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EDITORIAL:

The Construct of General Intelligence

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The construct of general intelligence is discussed in a number of different contexts. The fundamental empirical basis for it is the positive trend among the smallest correlations among cognitive measures. Differences among factor models which recognize this in different ways are discussed. Evidence for the general factor in intelligence is also found in the difficulty in finding evidence for differential validity of tests from one criterion to another. Performance on Piagetian tasks reflects mainly general intelligence. Individual differences in aural comprehension of language anticipate later individual differences in intellectual development. Selective forces which produce differences among schools operate largely on the general factor. To the extent that there is a genetic contribution to individual differences on cognitive tests, it appears to be to the general factor variance. Social class differences among whites appear to be largely on the general factor, but black-white differences require other dimensions. Although the general factor is, in a sense, real, it is not interpreted as an entity within the organism. Instead it is an abstraction resulting from the many genes, the many environmental pressures, and the many neural structures involved in the wide variety of human behaviors which can be labelled cognitive or intellectual.

In the years since the publication of the Primary Mental Abilities monograph (Thurstone, 1938), psychometrists and factor analysts have tended to lose sight of the general factor in intelligence. This has been more true of research workers in the United States than in the United Kingdom, where Burt (1941) and Vernon (1950) retained the construct of general intelligence while accepting group factors as well. In contrast to this disregard or even disrepute of the construct among research persons working in the domain of human abilities, the dominant point of view among clinical psychologists (Wechsler, 1958) has been quite different. Clinicians have retained the use of intelligence tests for the very good reason that an IQ or its deviation equivalent constitutes an important piece of information about a child or adult. It is more important than the variation in the profile of scores on a battery of primary ability tests.

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TABLE 1
Intercorrelations of Selected Measures from Project Talent Boys are Above, Girls Below, the Diagonal

		1	*2*	*3*	*4*	*5*	*6*	*7*
1.	Clerical Checking, R-3W	—	510	111	322	197	170	241
2.	Clerical Checking, R	679	—	911	-086	107	-004	019
3.	Clerical Checking, R + W	386	939	—	-254	029	-086	-094
4.	Numerical Operations	286	049	-072	—	237	282	343
5.	Memory for Words	190	088	022	285	—	294	383
6.	Farming/Home Economics	181	021	-059	303	282	—	454
7.	Measures of "g"	231	046	-050	351	390	449	—

Note: Decimal points are omitted from correlation coefficients.

THE BASIC EVIDENCE

The fundamental basis for a general factor in human cognitive functioning is the size of the *smallest* correlations among a wide variety of tests administered in a wide range of human talent. We can look at some of these small correlations in data from Project Talent. Ninth grade boys and girls represented very nearly the full range of talent in 1960 when Project Talent was initiated. The tests administered also represented a wide range of intellectual functions. Intercorrelations presented in an early publication (Flanagan et al, 1964) were based on more than 3900 boys and almost 3900 girls.

While the Project Talent tests do not cover all conceivable tests of information, aptitude, etc., the wide coverage allows a test of the hypothesis of generality in the cognitive domain. Inspection of the tables of intercorrelations in question reveals mostly positive correlations of rather substantial size. There are only a small number of near zero or even negative correlations. The location of these essentially zero correlations is revealing. They are connected with two of three scoring schemes for highly speeded tests containing very easy items. This finding is illustrated in Table 1, which contains intercorrelations for both boys and girls of six measures which are not ordinarily considered to be highly loaded on the general factor, including one of the highly speeded tests, Clerical Checking. The mean correlation with eight tests which would be considered good measures of the general factor is also included for each of the six initially selected.

It is seen that the only negative correlations in these subsets from the larger matrices are with two of the three scoring formulas for Clerical Checking. There is also a clear progression from the formula score which penalizes errors to the one which is the number of items attempted. Generality does not extend to mere speed of performance. There must be a small element of problem solving involved even if it is as simple as being correct when checking a name as same or different from a standard.

The generality extends to measures of rote memory, a speeded test of accuracy in simple numerical operations, and to information about either farming (for boys) or home economics (for girls). Note in this regard that the criterion tests of general intelligence cover a rather wide gamut of content and operations: Vocabulary, Reading Comprehension, Creativity, Arithmetic Reasoning, Abstract Reasoning, Visualization in Three Dimensions, English, and Introductory Mathematics. Note also that correlations with a composite of the preceding tests, which would more closely parallel a test of general intelligence than any one of the components, would be substantially higher than the means. An hypothesis that the generality in cognitive functioning extends to tests having right answers and in which some premium is placed on obtaining the right answer is a reasonable one. A test of black urban argot administered in either a black or white sample would be expected to have positive correlations with these eight measures.

MODELS OF FACTOR ROTATION

The neglect in the United States of the general factor in human abilities has arisen from the popularity of the group factor model and the almost universal restriction of that model to factors in the first order only. Investigators who prefer orthogonal rotations hide the general factor in the predominance of small positive loadings of measures that are supposedly in the hyperplane. Investigators who prefer oblique rotations reveal the general factor in the intercorrelations of their factors, but these correlations are typically not interpreted.

These problems are highlighted by the comparison of the two matrices in Table 2. Each matrix defines two common factors, no more, no less, but there is a great deal of difference in the psychological significance of the two patterns of correlations. Whether the two factors are rotated orthogonally or obliquely, the differences between variables 1 and 2, on the one hand, and 3 and 4, on the other, are the significant findings in Matrix A, while the communality among the four variables is the significant finding in Matrix B.

TABLE 2
Schematic Tables of Intercorrelations Each Defining Two Common Factors

	Matrix A				*Matrix B*			
	1	*2*	*3*	*4*	*1*	*2*	*3*	*4*
1.		90	00	00		90	75	75
2.	90		00	00	90		75	75
3.	00	00		90	75	75		90
4.	00	00	90		75	75	90	

NOTE: Decimal points are omitted from correlations.

TABLE 3
Unnotated and Rotated Factors in Matrix B

	Unnotated		*Orthogonal*		*Oblique*[a]		*Hierarchical*		
	I	*II*	*I*	*II*	*I*	*II*	"g"	*I*	*II*
1.	908	276	837	447	949	000	865	390	000
2.	908	276	837	447	949	000	865	390	000
3.	908	-276	447	837	000	949	865	000	390
4.	908	-276	447	837	000	949	865	000	390

Note: Decimal points are omitted from correlations.
[a]The correlation between the oblique factors is .831.

If all measures in Project Talent had their correlations corrected for attenuation, and if measures of two group factors were compared with each other pair by pair, the correlations would in general look more like those of Matrix B than Matrix A.

The communality among psychological measures of cognitive functioning is best portrayed by a hierarchical model of human abilities. Factors are extracted in more than one order and factors in all orders are transformed into a hierarchical, orthogonal structure in a single order by means of the Schmid-Leiman (1957) transformation. While there are certain difficulties with the hierarchical model in terms of its fit to empirical findings (Humphreys, 1962), these difficulties are not with the general factor. The smaller group factors do not break out of the larger group factors as clearly as one would like.

Table 3 contains centroid factor loadings for Matrix B of Table 2 along with orthogonal, oblique, and hierarchical rotations. While these matrices represent a very simple situation consisting of only four variables and two factors, they serve to highlight the different rotational models. The dramatic decrease in the size of the loadings on the group factors from either the orthogonal or oblique rotations to the hierarchical is typical of what happens in actual data. In a wide range of talent the column of general factor loadings not only accounts for much more variance than the group factors, but within any row of the hierarchical matrix the general factor loading is likely to be the largest.

FLUID AND CRYSTALLIZED INTELLIGENCE

Cattell (1971) has an incomplete hierarchical model. His fluid and crystalized intelligence factors, along with several others, were originally defined by factoring in the second order. Once defined, however, it is possible to do research on these factors by a careful selection of marker variables so that factors which are typically found in the second order in a more complete selection of tests can appear in the first order. Cattell's second-order factors are also given the symbol "g," along with an appropriate subscript. He faces a logical dilemma here in designating each of several coordinate factors as general factors.

The second-order factors are themselves positively intercorrelated and will define a single factor in the next higher order. The appropriate designation for this higher-order factor would be the general factor. In the complete hierarchical model, fluid and crystallized intelligence, along with their other second-order factors, become major group factors and the smaller group factors which typically appear in the first order become minor group factors. Whether measures of so-called fluid intelligence would have the highest loadings on the general factor is not presently known.

There is no problem in higher-order factoring of piling unknowns on top of unknowns when the results are reported in terms of the hierarchical model. Second-order factors need not be defined by first-order factors which are themselves subjectively interpreted, and third-order factors need not be defined by second-order factors which are themselves once removed from the original variables. In the hierarchical model, all factors are defined by the original variables, and interpretations become more rather than less tenuous as one moves from the general factor through major group factors to minor group factors. This reverses the usual conception concerning higher-order factors. The common-factor methodology as it has been developed extracts the least important factors first—and mistakenly calls them primary—and the most important factor or factors last.

PREDICTIVE VALIDITIES

When one turns from the intercorrelations of tests to correlations of tests with socially relevant criteria, one again is impressed with the importance of the general factor. In samples of adequate size, any cognitive test is related to any proficiency criterion with a cognitive component. That some industrial psychologists who had looked at too many validity coefficients based on small Ns convinced the Equal Employment Opportunity Commission that test validities were highly labile would be laughable if the consequences had not been so serious. Because test validities were supposedly sensitive to small changes in conditions, the requirement became one of validating tests anew in each job, location, time period, type of industry, etc. In point of fact, however, the problem is to find tests which have differential[2] validity from one criterion

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[2]Differential validity has been misused in recent years for comparisons of validities of tests for different subgroups of a population, e.g., blacks and whites. Such comparisons require analyses of standard errors of estimates, slopes of regression lines, and intercepts of regression lines. The older and correct use of the term can be illustrated by two tests and two criteria: test 1 is more highly correlated with criterion 1 than criterion 2 while the reverse is true for test 2. These differences must also be stable from the sampling point of view and sufficiently large to have a practical impact on selection and classification, or guidance, of examinees.

to another. The possibility of differential validity requires sizable group factors which are differentially related to the various criteria. After almost seven years of trying to achieve a useful degree of differentiation in the early and middle fifties, I reached the conclusion that it was possible to distinguish between mechanical and clerical criteria with two broad clusters of tests, but that finer discrimination in a wide range of talent was highly problematic. I have also had occasion recently to review current military personnel research reports and have not been able to observe any appreciable advance in that regard. Differential classification of pilots and navigators in WWII, although made easier by the restriction of range of talent on the general factor, was based on very similar clusters of cognitive tests.

PIAGETIAN COGNITIVE DEVELOPMENT

The generality in cognitive functioning can also be observed in the relationship between standard tests of intelligence and performance on typical Piagetian tasks. While the correlation between any one Piagetian task and total score on an intelligence test is far below unity, the same observation can also be made about intelligence test items and total score on the intelligence test. In a recent factor analysis in which we applied the hierarchical model to variables including the Wechsler subtests, three standard academic achievement tests, and 27 Piagetian tasks, the principal-factor loading for most of the Piagetian tasks as well as for the intelligence and achievement tests was on the general factor.[3] Furthermore, several of the individual Piagetian conservation tasks had general factor loadings as high or higher than the highest of the Wechsler subtests. As a final step we correlated unit-weighted composites of the Piagetian tasks, on the one hand, and the Wechsler and achievement tests, on the other. The correlation was .88 and involved no capitalization on chance. As a matter of fact, the Piagetian composite was less reliable and less valid than it could become because a number of the tasks were not sound psychometrically. These suspect tasks showed little communalitv with tasks of their own type.

In addition to the substantial contribution to total variance of the general factor, there was an easily identifiable academic achievement group factor and a Piagetian conservation factor. Neither described a very high proportion of the total variance, but both are so well defined that there is little doubt concerning their replicability. When one thinks in terms of the hierarchical model, most of the research involving Piagetian tasks is uninterpretable; i.e., one does not know whether a particular effect is related to the general factor

[3]Humphreys, L. G., & Parsons, C. *Piagetian tasks measure intelligence and intelligence tests assess cognitive development.* Manuscript submitted for publication, 1978.

or to a group Piagetian factor. This suggests the need for the use of multiple dependent variables in research concerned with cognitive development. From the present point of view also, relationships between independent variables and the general factor in Piagetian tasks would almost certainly be more important psychologically and socially than those with a group factor.

PRECEDENCE IN COGNITIVE DEVELOPMENT

Additional light is shed on the nature of the general factor in cognitive development by means of the cross-lagged panel correlation methodology. Atkin et al. (1977) have reported that Listening, a measure of aural language comprehension, anticipates individual differences on an intellectual composite which, in paper and pencil format, would be considered a good measure of general intelligence. The aural test not only stands out clearly from all of the printed tests as an antecedent of this composite, but it does so consistently for black males and females and white males and females for all combinations of grades 5, 7, 9, and 11. In addition to several tests of academic achievement and of rather narrow information, it is noteworthy that the composite included tests of reading comprehension, verbal, and quantitative aptitude.

The model developed to fit these data (Humphreys and Parsons, in press) suggests that there is a three-year lag between individual differences in Listening and on the composite during the time period covered by the data. That is, true scores in Listening, while students are in the 5th grade, are seemingly most highly correlated with true scores on the composite obtained three years later. Anticipation of later individual differences has been inherent in many discussions of general intelligence, but has been demonstrated, inadequately, by predictive validities alone. A combination of predictive and postdictive validities is required for such a demonstration, which in this case allows us to conclude that oral presentation may be a more valid format for assessing general intelligence than the visual presentation well beyond the childhood years.

SOCIAL SELECTION AND THE GENERAL FACTOR

Quite a different aspect of the importance of the general factor in human abilities is furnished by the effects of social selection. There were many, many social forces which determined in 1960 whether a given child would be in one high school rather than in another. There are many demographic differences among the nation's high schools: rural-urban, sectional, socio-economic, racial, public-private, and curriculum specialty, to name the obvious ones. We asked how these forces, in toto, affected the intercorrelations of the Project Talent cognitive tests. We added to the matrix selected demographic measures of the schools. We were able to obtain these intercorrelations for the means of 59 cognitive measures, one composite measure of the socio-economic status of individual students, and 19 school demographic measures for more than 700 high schools from the Project Talent Data Bank. Data for 10th grade students were requested to minimize the drop out problem and to avoid the junior-senior high problems.[4]

Our hypothesis was that social selection operated primarily on the general factor. Under these circumstances, it would be difficult to define the traditional group factors. We were also interested in trying to determine whether the effect on the general factor would operate through primary selection on socio-economic factors or whether selection was directly on the general factor. Support for the latter would require evidence that selection on socio-economic factors was indirect.

The results are convincing. There is a large general factor on which tests that are known to be good measures of "g" have loadings of from .90 to .95 for both boys and girls. For example, General Vocabulary and Reading Comprehension define the upper level. The three highly speeded clerical type tests referred to earlier and which in this research were scored by number right only, are the only ones which do not have appreciable loadings on the general factor in either sex. Hunting and fishing information for the girls are also not loaded appreciably on the general factor. The socio-economic index for the students' families has a general factor loading in the seventies. The amount of selection on this index is about at the mean of the cognitive tests; i.e., selection on socio-economic factors appears to be indirect. Of the school variables, rate of college going has the highest general factor loading.

Only one of the three small group factors was identified with confidence and this one did not represent a so-called primary mental ability. Variables loading on this factor included, especially for boys, hunting, fishing, farming, and mechanical information, a shorter school year, small classes, and relatively few students in the school. A designation of rural high schools seems apt. A second group factor was defined by the three highly speeded tests. It is not certain what factors produce student selection in high schools on speed of performance unrelated to "g." On the grounds that the very broad difference on cognitive tests between blacks and whites disappears when there is no correction for errors on tests of this type, a tentative identification of this factor with black schools was made. Identification of the third group factor was even more tenuous. Information about the Bible covaries with low teacher salaries and low student per capita expenditures. These may be private sectarian schools.

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[4]Humphreys, L. G., Parsons, C., & Park, K. *Dimensions involved in differences among means of cognitive measures.* Manuscript submitted for publication, 1978.

Another method of gauging the amount of social selection that determines school enrollment is to compare the standard deviations of schools with the standard deviations of individuals within the schools. The medians of these ratios for both boys and girls approaches .60, which is also the ratio for the socio-economic index. Since many of the Project Talent tests were of very modest reliability—tests had to be kept short because of restrictions on total testing time—the size of many of their variance ratios is substantially attenuated by errors of measurement. In contrast, the socio-economic index is undoubtedly highly reliable and had little attentuation of its variance ratio. We concluded that the amount of selection was large, that selection was on the general factor primarily, and the selection on the socio-economic index was mediated by its correlation with the general factor. We had only speculation to offer, however, concerning the bases for general factor selection.

HERITABILITY AND THE GENERAL FACTORS

Several years ago, I made use of the ratio of cross-twin to within-twin correlations to investigate the question of whether tests measuring functions such as abstract reasoning showed evidence of higher heritability of their scores than tests measuring narrow information (Humphreys, 1974). Three distinct methods of analyzing these data failed to reveal evidence for a differential degree of heritability as a function of the type of test. One of the comparisons which produced a null finding involved pitting all of the information tests against the remainder. I have since broken down the information tests into three subsets: academic, aesthetic, and nonacademic, again with negative results. To the extent that there is a genetic contribution to individual differences on cognitive tests, this contribution is seemingly to the general factor. On the other hand, individual differences on group factors as defined by the hierarchical model are probably acquired whether the group factor is identified as abstract reasoning or rural information. In interpreting this conclusion, the reader is reminded that loadings on the group factors in the hierarchy represent correlations with those factors after the general factor has been partialled out.

SOCIO-ECONOMIC AND RACE DIFFERENCES

The relationship between level on the general factor and socio-economic and race differences was investigated by Humphreys, Fleishman, and Lin (1977). We had available, again from the Project Talent Data Bank, mean scores on more than 70 cognitive measures for 24 demographic groups distributed as in an analysis of variance $2 \times 2 \times 2 \times 3$ factorial design. Three of the four dimensions were defined by sex, section of the country (south and nonsouth), and high school grade level (9 and 10 vs. 11 and 12). The fourth dimension was a mixture of race and socioeconomic status: blacks, a low-SES white group about the same size numerically and a bit lower economically, as the blacks, and a high-SES white group representing the remainder of the SES distribution. Because of the nature of the information in the data bank, only all-black and all-white schools could be used in the analysis. This restriction resulted in the loss of most middle-class blacks and many middle class whites as well. In 1960 high schools enrolling a small number of black students had higher SES and cognitive test means than 100% white schools.

The analysis involved, as a first step, the computation of intercorrelations of the 24 groups over the sample of cognitive tests. Next, mean cognitive profile correlations were computed between the various groupings made possible by the factorial design. The mean profile correlation between low- and high-SES white groups who also differ with respect to sex, section of the country, and grade in high school, is about -.90. This near mirror-image relationship indicates that the primary difference between these groups is in their mean scores on the general factor. There is essentially no across-the-board difference in cognitive means of the two sexes, but section of the country, grade in high school, and socio-economic status do show across-the-board differences, and in that order of size. If these across-the-board differences are primarily general-factor differences, as the -.90 correlation suggests, the credibility of a genetic difference between white SES groups is increased.

Profile comparisons of blacks with both low- and high-SES whites tell a somewhat different story. Although across-the-board differences of substantial size exist even when blacks are compared with low-SES whites, the profile correlations are very different. With low-SES whites, the profile correlation is very close to zero, and only slightly negative, while the much larger across-the-board difference with the high-SES white groups leads to a negative correlation of only moderate size. Thus there are other causes of differences in cognitive means of blacks and whites beside the general-factor difference. These other causes should be investigated thoroughly before an attempt is made to assess the size of the general-factor difference. A general-factor deficit of blacks cannot explain differences on several measures between black and white groups which are larger than one would expect on the basis of the general-factor loadings of those measures. The essentially zero correlation between black and low-SES white profiles, on the other hand, indicates that the lack of economic privilege is not the sole cause of black deficits on cognitive tests.

INTERPRETATIONS OF "g"

Acceptance of a general factor in human abilities as a descriptive construct does not lead automatically to an interpretation of "g" along the lines of Charles Spearman, (1914, 1927) who discussed the construct in terms of "mental energy". While most psychologists today would reject his terminology, many would still think of a factor, either general or group, as an entity, or as a unitary "thing" within the organism (see Guilford, 1967). Factors at all levels of all types are readily reified in this way. There is, however, a more acceptable alternative which can be traced most directly to Godfrey Thomson (1919). Others who have discussed factors in this more acceptable fashion are Edward Thorndike (1926), Robert Tryon (1935), and George Ferguson (1954).

Thomson discussed "g" in terms of multiple overlapping neural bonds. Thorndike brought in multiple stimulus-response bonds. Ferguson discussed group factors in terms of transfer of training resulting from environmental experiences. Their approaches are closer to observables both anatomically and behaviorally than constructs that are discussed as entities.

I have translated the point of view of Thomson and the others in the following way: To the extent that there is a genetic contribution to individual differences in general intelligence, that contribution is polygenic. Environmental contributions are also multiple. To coin a term, we might call these contributions polyenvironmental. Similarly, the biological substrate for general intelligence is polyneural, and the behavioral observations which define the phenotypic construct are polybehavioral. *Intelligence is the resultant of the processes of acquiring, storing in memory, retrieving, combining, comparing, and using in new contexts information and conceptual skills; it is an abstraction.*

In order to sample these behaviors adequately, intelligence tests must be composed of a large number of items heterogeneous in content and having only moderate levels of inter-item correlations. Imposing a criterion of high homogeneity impairs the construct validity of the intelligence test, and converts it into a measure of a phenotypic trait subordinate in the ability hierarchy.

While it is theoretically possible to estimate the genotypic level of a person from a continuously distributed phenotypic trait such as general intelligence, a dependable estimate of the correlation between genotype and phenotype in a specified population is required. Present estimates for the general factor are not dependable, and I do not anticipate any change in this state of affairs in the foreseeable future. Accepting evolutionary continuity in animal behavior as well as in structure, I am 99% confident that the square of this correlation, the heritability coefficient, lies between .2 and .8. The pattern of family resemblance coefficients suggests, but does not demonstrate, the value toward the high end of this range. Other data, or, more precisely, the lack of adequate data on the effects of prenatal, perinatal, and early postnatal environmental conditions, suggests the need for the wide range of possible values.

Interpretations of intelligence test scores which involve inferences concerning native ability compound that error, for error it is, by equating phenotypic level with genotypic level. Whatever the correlation may be, it is surely less than unity. If we knew the correlation, the estimation of genotype would be made by means of an ordinary regression equation in which standard scores with a mean of zero and a standard deviation of one would be the sensible choice for the genotypic scale. Estimation of genotypes would necessarily involve regression toward the population mean of zero from extreme phenotypes. This regression would be accentuated by the presence of measurement error in the phenotypic measure.

The problem of inferring genotype from phenotype is complicated further in children and adolescents in ways that make the equation of phenotypic score with native ability even more erroneous. It is probable that the phenotypic-genotypic correlation varies with chronological age, and it is quite certain that there are individual differences in the rate of development. Differences in rate, whether produced by genetic or environmental causes, result in a simplex matrix of intercorrelations of true scores on intelligence tests administered over successive occasions. (See Humphreys, 1960.) Estimates of individual genotypes would be everchanging during development and would not become relatively stable until maturity.

RACE AND INTELLIGENCE REEXAMINED

With this point of view toward the nature of general intelligence as background, I shall now return to race and intelligence. Note in the first place, that acceptance of nonzero heritability within groups does not require a genetic explanation for between-group differences in phenotypes. The former does provide for a *possible* causal relationship. Some environmentalists may insist, therefore, on zero heritability of intelligence within groups in order to avoid any need to grapple with the genetic hypothesis for the between-group differences.

There are good reasons, however, to be even more cautious about the causes of race differences than about the causes of individual differences within either group. In addition to our inability in research on humans to hold the environment constant while systematically varying genotype, or the reverse, our black population has certainly experienced discrimination over a period of many generations. My own research, described earlier, indicated that factors other than or in addition to the general factor, which is probably most highly heritable, were involved in the black-white differences on cognitive tests. The environmental causes of group-factor differences may in combination have relatively broad effects, though their effects do not follow the pattern required for a general factor difference.

The caution required in the absence of solid information applies, incidentally, to both hereditarians and environmentalists. Inability to reject one null hypothesis is matched by inability to reject the other. For example, the research on cross-racial adoptions by Scarr and Weinberg (1976) is as badly flawed as the data of the hereditarians. The former authors had very inadequate information concerning the intellectual levels of the biological mothers and virtually no information about the biological fathers. The assumption that years of education is an adequate substitute for a measure of intelligence is especially suspect for a sample of young, largely white mothers who have probably not completed their educations. The assumption that the largely black fathers are a random sample of blacks nation-wide is at least equally suspect. In spite of the defects in the data on both sides of the question, however, the phenotypic difference between random samples of blacks and whites, is both real and substantial in size. On the average blacks are less intelligent than whites in this country at this time in our history. There is so much overlap between the two distributions, however, that estimates of intelligence from race are quite inaccurate and, are also highly undesirable in a democratic society.

Although neither the genetic nor the environmental hypothesis can be ruled out as an explanation for the phenotypic difference on the basis of available data, there are some well established empirical generalizations involving phenotypes which serve to place limits on the content of any environmental hypothesis. I have described these generalizations elsewhere (1976) and shall list here only the limitations. First, the locus of the cause or causes is bounded by conception and the end of the preschool period. Schools do not produce the difference. Second, the linguistic difference between black and standard English, which is not applicable to all blacks and all whites, must itself be an effect and not a cause. There is probably a common explanation for the substantial deficits on both verbal and nonverbal tests. Third, lack of economic privilege can at most explain only a minor part of the difference between children of the two races. The intellectual deficit, on the other hand, is a cause of economic deprivation among adult blacks. Fourth, the causes of intellectual differences have broad effects extending far beyond performance on intelligence tests to performance in education, industry, and the military. Both individual differences within the black group and the mean difference between black and white groups are predictive of socially and economically relevant behavioral criteria among blacks.

To summarize, the difference is large, appears early, generalizes widely beyond performance on the test, and has causes more subtle than the ones that have commonly been advanced. In addition, we are not now correcting the deficit by the policy initiatives which have been undertaken nationally. These statements define an important problem which is certainly not lessened by our ignorance about causation. Furthermore, if the deficit is correctible by environmental means, as indeed it may be, we do not know with any confidence how to correct it. The research literature contains hints and promises, but not prescriptions. Thus, one can abandon caution in evaluating the personal and social consequences of the phenotypic difference in mean scores while remaining cautious about causation. The consequences are important; ignoring or denying the difference will not make it or its consequences disappear.

This last conclusion has of course been disputed by a number of critics of intelligence tests and of the construct of intelligence. I have yet to see, however, solid evidence behind the rhetoric. It is really quite paradoxical that the dimension, and the behaviors that define it, which distinguishes humans from their primate relatives most sharply has come under attack. It is at least equally paradoxical that these criticisms are voiced by many persons who are themselves highly intelligent and who select graduate and professional students and faculty colleagues more largely and on the basis of intelligence than on any other dimension.

INTELLIGENCE AND ADAPTABILITY TO ONE'S ENVIRONMENT

Criticisms of the construct of general intelligence have also been expressed in recent years along one or more of the following lines: The tests measure the content of middle class white culture; adaptability to the environment is more important than measured intelligence and is highly relative from culture to culture; survival in the ghetto is a more important criterion of intelligence than inability to read and write.

There is a modest amount of validity in such statements. The construct of general intelligence is itself adaptable to cultures other than our own, but the measuring instruments must of necessity be geared to the culture. On the other hand, to accept some degree of cultural relatively does not and should not imply the equation of intelligence to adaptability to the environment. Survival in some cultures may be heavily dependent on size, strength, muscular coordination, and sensory acuity. For a given group also, whether a separate species, or merely an isolated subset of a particular species, fertility rate contributes heavily to group survival.

One can isolate a contribution of general intelligence to survival even though the cultural group has neither books nor a number system. There were individual differences among the Polynesians who colonized the Pacific in their accuracy of navigation. Similarly, there were individual differences among American Indians in hunting and warring skills that went beyond size, strength, coordination, and sensory acuity. Once books and numbers are introduced and valued highly by a society, those who would otherwise have been the most successful navigators or the most successful strategists in the hunt or in war become most successful in reading comprehension and in the manipulation of numbers and mathematical symbols. Our so-called middle class intelligence tests reflect behavior this society considers important, but intelligence can also be manifest in other behaivors. Survival in the ghetto does require intelligence, but it also requires size, strength, coordination, and sensory acuity. In the American culture, also, with the availability of public education, radio, TV, newspapers, and books, the intelligence-component of survival in the ghetto is tapped by scores on standard test of intelligence. Individual differences within the black population as measured by present tests provide valid information about individuals, even though there is no adequate explanation of the difference between the black and white means.

In retrospect this interpretation of general intelligence is very similar to Cattell's description of fluid ability. Cattell's measures of fluid ability, however, are not the only nor possibly even the best measures of general intelligence. Intelligence is too fluid to be tied to a particular subset of cognitive tests, and there is a fluid (general) component in the variance of the most crystallized information or achievement test.

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