

Patterns of Mental Abilities: Ethnic, Socioeconomic, and Sex Differences¹

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Past research has shown that males and females exhibit characteristic patterns of mental abilities; however, comparatively few studies have considered the patterns of mental abilities that distinguish different ethnic and socioeconomic groups (Anastasi, 1958).

One such study, conducted by Lesser, Fifer, and Clark (1965) found characteristic patterns of mental abilities for first grade children from different ethnic backgrounds (Chinese, Jewish, Negro, and Puerto Rican). The ethnic patterns differed in shape and average level. Socioeconomic status (SES) was not related to the shape of the patterns, but those of higher SES tended to have higher mean scores on the mental ability tests. A replication study (Stodolsky and Lesser, 1967) confirmed these results on a sample of Negro and Chinese first graders; however, no common ethnic pattern emerged for samples of lower- and middle-class Irish-Catholics.

It was felt that examining the patterns of mental abilities of students beyond the first grade would contribute to the understanding of the development of mental abilities. Thus, the present study was designed to investigate the relationships of ethnicity, SES, and sex to patterns of mental abilities of adolescents.

¹ This paper is based on a dissertation submitted to Teachers College, Columbia University, in partial fulfillment of the requirements for the Ph.D. in psychology. The author wishes to thank Professors R. L. Thorndike, E. P. Hagen, and R. M. Wolf for their supervision and guidance.

METHOD

Subjects

The subjects were 2,925 twelfth grade students from among those who had participated in Project TALENT, a study of 4.5% of the U. S. students in grades 9 through 12 in the spring of 1960 (Schoenfeldt, 1968).² Approximately 100,000 students in each grade had been given a two-day battery of tests and inventories gathering information on their abilities, interests, and backgrounds.

The present sample was restricted to those who had responded to a follow-up survey five years after graduation, as information on ethnic background was not collected until that time. The sample was composed of 1,236 Jewish-whites, 1,051 non-Jewish-whites, 488 Negroes, and 150 Orientals.

SES was defined by the Project TALENT Socioeconomic Environment Index (Flanagan, Cooley, Lohnes, Schoenfeldt, Holdeman, Combs and Becker, 1966; Shaycoft, 1967). The Index has a mean of 100 and a standard deviation of 10 for twelfth graders, and reflects father's education and occupation, mother's education, family income, value of the home, and number of specific facilities and economic goods in the home, such as a television set, radio, and typewriter.

Data had originally been obtained from Project TALENT for a sample of 3,086 respondents: This included only those for whom information on all essential variables was available; since a large majority of the students were non-Jewish-white, data were obtained for only a 5% sample of that group. As there were only a small number of students at the extreme ends of the SES scale, it was not considered feasible to make comparisons of extreme SES groups. Also, although the SES distributions of the ethnic groups overlapped, the Jewish-whites tended to be displaced toward the upper end of the SES scale and the Negroes toward the lower end. To control for differences in SES the analysis was restricted to those in the middle range of the SES scale. The resulting sample of 2,925 students was divided into two groups: upper-middle SES and lower-middle SES, which covered 80-99 and 100-119 respectively on the SES scale.

Patterns of Mental Abilities

Factor analysis of 60 information, achievement, and aptitude tests administered to the students in Project TALENT had yielded 11

² This investigation utilized the Project TALENT Data Bank, a cooperative effort of the U. S. Office of Education, the American Institutes for Research, and the University of Pittsburgh. The design and interpretation of the research reported herein are solely the responsibility of the author.

orthogonal ability factors (Lohnes, 1966). Factor scores are reported on a scale with a mean of 50 and standard deviation of 10 for high school students, grades 9-12 combined.

Six of the factors were examined for the presence of patterns in specific ethnic, SES, and sex groups. The other five factors not included in the present study were primarily measures of information in areas considered relatively unimportant as dimensions of mental ability: Hunting-Fishing, Color-Foods, Etiquette, Games, and a factor called Screening which had its highest loading on a test designed to identify illiterates and uncooperative subjects.

The six mental ability factors examined were: Verbal Knowledges (VKN)—a general factor, but primarily a measure of general information; English Language (ENG)—a measure of grammar and language usage; Mathematics (MAT)—a measure of high school mathematics with a minimum of computation; Visual Reasoning (VIS)—a measure of reasoning with spatial forms; Perceptual Speed and Accuracy (PSA)—a measure of visual-motor coordination under speeded conditions; and Memory (MEM)—a measure of short-term recall of verbal symbols.

Statistical Procedures

The statistical model was a 4 x 2 x 2 x 6 fixed effects analysis of variance in which ethnicity, SES, and sex were treated as between-subjects variables and the mental ability factors were treated as a within-subjects variable (Block, Levine and McNemar, 1951; Myers, 1966, Ch. 8). Differences in the shapes of the patterns of mental abilities were reflected by the interactions of ethnicity, SES, and sex with the mental ability factors. Differences in the levels of the patterns of mental abilities were reflected by the main effects of ethnicity, SES, and sex, and their interactions.

Estimates of ω^2 , the proportion of the total variance accounted for by the variables and their interactions, were also obtained (Hays, 1965, pp. 406-407; Schutz, 1966).

Hays (1963, p. 408) recommends having equal numbers of observations per cell in an analysis of variance; equal cell frequencies are considered advantageous in that the resulting experimental design is orthogonal and the assumption of homogeneity of variances can be violated without serious risk. The present sample was composed of 16 subgroups when stratified according to ethnicity (four levels), SES (two levels), and sex (two levels). As there was a great disparity in the numbers of subjects in the different subgroups, the procedure called replicated sampling was used to obtain equal cell frequencies (Cochran, 1963, pp. 383-385; Kish, 1965, pp. 127-132). According to this procedure, the subjects within each of the 16 subgroups were randomly

divided into 4 subsamples or replicated samples. Each replicated sample was "regarded as a single complex unit, the sample [subgroup] being in effect a simple random sample of those complex units, with uncorrelated errors of measurement between different complex units" (Cochran, 1963, p. 385).

Since all the 2,925 subjects were used, the group means, computed by summing over replicated samples, were very reliable. The standard deviations reported in Table 1 were based on deviations of the means of the four replicated samples from their own mean. These deviations squared were considered estimates of the error variance, as they did not include systematic variance related to the effects of ethnicity, SES, and sex. Although the standard deviations were based on an equal number of replicated samples, they did differ considerably for ethnic groups because of the wide variation in the number of subjects in each group. The standard errors of the mean in Table 2 and the confidence intervals in Figures 1 and 2 were obtained by squaring and pooling the standard deviations in Table 1 (Hays, 1963, pp. 209-210).

RESULTS AND CONCLUSIONS

Ninety percent of the total variance was accounted for by the main effects and interactions of the variables (Table 3). Sex accounted for a much larger proportion of the total variance than did either ethnicity or SES. Sex was significantly ($p < .001$) related to both the shape and the level of the patterns. The relationship of sex to the shape of the patterns accounted for 69% of the total variance. Females received higher mean scores on ENG, PSA, and MEM, and males received higher mean scores on VKN, MAT, and VIS (Table 2). The relationship of sex to the level of the patterns was considered to be unimportant as it accounted for .00 of the total variance when rounded to two significant figures.

Ethnicity, the only other variable showing a substantial effect on the patterns, accounted for 13% of the total variance: 9% associated with shape and 4% associated with level. The pattern of mental abilities of the Jewish-whites was characterized by high mean scores on VKN and MAT and low mean scores on VIS and MEM (Table 2). The pattern of mental abilities of the Orientals was characterized by a high mean score on MAT; little difference was noted among their mean scores on the other mental ability factors. Negroes received higher mean scores on PSA and MEM than on the other factors; their mean scores on the other factors did not differ from each other to any great extent. There was little variation among the mean scores on the six mental ability factors for the non-Jewish-whites; this was expected as the

TABLE 1
Patterns of Mental Abilities by Ethnicity, SES, and Sex

<i>Ethnic group</i>	<i>VKN</i>		<i>ENG</i>		<i>MAT</i>		<i>VIS</i>		<i>PSA</i>		<i>MEM</i>		
	<i>N^a</i>	\bar{X}	<i>SD^b</i>	\bar{X}	<i>SD^b</i>	\bar{X}	<i>SD^b</i>	\bar{X}	<i>SD^b</i>	\bar{X}	<i>SD^b</i>	\bar{X}	<i>SD^b</i>
Males, Upper-middle SES													
Jewish-white	542	61.7	0.5	41.5	0.5	73.0	0.8	53.5	1.2	50.7	1.7	41.0	0.8
Non-Jewish-white	280	56.2	0.9	40.7	0.9	65.0	2.0	58.0	0.8	48.0	2.5	45.0	1.1
Negro	43	53.0	4.5	36.5	4.4	55.0	3.4	53.2	2.0	49.5	5.5	44.0	2.9
Oriental	31	53.2	2.5	44.5	2.0	72.5	4.3	55.7	2.2	50.5	2.6	45.5	5.8
Males, Lower-middle SES													
Jewish-white	116	59.0	2.1	40.7	0.5	67.0	3.1	51.0	1.4	48.7	0.5	41.2	0.9
Non-Jewish-white	227	51.7	2.0	41.7	1.2	61.5	0.5	58.5	1.2	48.0	0.8	45.2	1.2
Negro	130	44.7	2.2	41.0	1.4	54.5	2.3	51.0	0.8	50.0	1.8	46.5	1.0
Oriental	37	50.2	1.5	40.7	2.8	62.7	6.6	55.0	2.5	48.0	2.1	46.2	2.6
Females, Upper-middle SES													
Jewish-white	491	55.2	0.9	60.7	0.9	48.7	1.2	40.5	0.5	52.7	0.5	54.7	0.9
Non-Jewish-white	282	52.2	0.5	61.0	0.0	42.5	0.5	46.0	0.8	51.2	0.5	56.2	1.7
Negro	73	45.5	1.7	57.5	1.2	40.5	2.3	40.0	2.1	51.7	2.0	55.2	1.7
Oriental	30	47.2	3.2	62.5	3.1	52.2	4.9	44.5	4.9	50.2	2.9	58.5	5.0
Females, Lower-middle SES													
Jewish-white	87	52.7	0.5	60.2	1.5	46.0	4.0	39.0	2.9	52.0	3.7	54.2	0.9
Non-Jewish-white	262	47.5	1.0	61.0	0.8	39.2	1.7	45.0	0.8	50.7	0.9	57.2	0.9
Negro	242	40.7	0.5	55.2	1.2	39.2	0.5	36.2	0.5	52.5	2.3	56.0	2.7
Oriental	52	45.5	1.0	62.2	2.5	49.0	1.4	42.5	4.2	52.7	3.3	56.2	3.0

^a Number of subjects; data based on 4 replicated samples per subgroup

^b Based on deviations of the means of the 4 replicated samples in each subgroup

TABLE 2

Patterns of Mental Abilities of Ethnic, SES, and Sex Groups

Group	VKN		ENG		MAT		VIS		PSA		MEM	
	\bar{X}	$SE_{\bar{X}}^c$	\bar{X}	$SE_{\bar{X}}^c$	\bar{X}	$SE_{\bar{X}}^c$	\bar{X}	$SE_{\bar{X}}^c$	\bar{X}	$SE_{\bar{X}}^c$	\bar{X}	$SE_{\bar{X}}^c$
Ethnic group ^a												
Jewish-white	57.1	0.3	50.8	0.2	58.6	0.7	46.0	0.4	51.0	0.5	47.8	0.2
Non-Jewish-white	51.9	0.3	51.1	0.2	52.1	0.3	51.8	0.2	49.5	0.4	50.9	0.3
Negro	46.0	0.7	47.5	0.6	47.3	0.6	45.1	0.4	50.9	0.8	50.4	0.6
Oriental	49.0	0.6	52.5	0.7	59.1	1.2	49.4	0.9	50.3	0.7	51.6	1.1
SES ^b												
Upper-middle	53.0	0.4	50.6	0.4	56.2	0.5	48.9	0.4	50.5	0.5	50.0	0.5
Lower-middle	49.0	0.3	50.3	0.3	52.4	0.6	47.2	0.4	50.3	0.4	50.3	0.3
Sex ^b												
Male	53.7	0.4	40.9	0.4	63.9	0.6	54.5	0.3	49.1	0.5	44.3	0.5
Female	48.3	0.3	60.0	0.3	44.6	0.5	41.7	0.5	51.7	0.4	56.0	0.4

^a Data based on 16 replicated samples per ethnic group

^b Data based on 32 replicated samples per SES and sex group

^c Based on pooled estimates of the error variance computed from Table 1 for the subgroups that constitute the larger groups reported in this table

Patterns of Mental Abilities

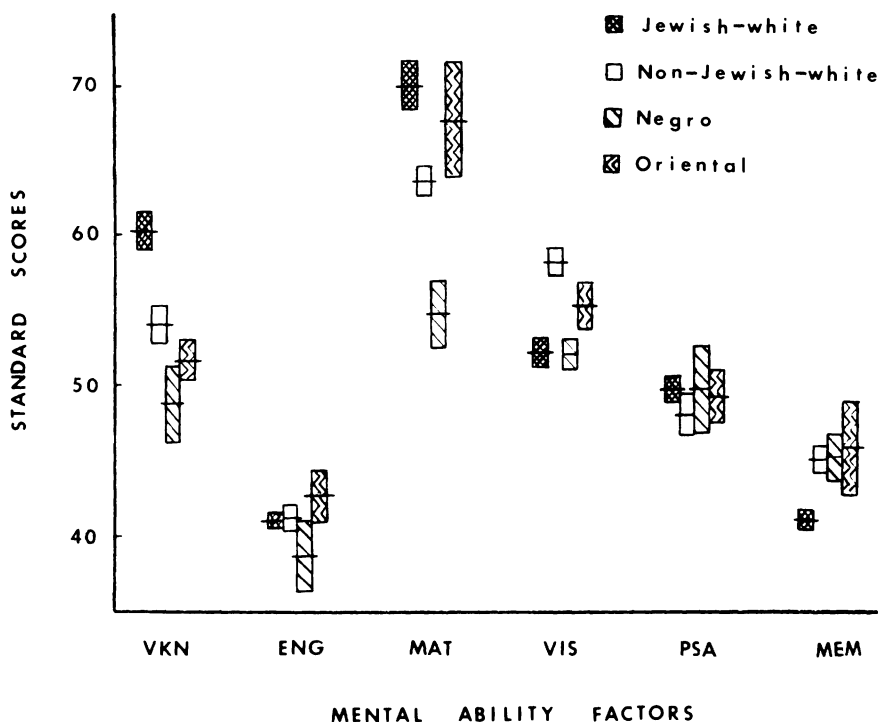


FIGURE 1.
Patterns of mental abilities of twelfth grade students by ethnic group: males. Vertical bar represents 95 percent confidence interval; horizontal line in center of bar represents group mean.

factor scores had been standardized on a sample that was predominantly non-Jewish-white.

A Scheffé test revealed that the average level of the pattern of mental abilities of the Negroes (47.9) was significantly lower ($p < .01$) than the average level of the patterns of mental abilities of the other ethnic groups (Jewish-whites—51.9; non-Jewish-whites—51.2; and Orientals—52.0).

The combined effects of ethnicity and sex are illustrated in Figures 1 and 2. Differences between the means were considered to be due to chance if the confidence intervals overlapped. It should be pointed out that the interaction of ethnicity and sex accounted for only 1% of the total variance and was considered unimportant.

Although the patterns of mental abilities of the SES groups differed significantly in both shape and level ($p < .001$), these differences accounted for only 2% of the total variance and were judged to be too small to be important. The interaction of ethnicity and SES also

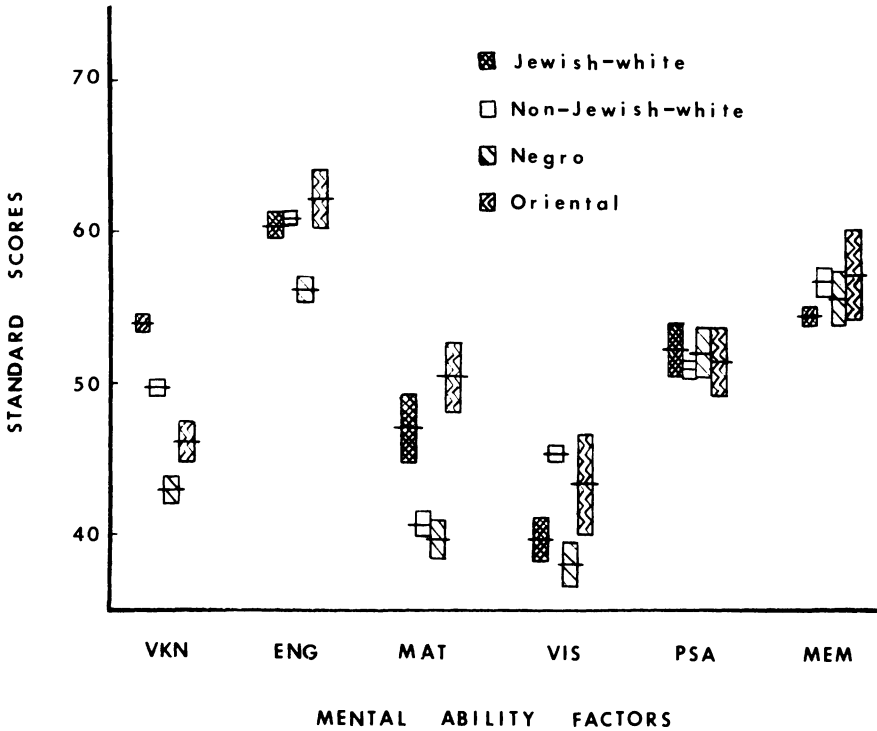


FIGURE 2.
Patterns of mental abilities of twelfth grade students by ethnic group: females.
Vertical bar represents 95 percent confidence interval; horizontal line in center of bar represents group mean.

TABLE 3

Analysis of Variance and Estimated Proportion of Total Variance Accounted for by the Variables

Source of variation	df	Mean square	F	Est. ω^2
Ethnicity (A)	3	364.95	56.32***	.04
SES (B)	1	250.26	38.62***	.01
Sex (C)	1	44.01	6.79*	.00
A × B	3	5.45	.84	.00
A × C	3	3.64	.56	.00
B × C	1	3.01	.46	.00
A × B × C	3	11.42	1.76	.00
Between-replicated samples error	48	6.48		
Mental ability factors (D)	5	259.85	45.75***	.05
A × D	15	157.40	27.71***	.09
B × D	5	58.79	10.35***	.01
C × D	5	3,428.05	603.52***	.69
A × B × D	15	10.17	1.79*	.00
A × C × D	15	15.30	2.69**	.01
B × C × D	5	9.54	1.68	.00
A × B × C × D	15	5.93	1.04	.00
Within-replicated samples error	240	5.68		

*p<.05 **p<.01 ***p<.001

did not account for a sufficient proportion of the total variance to be considered meaningful ($\omega^2 = .00$). The remaining 5% of explained variance was related to the variation among mean scores for the total sample: VKN—51.0; ENG—50.5; MAT—54.3; VIS—48.1; PSA—50.4; and MEM—50.1.

DISCUSSION

The results of the present study revealed that for a given ethnic group males and females tended to exhibit patterns of mental abilities characteristic of their sex; these patterns were only slightly modified by ethnic background. The relationship of SES to the patterns of mental abilities—although statistically significant—was considered too weak to be important. Had a wider range of SES been studied, a stronger relationship between SES and the patterns of mental abilities might have been found.

In contrast, Lesser *et al.* (1965) reported that “no marked pattern differences emerged when [first grade] boys and girls were compared”

(p. 65). First grade children from different ethnic groups did, however, exhibit characteristic patterns of mental abilities; SES was related to the level but not the shape of the patterns.

Thus, differences between the sexes apparently become more marked with age. In addition, it appears that sex may play a greater role in the development of patterns of mental abilities than either ethnicity or SES. Although previous research had reported characteristic patterns of mental abilities for adolescent males and females, it was unexpected that sex would account for such a large proportion of the total variance (69%), as compared to ethnicity (13%) and SES (2%). An examination of tests with loadings on the specific factors may shed some light on this question.

For example, the higher mean score of the males on VKN probably reflects the large percentage of tests with loadings on this factor that would be expected to favor males, e.g., tests of information about the military (.59), aeronautics and space (.50), outdoor activities (.50), sports (.48), and electricity and electronics (.36). The tests with high loadings on ENG and MAT measure to a large extent school-related experiences, and differences between the sexes on these factors may be related to different curricula followed by males and females. For example, the sex differences on MAT may reflect the common situation in which fewer females than males study mathematics beyond the usually required ninth grade algebra (National Center for Educational Statistics, 1968); by twelfth grade, in addition to not knowing the advanced mathematics required for a high score on MAT, the females may have forgotten much of the algebra studied several years earlier.

When interpreting the results of this study, one should keep in mind that the sample was rather select. Using a sample of students who were in the twelfth grade and who were also respondents to a follow-up survey would be expected to bias the results toward higher SES and higher mental ability factor scores (Flanagan *et al.*, 1967, Appendix C). Bias related to SES was reduced by restricting the sample to the middle range on the SES scale. When the respondent sample was compared to a sample of twelfth graders representative of the total twelfth grade population, the level of the pattern of mental abilities of the respondent sample was only about one-tenth of a standard deviation higher than that of the other sample (Lohnes, 1966, Ch. 7). The respondents, as expected, also had higher mean scores when compared to a sample of nonrespondents subsequently interviewed by Project TALENT field representatives. The shapes of the patterns, however, were similar for respondents and nonrespondents from specific ethnic

and sex groups (Backman, 1970). Thus, it does not appear that using a respondent sample seriously biased the results of this study.

It is also important to point out that the present study was not designed to answer questions regarding heredity and environment; ethnic groups were defined sociologically and not biologically, and there was no way to determine the contributions of heredity and environment to the variation among ethnic groups on the mental ability factors. Although the groups were approximately matched on score on an index of SES, differences could still be due to SES factors not measured by the index. Also, groups that can be identified according to physical characteristics—such as males and females—are differentially reinforced by society; the social implications of the physical differences can play an important role in the development of characteristic abilities.

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American Educational Research Journal

STODOLSKY, S. J., & LESSER, G. Learning patterns in the disadvantaged.
Harvard Educational Review, 1967, 37, 546-593.

(Received March, 1971)

(Revised May, 1971)

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