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Intelligence, Learning Ability, and Socioeconomic Status.

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Discussed are the theoretical explanations of the observation that low intelligence quotient (IQ), low socioeconomic status children appear to be brighter in certain ways than low IQ middle class youngsters. The two different theories on IQ as a function of socioeconomic status--environmental or cultural vs. genetically determined biological potential factors--are evaluated. Also presented is a discussion of the importance of cultural bias in tests and of the various correlations of IQ and learning tests. It is felt that "heritability" offers a more useful criterion to account for the extent of the cultural loading dimension. Postulated is the simplest possible model to explain IQ differences, a hypothesis which formulates two types of mental processes, Level I (associative learning) and Level II (abstract problem solving and conceptual learning). Empirical findings are then more understandable when three further hypotheses are considered--(1) there is a genotypic independence of Level 1; and (3) genotypes are differentially distributed in upper and lower social classes. The practical educational consequences of this theory are briefly mentioned. (NH)

INTELLIGENCE, LEARNING ABILITY, AND SOCIOECONOMIC STATUS

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Intelligence, Learning Ability and Socioeconomic Status

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The research and theory presented here had their origins in the observation that low IQ children called culturally disadvantaged appear in certain ways to be considerably brighter than their more advantaged middle-class counterparts of similar IQ.

We know that on standard intelligence tests, like the Stanford-Binet, the Wechsler scales, or group tests intended to measure the same abilities, children of low socioeconomic status (SES) perform almost one standard deviation below the general population mean and upper-middle class children perform about one standard deviation above the mean (Tyler, 1965, Ch. 13).

There have been two theories of these differences in the distribution of IQ as a function of SES.

The first theory holds that SES differences in IQ are due entirely to environmental or cultural influences (e.g., Eells, Davis, Havighurst, Herrick, & Tyler, 1951). According to this view, SES differences in measured intelligence do not reflect any biological realities but reflect only the degree of cultural bias that exists in the tests, which, as we know, are devised by middle-class persons and are standardized and validated on largely middle-class populations.

The second theory holds that SES differences in measured intelligence do, indeed, reflect cultural differences to some degree, but also reflect, perhaps to a greater degree, genetically determined differences in biological potential for intellectual development (e.g., Burt, 1959, 1961).

The preponderance of the evidence supports the conclusion that the first theory is decidedly wrong and the second theory is essentially correct (Jensen, 1968a, 1968b).

But then what about the common observation that in some ways low SES children with low IQs appear brighter than middle-class children of the same IQ. Is this only because standard IQ tests are culturally biased so as not to give a true picture of the disadvantaged child's intellectual ability?

Direct Learning Tests

To study this phenomenon I decided to measure children's learning ability directly, by giving them something to learn and seeing how fast they could learn it.

The method worked. Many disadvantaged children with low IQs (i.e., IQs from 60 to 80) showed a level of ability on these learning tests that would be entirely unexpected from their low IQs or their poor scholastic achievement. The children's learning performance, however, would often correspond to the teacher's judgment of the child's brightness when observed in play or in social situations. On the other hand, upper-middle-class children in the same range of IQ (i.e., 60 to 80) performed on the learning tasks in a way that was consistent with their low IQs and poor scholastic performance. They were consistently slow learners.

The learning tasks are varied: serial and paired-associate rote learning (Jensen, 1961; Jensen & Rohwer, in press; Rapier, 1968), selective trial-and-error learning (Jensen, 1963), and free recall (Jensen, 1961), all using a variety of materials and methods of presentation. Our most recent work exploits the digit span paradigm. Digit span seems to be the purest measure of the learning ability factor measured by all the other learning tests, and it displays the same interaction between IQ and SES as the other tests (see Jensen, 1968, pp. 20-21).

Our subjects have been low SES children, typically called culturally disadvantaged, and middle and upper-middle class children as determined by the neighborhood of their home and their father's occupation. Their ages range in various studies from preschoolers to junior high school pupils, that is, from about 4 to 14. Mexican-American, Negro, and Caucasian populations have been sampled. Low SES children in each of these groups are much alike, on the average, with respect to the phenomenon I am describing.

Essentially the same results have been found so consistently with various learning tasks, in different age groups, and in different ethnic samples that there can now be hardly any doubt that we are studying a very substantial psychological phenomenon.

The essential results of these studies are summarized in Fig. 1.

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Insert Fig. 1 here.

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Note the large average difference in learning ability between the high and low SES groups in the low IQ range. But also note that in the above-average range of IQ, the high and low SES groups do not differ appreciably in learning ability as measured by our learning tests.

Another important related fact is that the learning tests show quite different correlations with IQ in the low-SES and middle-SES groups. In the low-SES groups the correlations between the learning tests and IQ are in the range from .10 to .20. The correlations for middle-class children for various tests range between .60 to .80, which is about as high as the inter correlations among various standard IQ tests. In other words, our learning tests could substitute for IQ tests in the middle-class segment of the population, but not in the lower-class segment.

These SES differences in correlation are not attributable to SES differences in the variance on either the learning or the IQ tests. Nor are they attributable to SES differences in test reliability. The SES difference in correlations is not due to any psychometric artifact as far as we can determine. It is a genuine phenomenon calling for further analysis and theoretical explanation.

Examination of the correlation scatter diagrams for the two SES groups is revealing. The general finding is as shown in Fig. 2., which illustrates the locus of the SES difference in the magnitudes of the correlation between associative learning ability and IQ.

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Insert Fig. 2 here.

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Another interesting finding results when a number of learning tests and intelligence tests are intercorrelated and subjected to factor analysis separately in low- and middle-SES groups. The general factor common to all tests accounts for a much larger proportion of the total variance in the middle-SES than in the low-SES group. (This finding was markedly apparent in a comparison of low-SES Negro children with middle-SES Caucasian children.)

Two Dimensions of SES Differences

These results do not readily lend themselves to explanation in terms of greater cultural bias in the IQ tests than in the learning tests. A more complex formulation is needed to explain these results as well as a number of other findings reported in the literature--findings which appear paradoxical if one thinks in terms only of cultural bias in tests as an explanation of SES differences or racial differences in test performance.

For example, culturally disadvantaged children often perform better on verbal than on non-verbal intelligence tests. By what rationale can one call the non-verbal tests more culturally biased than the verbal? Negro children perform much better on the digit span test than on the vocabulary test of the Stanford-Binet (see Jensen, 1968, pp. 20-21; Kennedy, Van de Riet, and White, 1963). Is this only because vocabulary is more culturally loaded than digit span? Then why do Negro children do worse on Raven's Progressive Matrices than on the Stanford-Binet (Higgins and Sivers, 1958)? Also, several studies have shown that Negro youths performed better, relative to whites, on intelligence test items judged to be cultural than on items judged to be noncultural (McGurk, 1951; Dreger and Miller, 1960, pp. 366-367; Sperrazzo, 1959; Sperrazzo and Wilkins, 1958).

Findings such as these lead to the conclusion that another dimension in addition to the cultural loading of tests must be hypothesized in order to comprehend all the relevant facts.

We surely cannot discard the concept of culture-free vs. culture-loaded tests. This is a real and useful continuum, and just because no existing tests of intelligence fall at either extreme on the continuum does not warrant our throwing out the concept. Various tests do, in fact, stand at different points on this continuum. Much of the discouragement of attempts to devise culture-free tests has resulted from the choice of the wrong criteria for determining the degree of "culture-freeness" of a test. Those who chose as the criterion the degree to which the test minimized social class differences have utterly failed (e.g., Ludlow, 1956; Lambert, 1964). They have produced either tests having meager correlations with other measures of intelligence even in culturally advantaged segments of the population or tests which on cross-validation do not reduce SES differences in IQ.

The proper criterion for the "culture-freeness" of a test, I submit, is the magnitude of heritability estimates that can be obtained for the test in a specified population. The higher the heritability ($\underline{h}^2$), the less culturally or environmentally biased is the test for the population in which this determination of $\underline{h}^2$ is made. The magnitude of $\underline{h}^2$ tells us the extent to which the test is indeed measuring something that is genetically determined. (I have discussed the rationale of the meaning and computation of $\underline{h}^2$ elsewhere [Jensen, 1967, 1968]).

Intelligence test items can, of course, be classified by factor analysis or related techniques into many categories or dimensions (Guilford, 1967). The two dimensions I am hypothesizing as minimally necessary for comprehending the phenomena I have just described are shown in Fig. 3.

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Insert Fig. 3 here.

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Conceptually these two dimensions are best thought of as completely orthogonal (uncorrelated), although their manifestation in actual test items may necessarily be correlated.

Little more need be said about the cultural-loading dimension at this point. It is defined by the value of $\underline{h}^2$ (heritability estimate) for the test in a given population Research on social-class and race differences in abilities can be aided by taking greater account of this dimension. I would suggest that group comparisons be made on two or more tests that stand at distinctly different points on this continuum in both of the groups being compared. Differences between the group means on the various tests should be plotted and studied as a function of $\underline{h}^2$.

The second dimension, orthogonal to the culture-loading dimension, is more difficult to describe, partly because its nature is still being elucidated in our current research.

The vertical axis in Fig. 3 represents a continuum of tests ranging from memory span and associative learning at the one extreme to conceptual learning, abstract reasoning and problem solving at the other. Near one end of this continuum we find such tests as digit span, serial rote learning, paired-associate learning and free-recall. These tests, to be sure, stand at different points on this continuum, but they are in the region below the horizontal axis in Fig. 3. At the other extreme of the continuum are tests such as the Progressive Matrices, the Dominoes test, analogies tests, verbal similarities, and tests of the speed of concept attainment.

Another way of characterizing this test dimension is in terms of the amount of self-initiated activity required of the testee. As we move up from the digit span test to the Progressive Matrices, for example, the subject spontaneously must bring more and more covert "mental" activity (discrimination, generalization, verbal mediation, deduction, induction, and hypothesis testing) to bear on the task in order to perform successfully. The increasing complexity of these processes may be thought of as hierarchical--the more complex processes being functionally dependent upon the "simpler" or more basic processes. Consequently, individual differences in test performance ~~among~~ along this continuum should be asymmetrically correlated between tests of a low and a higher level. Poor performance at a lower level is sufficient cause for poor performance at a higher level, while good performance at a lower level is necessary but not sufficient for good performance at a higher level.

A Minimal Hypothesis

At the present stage of our research on this problem I am proposing a simplest possible model--a minimal hypothesis--to comprehend our findings and the related evidence in the literature.

The hypothesis states that the continuum of tests going from associative to conceptual is the phenotypic expression of two functionally dependent but genotypically (or structurally) independent types of mental processes, which I shall label Level I and Level II. Level I processes are perhaps best measured by tests such as digit span and serial rote learning; Level II processes are represented in tests such as the Progressive Matrices.

(a) The biological or structural basis of level I and Level II are thought of as being independent, although functionally they are related, since the rate and symptote of phenotypic development of Level II performance depends upon the individual's status on Level I processes. (E.g., short-term memory is necessary for solving Progressive Matrices but the covert mediation and abstraction needed for the Matrices are not necessary for digit span performance.) One might say that the individual's performance on Level

II tasks cannot rise much above the limitations set by his status on Level I abilities. Conversely, the individual's status on Level I cannot express itself in Level II performance much above the individual's status on Level II functions.

(b) Secondly, the hypothesis states that Level I and Level II processes are distributed differently in upper and lower social classes. Level I is distributed about the same in all classes, while Level II is distributed about a higher mean in the upper classes than in the lower. This is illustrated in Fig. 4. (The exact form of the distributions is not a crucial point in the present discussion.)

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Insert Fig. 4 here.

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Our empirical findings become entirely understandable, given these three hypotheses: (a) the genotypic independence of Level I and Level II processes, (b) the functional dependence of Level II upon Level I, and (c) the differential distributions of individual differences in Level I and Level II genotypes in upper and lower social classes, as shown in Fig. 4. (I am using the terms genotype and phenotype in a very loose sense, not in a strict genetic sense, in order to distinguish between test performance and the psychological or structural processes underlying performance.)

Children who are above average on Level I but below average on Level II performance usually appear to be bright and capable of normal learning and achievement in many life situations, although they have unusual difficulties in school work under the traditional methods of classroom instruction. Many of these children, who may be classed as mentally retarded in school, suddenly become socially adequate persons on leaving the academic situation. Children who are quite below average on both Level I and Level II seem to be much more handicapped. Not only is their scholastic performance poor, but their social and vocational potential seems to be much less than that of children with normal Level I functions. Yet both types of children look much alike in overall measures of I.Q. and scholastic achievement. This is a major shortcoming of our traditional testing procedures. Tests which clearly assess both Level I and Level II abilities need to be developed for general use in schools, in clinics, in personnel work, and in the armed forces. Also, instructional methods which capitalize more on Level I abilities must be sought as a means of improving the educational outcome for many of the children now called culturally disadvantaged.

Determinants of Level I and Level II

Level I abilities may be less affected by environmental deprivation than Level II abilities, since the distribution of Level I seems to be about the same across all SES and racial groups.

The extent to which Level II is dependent upon the quality of the environmental input is an open question. Level II could be an acquired set of cognitive abilities. The rate and asymptote of their acquisition could be viewed as a joint function of inherited Level I ability and the quality of the environment. According to this view, individual differences in Level II would have no genetic component independent of Level I. But this seems rather unlikely, considering the high heritability of Level II tasks, such as the Progtessive Matrices. Our current research is attempting to answer this question. We are especially interested in studying children who by all criteria, come from a good environment, yet who show essentially the same pattern of Level I and Level II abilities as typical children from poor environments. If Level II is not genotypically independent, then we should not find low Level II performance (ruling out brain damage, test anxiety, etc.) in the presence of superior Level I ability plus superior environment.

Growth Curves of Level I and Level II

An ancillary hypothesis concerns the growth functions of Level I and Level II measures, which are shown in Fig. 5. These hypothetical curves

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Insert Fig. 5 here.

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are inferred from certain empirical findings which I have reviewed in some detail elsewhere (Jensen, in press). Memory span and serial learning ability, for example, rapidly approach their asymptote in childhood and soon level off, while matrices performance increases slowly throughout childhood into early adulthood. This formulation is also consistent with the pattern of correlations between intelligence test scores at early and later ages.

The different forms of these two growth functions in middle and lower-class children would also account for the so-called "cumulative deficit" phenomenon (the relative lowering of I.Q. and scholastic achievement) apparently found in culturally disadvantaged children as they progress from early childhood to maturity.

Group vs. Individual Testing

We have found that a caution must be observed in obtaining and interpreting test results from low-SES children. It appears from recent findings in our laboratory that middle-class children perform about the same on Level I learning tasks whether they are tested as a group in the classroom or are tested individually. (The entire test procedure is identical in both cases.) Lower-class children, on the other hand, seem to perform considerably worse in the group situation than when tested individually. We have now begun to investigate this phenomenon in its own right. It may be a crucial matter when thinking in terms of developing standard procedures for assessing the learning ability of disadvantaged children.

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Figure Captions

Fig. 1. Summary graph of a number of studies showing the relationship between learning ability (free recall, serial and paired-associate learning, and digit span) and I.Q. as a function of socioeconomic status (SES).

Fig. 2. Contingency tables illustrating the essential form of the correlation scatter-diagram for the relationship between associative learning ability and I.Q. in Low SES and Upper-Middle SES children.

Fig. 3. The two-dimensional space required for comprehending social-class differences in performance on tests of intelligence and learning ability.

Fig. 4. Hypothetical distributions of Level I (solid line) and Level II (dashed line) abilities in middle-class (upper curves) and culturally disadvantaged (lower curves) populations.

Fig. 5. Hypothetical growth curves for Level I and Level II abilities in middle-SES and low-SES populations.

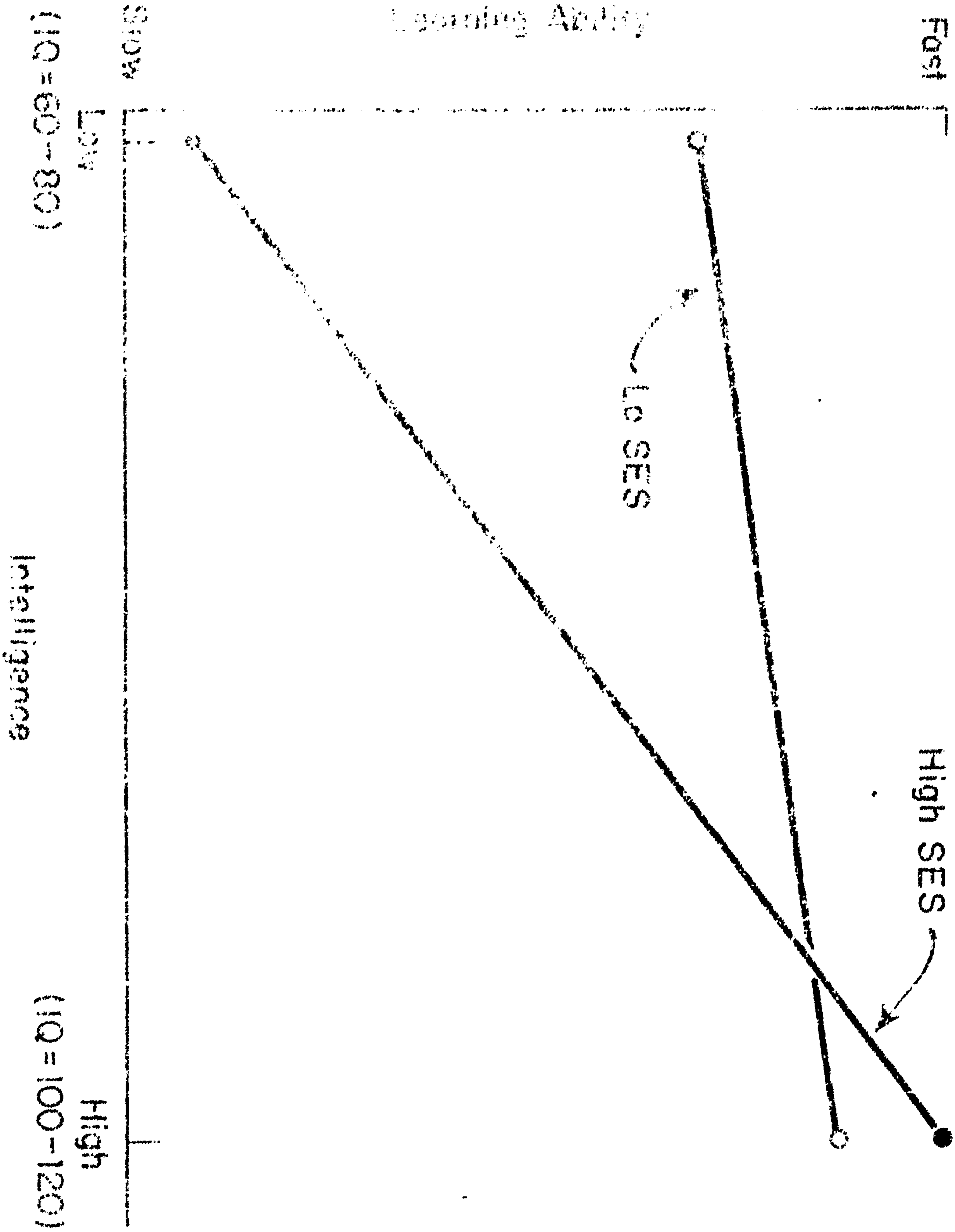
Learning Ability
Slow
Fast
Intelligence
Low
(IQ = 60-80)
High
(IQ = 100-120)
Lo SES
High SES

Fig. 1

IQ

Learning Ability	Below	Above
Above		++
Below	++	

High SES

IQ

Learning Ability	Below	Above
Above	++	++
Below	++	

Low SES

Fig. 2

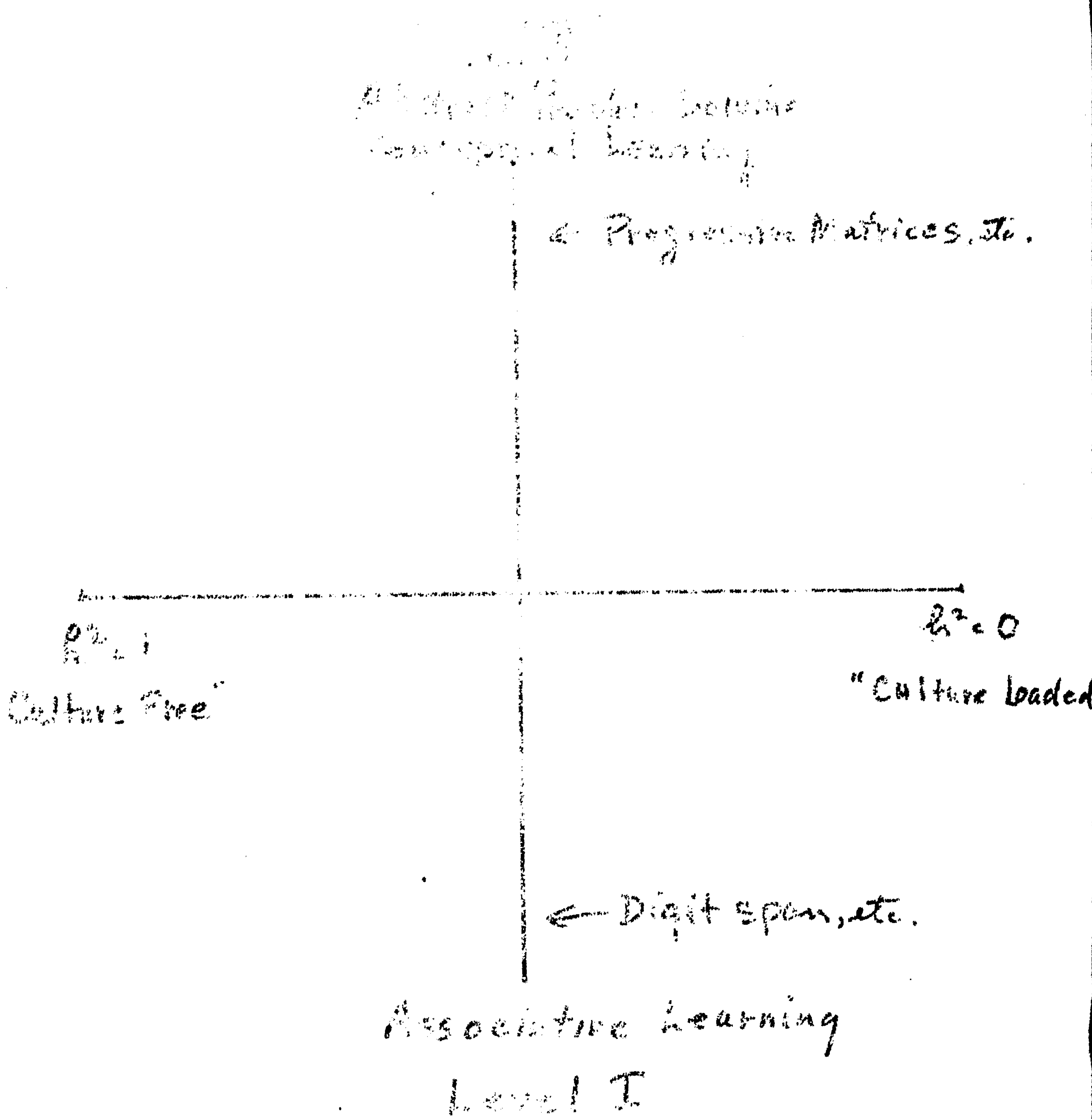
Matrices, etc.
$h^2 = 0$
"Culture Loaded"
"Culture Free"
← Digit span, etc.
Associative Learning
Level I

Fig. 3

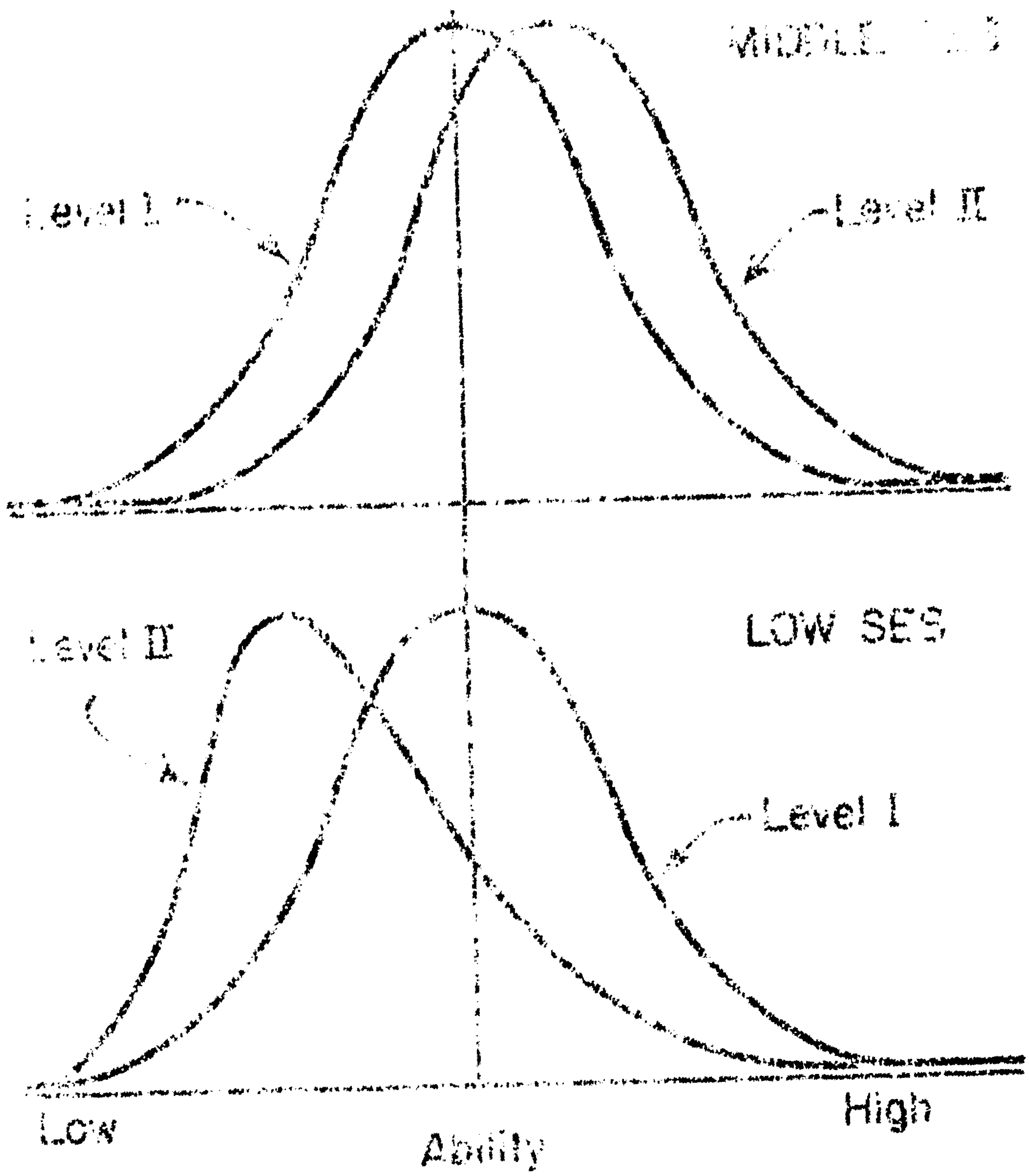

Fig. 4

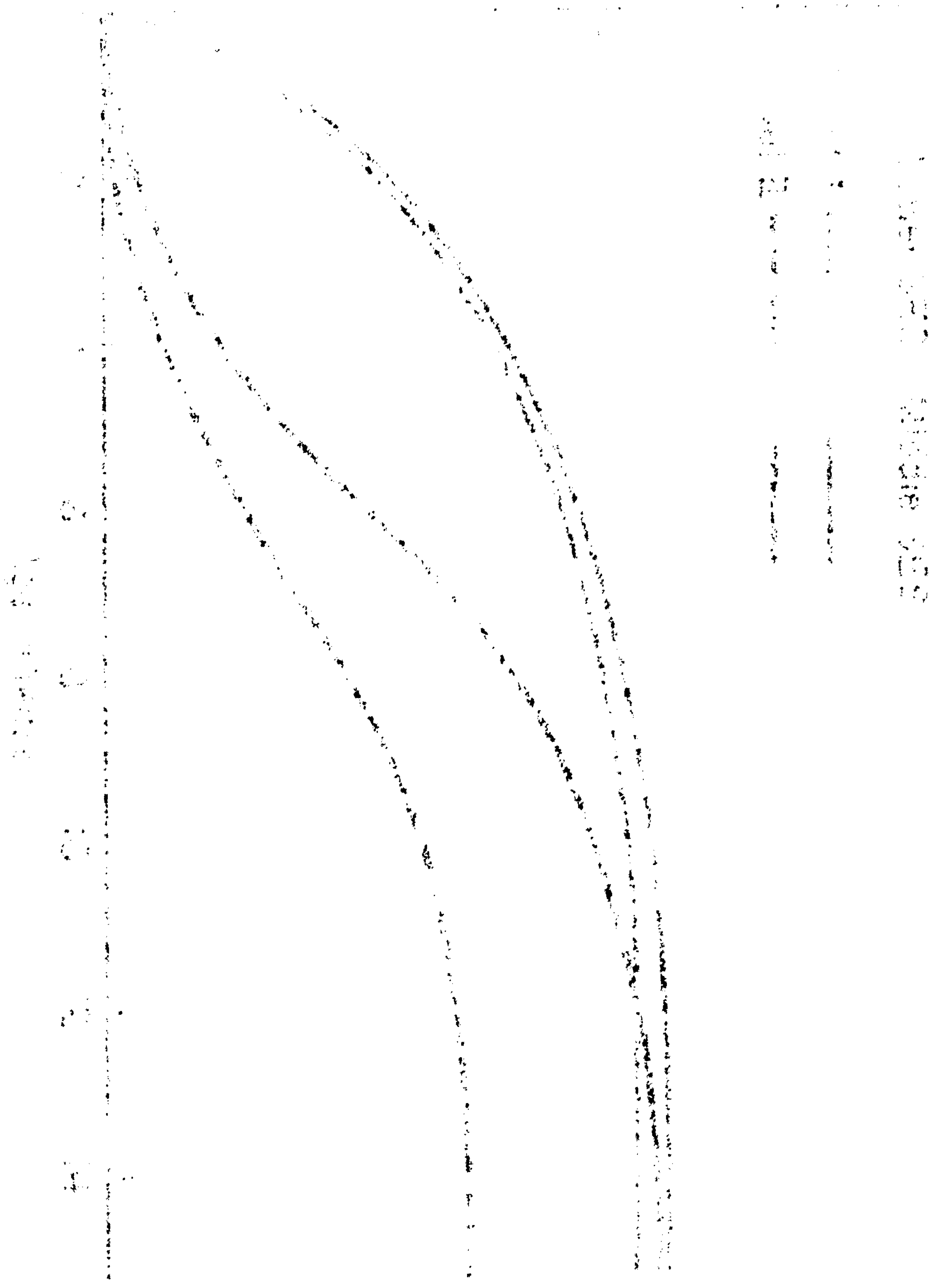

Fig. 5