO MORE WAYS, HE MAY BE REMINDED THAT HE STILL HAS MORE TIME.)

(UPON THE TERMINATION OF THIS TESTING PROCEDURE, SHOW THE CHILD, IN ORDER OF DIFFICULTY, EACH SORT HE HAS NOT PERFORMED CORRECTLY, CONTINUING UNTIL HE HAS MISSED OR EXCEEDED 120 SECONDS IN IDENTIFYING

THREE SORTS. RECORD EACH VERBAL RESPONSE AND THE TIME REQUIRED TO IDENTIFY EACH SORT.)

OBJECT SORTING TASK (OST)

SCORING GUIDE FOR SORT

VERBALIZATIONS

All positive sorts, both divergent and conergent are scored for verbalization. Duplicates, blank and false positive sorts are not scored. The scoring rationale is as follows:

"0" is given for motoric gestures only, "I don't know" response, and for verbalizations that appear to be given just to satisfy the adult demand for an explanation. (This type of responding is usually found only with very young children.)

"1" is recorded if the explanation can be justified, but only be means of considerable extrapolation on the part of the scorer.

"2" is given when the subject demonstrates an implicit recognition of the correct attribute. In this case he apparently has the correct idea with regard to the attribute; however, the conceptualization of that attribute is so poorly organized that the explanation often includes erroneous and/or inaccurate statements. That is, his verbal justification of his sort is arrived at by attempting to force on the object certain attributes that they don't, in fact, have.

"3" is recorded when the subject explicitly states the correct attribute. Here the verbalization consists essentially of detailed descriptions of the correct attribute and/or qualifications of "1" point responses; such as changing an adjective like "round" to a modifier such as "roundish"; this eliminates erroneous assertions about the blocks. The response must be correct but not necessarily comprehensive.

"4" is recorded for a precise, and concise, statement of the significant attribute. A "4" response is a high order abstraction whereas the "3" point response is essentially descriptive and concrete in nature. The availability of such a precise statement suggests that the concept is clearly defined in the child's mind and is available for use on demand.

Examples:

Sort #1 - Roundness.

0 - no answer, motoric gesture, "I don't know, "these match with each other, go together."

1 - ambiguous answer, not round, not square.

2 - correct idea but very poorly stated, often including an erroneous or inaccurate statement, such as"round corners," "these are all round," "these have sharp edges," "these are circles," "these are squares," "these have pointed ends," "these are like cubes," "these have round edges," "these are elipse and circles."

3 - an attempt at a qualified statement. Example: roundish, circular, rounded off, rounded lines, oval shaped, round in some places, squarish. Sometimes a child might also focus on some subset of attributes associated with the more general concept being sought. For example, square edges, straight lines, all sides are flat, curved sides, 8 points, almost round, almost square.

4 - a 4 point response is a precise statement of the significant attribute. Example: angular, rectalinear, curvilinear, these are straight and these are curved-lined objects.

Sort #2 - Hue (Red-Blue)

0 - no answer, "I don't know", "these match with each other, go together."

1 - not blue, not red.

2 - red, pink, blue; these are red and pink and orange and these are blue; light colors -- dark colors; these are almost red, these are almost blue.

3 - these are all colors of red; they're reddish, pinkish, bluish, blue colored; they're all different kinds of blue; they're reddish in tint; these are a blue hue.

4 - these are shades of red, blue; hue (s) of blue; these are in the red family.

Sort #3 - Transparency

0 - no answer, "I don't know, "these match with each other, go together," "these are pretty"

1 - ambiguous response; not clear, these are blocks.

2 - implied optical properties: you can see scratches on the other side, it sparkles, it's shiny, translucent, it's made out of plastic, glass; these are painted and these are not, these are wood, light colors -- dark colors, solid colors.

3 - a functional optical property: you can see through these; it transmits light; it magnifies things; it catches or filters light (clear objects); it reflects light (opaque objects).

4 - clear, transparent, opaque

Sort #4 - Tall

0 - round shapes (when occurs in conjunction with "talls"); no answer, "I don't know," "these match with each other, go together"

1 - ambiguous answer, not tall, not short.

2 - big, little; small, these are level, these are all the same size.

3 - these have long lines; these have short lines; these are high and these are low; these are flat.

4 - tall, short

Sort #5 - Beveled

0 -

1 - these are fatter than those; these are narrower than these. These have flat edges; all the bottoms are even, these are triangles, these are not straight.

2 - these curve out and these go straight; these get width as they go down; these are shaped like a pyramid; these go out; these go out at the bottom; these tilt down; these are cone shaped; these are bigger at the bottom than at the top; these are

these come up in a triangular shape.

3 - the top edges are the same size as the bottom edges; these are shaped like a triangle with the top cut off; these are shaped like a pyramid with the top cut off; sort of like a pyramid; these are straight on the sides; these go straight up; these have slanting lines; these have slanting edges.

4 - a response indicates a recognition that it is the sides themselves that are slanting not some particular aspect of the side much as an edge. These have slanting sides; sloping sides, beveled sides; these sides are slanting; these sides are not perpendicular; these sides go straight up.

Sort #6 - Oblong

0 - no answer, etc.

1 - ambiguous answer, these are thinner; these are fatter.

2 - the implicit awareness of elongation but a very awkward or erroneous way of stating it. For example, these are long and these are not; all the tops are even (referring to the regular objects); all the tops are equal (implying length and width of the tops are equal for each top); these are all like cubes (referring to the regular objects).

3 - the explicit notion of proportionality, i.e., comparing length to width, but stated in a roundabout way. These are longer than they are wide. These are skinny compared with their size. These are longish; any quality of radialaxes, these figures are all like circles, they approach a circle in shape, (all refer-

ring to regulars).

4 - The verbalization should indicate the presence of a well and clearly defined verbal label for the criterial attribute: elongated, oblong, regular.

Sort #7 - Pastel

0 -

1 - ambiguous answer

2 - light colors, dark colors, bright and dark colors.

3 - These have light shades of red and blue and these have dark shades of red and blue.

4 - A statement with regard to the fact that these are pastels and these are not; or these are pastels and these are intense colors.

Sort #8 - Volume

0 - these are taller

1 - ambiguous response

2 - big, little, small, large, heavier, lighter, thin, thick, these are bigger than these.

3 - Larger in size, smaller in size; these would hold more water than these if they were empty: it would take more material to make these, these weigh more.

4 - The volume of this group is larger than the volume of this group. These have large volumes; these have small volumes; etc.

Sort #9 - Area

0 -

1 - ambiguous answer

2 - An implied recognition of area differences but very poor specifications, such as, these are fatter than these; these are skinnier than these; these are thinner than these; these are big and these are little, these are bigger than these.

3 - These cover up more of the table top than these; it would take more paint to paint the bottoms of these; these bottoms are bigger than these; these have big bottoms and these have little bottoms.

4 - A statement to the effect that this group has a larger base area than the other group. The base areas of these are larger than the base areas of these.

APPENDIX B

Subject Directions for the Various Learning Tasks

PAIRED ASSOCIATE

I am going to show you a number of cards. Each card has two pictures. I want you to remember which two pictures go together. I will first go through all of the cards. I will then show you one of the pictures and your job will be to guess the other pictures which goes with it. After you give me your answer, I will show you whether you are right. For example, here is a picture of a ball (point) along with a picture of some blocks. Since you have seen the ball with the blocks, you would say block whenever I showed you the ball by itself. We will be doing the same things for all of the rest of the cards.

REVERSAL-NON REVERSAL CONCEPT

I am going to ask you to figure out a game I will play with you. The idea is to figure out which is the right group and which is the wrong group. For example (E separates a few number and face cards from a deck and points to the number cards as the right group and the "face cards" as the wrong group.) I can say these cards (show face cards) are right because they have pictures on them while these cards (show number cards) are wrong because they do not have pictures but all have numbers. My rule is picture cards are right and number cards are wrong.

Now this is the same idea with this game. I have some blocks and your job will be to tell me whether each block I show you is from the right group or wrong group. After you make your choice I will tell you whether you are right or wrong. Just say either right or wrong. Try to figure out a rule to help you decide whether each block I show you is from the right or wrong group.

INFORMATION

I am going to let you listen to a story. When the story is finished, I am going to ask you some questions about what you just read.

(Then present an interposed activity one min.)

(Then present retention test, asking S to circle right answer.)

MEANINGFUL SERIAL

I am going to show you some pictures of things. I want you to remember the order in which I show you the pictures. I will show the first picture and I want you to tell me the picture which follows it. Then I will show you the second picture and you tell me the name of the picture which follows it and so on. So your job will be to guess which picture follows the picture I show you. Do you understand?

PICTURE CONCEPT

Many things can be separated into two groups. For example, I can separate cars from bikes because cars, whether they are big or small, have four wheels, and bikes of all sizes have two sheels. I can also separate them because cars have steering sheels and bikes have handlebars. In each case, I am following some rule for separating groups of cars from groups of bikes. Each group is alike in some way but different from the other group. The same idea goes for what I want you to do now. I have a pack of cards, with different pictures on each card.

I will place one card in front of you at a time. Your job is to tell me whether the card I show belongs to the right pile or to the wrong pile.

Just say right or wrong for each card I show you. If you pay close attention, you may find a rule which will let you pick the right card every time. Do you understand what we are going to do?

RELATIVE DISCRIMINATION

I have a number of cards. (Hold cards, but don't show to S.) Each card I show you will be different from each of the other ones I show you. Your job will be to guess which card I show you is a right card or a wrong card. If you pay close attention, you can figure out the rule for deciding which are right cards and which are wrong ones. After you make a guess, I will tell whether you are right or wrong. Any questions?

APPENDIX C

Intercorrelations Between Study Sample for Total Sampling, N=120

Intercorrelations Between Study Sample for Total Sampling, N=120[1]

Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	--																			
2	-18	--																		
3	99	-02	--																	
4	33	21	37																	
5	20	-10	18	-12	--															
6	32	-34	27	-15	16	--														
7	30	-08	-31	-38	03	02	--													
8	79	-18	77	10	22	32	34	--												
9	-27	21	-24	64	-27	-34	-27	-43	--											
10	23	25	27	92	-10	-17	-25	08	49	--										
11	-18	-06	-20	51	-19	-14	-19	-31	78	31	--									
12	-24	-08	-25	-41	08	06	74	24	-32	-29	-23	--								
13	21	-26	17	-73	29	43	27	35	-67	-73	-48	34	--							
14	19	-20	16	-74	27	42	26	34	-67	-73	-48	33	99	--						
15	86	-09	86	26	24	25	-27	68	-23	16	-16	-21	17	17	--					
16	94	-16	93	49	14	28	-36	69	-07	38	-05	-31	03	02	80	--				
17	-21	-01	-22	52	19	-13	-16	-30	53	29	61	-24	-57	-58	-20	-10	--			

[1]This correlation matrix includes those variables (41-47) for which data were collected on sub-samples (N=30). Table 2 gives the description of each of these variables.

Note: - Decimals have been omitted from the correlations; correlations greater than .18 are significant at .05, iled test for 118 degrees of freedom. This test of significance applies to variables 1-40.

Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
18	-16	-09	-17	-24	01	08	45	13	16	-15	-17	56	18	20	-10	-20	-13	--		
19	04	23	01	11	01	-31	-12	09	09	13	02	-08	-18	-16	02	-03	03	-03	--	
20	-16	19	-13	01	03	-26	20	-01	06	06	02	03	-05	04	-15	-15	-01	-08	55	--
21	-12	34	-07	08	04	-35	-05	-14	10	11	-11	-11	-20	-19	-01	-14	03	-08	26	10
22	-11	32	-06	10	06	-34	-03	-12	13	11	-10	-09	-20	-18	01	-12	04	-07	24	09
23	-14	-07	-14	-03	-01	01	16	-04	10	-11	18	09	03	02	-14	-14	18	-02	15	16
24	-17	-10	-18	-01	-04	02	15	-08	15	-09	24	10	00	-01	14	-16	22	04	19	16
25	-17	16	-15	02	05	-17	08	-11	13	-02	08	-01	-09	-09	-12	-17	14	-07	24	17
26	-19	13	-17	05	04	-17	09	-12	20	-01	14	02	-11	-11	-11	-18	17	-03	27	17
27	22	-11	20	-10	08	22	-05	16	-21	-05	-21	02	23	23	16	18	-23	02	-18	-14
28	30	-08	29	-08	-01	33	04	30	-26	-04	-17	08	27	28	22	26	-24	14	-36	-20
29	29	-16	27	-01	05	22	-02	27	-22	05	-14	-03	10	08	20	19	-22	01	-09	-04
30	14	-13	12	-13	06	15	02	14	-19	-13	-19	-02	16	15	04	09	-12	-02	-15	-05
31	28	-19	26	-08	07	24	00	27	-26	-04	-20	-03	16	14	16	18	-22	-01	-15	-06
32	29	-16	27	-31	08	31	11	35	-43	-28	-39	18	44	42	26	20	-36	07	-24	-18
33	20	-18	17	-27	-05	26	04	23	-35	-25	-25	13	35	34	10	16	-24	06	17	-11
34	16	-17	14	-20	-13	24	13	24	-33	-18	-22	13	24	23	12	10	14	05	-14	-04
35	14	-18	12	-24	-19	24	05	18	-29	-23	-20	14	27	26	09	13	-20	08	-21	-21
36	30	-08	29	-12	02	29	02	31	-31	-11	-20	11	26	25	21	27	-21	06	-11	-09
37	25	-18	22	-25	-06	30	08	30	-39	-23	-28	16	35	33	18	20	-26	07	-20	-15

Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
38	25	-26	21	-29	05	42	09	28	-37	-32	-21	14	46	45	06	18	-24	03	-31	-15
39	20	-17	18	04	03	18	-07	16	-16	05	-06	05	11	10	15	20	-01	02	-13	-21
40	-03	13	-01	13	22	-19	-02	-03	16	13	06	-11	-21	-22	-06	03	04	-06	02	08
41	-28	00	-28	14	-33	-36	-14	-34	27	16	30	-13	-29	-29	-29	-25	24	25	00	12
42	-05	00	-05	20	-17	-29	30	13	06	27	13	15	-28	-05	-05	-04	18	23	00	08
43	43	-20	41	34	15	-26	-41	17	19	23	04	-27	-16	44	44	45	10	-05	00	45
44	31	-16	29	35	18	-25	-36	07	31	23	19	-20	-23	36	36	36	19	09	00	34
45	-19	26	-12	03	-06	-30	-22	-36	10	08	-05	-09	-14	07	-07	-22	-18	-29	00	23
46	01	12	04	16	07	-22	-44	-33	18	20	04	-17	-16	13	13	05	-10	-09	00	04
47	-29	38	-24	02	10	-28	-08	-27	22	-05	23	-04	-21	-04	-04	-27	22	11	00	47

Variables

Variables	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
18																			
19																			
20																			
21	--																		
22	99	--																	
23	-20	-20	--																
24	-23	-22	95	--															
25	48	47	88	82	--														
26	49	50	84	87	95	--													
27	-16	-16	-01	-09	-09	-16	--												
28	-18	-18	-19	-23	-24	-27	56	--											
29	-11	-13	-05	-02	-10	-10	11	14	--										
30	-06	-06	-15	-15	-19	-18	17	07	21	--									
31	-11	-12	-13	-10	-17	-17	18	14	82	73	--								
32	-10	-09	-10	-17	-14	-18	64	60	26	19	29	--							
33	-19	-19	-09	-11	-19	-22	54	51	30	26	36	77	--						
34	-11	-11	-06	-07	-14	-15	40	37	29	18	31	60	68	--					
35	-19	-20	-14	-15	-23	-26	47	46	28	10	25	66	79	76	--				
36	-18	-18	-11	-14	-14	-22	46	45	30	15	29	57	67	72	71	--			
37	-17	-17	-11	-14	-14	-22	58	55	33	20	35	84	90	87	89	82	--		

Variables

Variables	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
38	-28	-28	-11	-15	-22	-26	54	48	30	28	37	67	64	60	68	65	75	--	
39	-17	-18	-06	-14	-13	-22	35	36	07	14	13	38	41	28	34	31	40	38	--
40	12	12	-01	-01	06	07	-20	-17	-12	-06	-12	-21	-25	-12	-14	-15	-21	-25	-54
41	06	16	13	03	27	28	29	04	-13	-05	04	07	-06	-08	07	-02	02	-03	-12
42	11	05	03	-03	04	-01	-02	09	-01	-19	02	-15	04	-04	32	-04	13	09	-08
43	38	01	01	22	28	14	22	-22	-16	06	08	09	-06	-17	-35	-30	-29	-28	-34
44	32	00	04	34	35	21	25	-21	-21	06	-10	-02	-08	25	-26	-28	-32	-28	-36
45	13	37	39	-26	24	04	06	-11	-24	07	-19	-14	-15	29	-05	-12	-16	-18	-32
46	06	23	22	-30	27	-08	-06	09	02	-17	-45	-33	-07	-09	-07	11	-13	-05	-17
47	47	31	30	-02	00	21	21	-28	-31	-09	-27	-22	-18	-23	-26	-34	-23	-27	-49

	Variables							
	40	41	42	43	44	45	46	47
38								
39								
40	--							
41	01	--						
42	-17	65	--					
43	-28	00	00	--				
44	-20	00	00	88	--			
45	-23	00	00	00	00	--		
46	-14	00	00	00	00	68	--	
47	-27	00	00	00	00	00	00	--

Variables

Variables	40	41	42	43	44	45	46	47
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Variables

Variables	40	41	42	43	44	45	46	47
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Variables

Variables	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
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