Proceedings of the Iowa Academy of Science

Volume 49 | Annual Issue Article 8

1942

New Light on Intelligence - Paper Presented at the Fifty-Sixth Annual Meeting

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NEW LIGHT ON INTELLIGENCE

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1. SOME CURRENT ISSUES

Discussions of the meaning of intelligence frequently begin with attempts to separate heredity from environment, or nature from nurture. Such studies can be carried out only in a population in which control can be exercised over the two sets of factors. The control of hereditary factors increases as we go from unrelated children to siblings to twins. When we think of the individual child, we must recognize at once that he is a product of nature and nurture. It is not feasible to assume either that the human organism can develop independently of its genetic basis or that any set of factors can be completely gene-controlled. This point I have developed elsewhere (Stoddard, 1939):

> "It is certainly true that the talented inherit appropriate potentialities. The very fact that they are talented indicates, in a circular fashion, that they could have been talented. But this does not say that their parents were talented or that their children will be talented; nor does it indicate what proportion of their talent was ascribable to hereditary factors.
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> "Talents can ordinarily be hung on some framework as follows:
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> 1. Hereditary factors (those carried in the genes).
> 2. Constitutional factors (characterizing a specific individual, but not carried in genes and not a resultant from social pressures; *e. g.*, prenatal hemorrhages, endocrinal relationships).
> 3. Environmental factors (nutrition, stimulation, and education).
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> "I should regard intelligence as always an emergent from factors 1, 2, and 3 above, with full recognition that any one of these factors may vary from almost negligible to almost crucial strengths. Thus any gene-carried tendency toward microcephaly will result in feeble-mindedness regardless of the pressures of 2 and 3, but potential genius may be unlucky in 2 and pathologically depressed in 3 so as never to emerge in the individual. Even as we go toward the central tendencies of the distributions of these factors, we get results that are complex, unpredictable, and perhaps truly indeterminate.
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> "Of course neither feeble-mindedness nor genius can be controlled by paying attention only to the extremes of a population distribution. H. S. Jennings estimates that, if one were to assume that a single gene could carry a feeble-mindedness taint, there are thirty times as many individuals with

this gene as there are feeble-minded persons. Thus, even to a geneticist, the mass of feeble-minded, as well as of genius, arises out of the mass of the people. Nevertheless the segregation of the feeble-minded, the criminal, the insane, on a combination of genetic and social grounds, is one procedure on which we may all agree. It cannot, of itself, solve our great social problems down through the generations, but it is humane and helpful.

"Here again, Jennings, who is a distinguished Johns Hopkins zoologist, points to the intricate nature of the problem. To quote:

" 'Under certain conditions, a given set of genes may produce a defective individual; under other conditions, a normal one. The defectiveness of the individuals could therefore be prevented either by starting them with a different set of genes, or by changing the environment in which they develop. In the fruit fly, defectiveness of a certain gene produces under ordinary conditions an abnormal structure of the abdomen. But if the individuals are kept in a dry atmosphere, the abnormality does not appear. A change of environment has prevented the effects of a defective gene. . . .Essentially the same in general principle is the effect of education, training and the like, in changing the behavior that would without it result from the genes present in the individual. In some of these matters the effects of genes and environment are inextricably intermingled. Behavior is bound to be relative to environment; it cannot be dealt with as dependent on genes alone'. (Jennings, 1930)

"It may be said that until comparatively recently the euthenic approaches to these human problems seemed almost as hopeless as the genetic. There was much to justify the old Biblical morality about the sins of the fathers being passed on to the sons, generation after generation. The poor, the unlettered, the stupid, the starved remained in this primitive state so consistently, so downright wilfully, that it appeared plausible to postulate gene-carried factors, strong in their enduring ability to produce weaklings.

"But there have been straws in a counter-wind, and some of them have blown from over the rolling plains of Iowa." (p. 490-491)

Since the intelligence quotient (IQ) is a ratio, the fixity of this measure of brightness, could be established only in terms of a deceleration in mental age for some children (the dull), an acceleration in mental age for others (the bright), and a constant growth in mental age for still others (the average). Any attempt to associate a concept of fixity *in a ratio* to a set of gene-controlled factors will give us an idea of the complications involved. The mental age itself is derived from simple verbal tests in which

the chief factors are vocabulary, memory, reading comprehension, and problem solving—all measures which are derived not only from the quality and maturity of a child's nervous system but from cultural conditions. The crudeness of the particular measures can be sensed from a brief quotation (Stoddard, 1941):

> "In reality the IQ concept is not simple. Let us take a quick look at the numerator, or mental age, as determined, let us say, by the 1937 Stanford Revision. Since at this point no controversial issues are involved, time can be saved by a simple enumeration of the considerations given weight in the selection of test-items:
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> (1) increase in percentage passing with increase in chronological age
> (2) a correlation of the per cent passing an item with mental ages from the 1916 revision, or with a composite total score
> (3) ease of administration and scoring
> (4) appeal to the child
> (5) brevity
> (6) lack of sex imbalance.
>
> "All these variously employed and pragmatically weighted criteria were taken in conjunction with the tacit understanding that, for a sampling of American-born white children, each test and the composite should be related to pupil achievement in standard subject matter. They do not, however, throw much light on the meaning of intelligence, for we come out with the old tests familiar to Binet or to the Army workers: opposites, comprehension, analogies, vocabulary, similarities and differences, completions, absurdities, memorizing, etc." (p. 250-251)

II. Some Recent Studies

Typical of recent findings on the effect of nursery school attendance on the IQ is the work of Wellman (1940). For 652 children in attendance at the Iowa preschool laboratories, the mean initial IQ was 117, and the average gain during the year of preschool attendance was 7 points. The distribution of change is given below:

Points of Changes	Number of Children	Points of Changes	Number of Children
+43– +47	1	– 3– – 7	69
+38– +42	1	– 8– –12	31
+33– +37	9	–13– –17	12
+28– +32	19	–18– –22	6
+23– +27	24	–23– –27	7
+18– +22	55	–28– –32	0
+13– +17	72	–32– –37	1
+ 8– +12	108		
+ 3– + 7	124	Total	652
– 2– + 2	113		

For two years of attendance (based on 228 cases) the total net gain was 10 points; there was no further net gain for longer attendance.

In a follow-up study, Virginia Messenger compared nursery school and non-nursery school children in Iowa City and Stillwater, Oklahoma (Messenger, 1940). Altogether she had about 100 children available in the two situations. The study was carried on over a two-year period, with some interim measurements at the end of the first year. Many of the control children were on a nursery school waiting list; as a group they were comparable to the children entering nursery school, and their families were of the same socioeconomic status. The groups under comparison were fairly stable in both situations. In Iowa City, 20 out of 25 nursery school and 22 of 27 non-nursery school children remained in the study for a two-year period; in Stillwater, 16 of the 26 nursery school and 17 of the 27 non-nursery school children were available for the two-year period. At the beginning of the study, in the fall of 1937, IQ's for the Iowa City nursery school children ranged from 100 to 148, with a mean of 119; for the non-nursery school children, the range was from 100 to 154, with a mean of 116. In the initial testing at Stillwater, the nursery school children ranged in IQ from 95 to 154, with a mean of 122; the non-nursery school children ranged from IQ 97 to 142, with a mean of 118. These slight differences in initial ability were taken into account in the method of covariance which was employed in analyzing the data. Children under 3½ years of age were given the Kuhlmann Revision, and those above this age, the original Stanford Revision. The Stanford Revision was the final test used in all cases. All tests were given by experienced persons.

At the end of the first year of nursery school experience there was a gain of 10 points in the Iowa City situation, and of 7 points in Stillwater. During the second year, the nursery school children failed to add to their gains. At the end of the second year, the gain was 8 points in Iowa City; in Stillwater, the total two-year gain was 3 points. The entire picture for the non-nursery school group is a maintenance of the initial IQ status. The final differences between the nursery school children and non-nursery school children, both at Iowa City and Stillwater, are significant at the 1 per cent level of confidence.

In summing up the Iowa studies, together with reports from six other institutions, we have found that no nursery school re-

ported a loss on the retesting of children who had attended nursery schools for a period of from 6 months to 3 years. In some cases the gain was substantial; in others it was not statistically significant. To quote (Stoddard, 1940):

> "The general picture is one of gain. How can one explain this? There are two possible explanations. The first is that there exists a constant error in the standardization of the tests at these ages. Such an error would have to run through the 1916 Stanford Revision, the Kuhlmann Revision, the Minnesota preschool tests, the Merrill-Palmer tests and the 1937 Stanford Revision. If such an error existed, very likely it would have been found long ago, and appropriate adjustments made in the latest revisions. There is another alternate; namely, some nursery schools and comparable homes, of the high quality found when careful matching is done with nursery-school children, are really exerting a favorable effect upon mental development. In some cases such a group of homes may do about as well as the nursery school; in other situations, the nursery school is able to maintain a superiority. (In Iowa City, for example, the nursery-school children made their gains from fall to spring, that is, while attending the nursery school).
>
> "There is no mysterious advantage accruing to the nursery school as such. In homes that can provide their children with good play and reading facilities, with good opportunities for exploration, companionship and language, stimulation should equal that in the nursery school." (p. 230-231)

As we move up to older children in elementary schools there may be, under certain conditions, a similar gain; in any case, we always find a tremendous amount of variation in IQ on remeasurement. This is shown in the work of R. L. Thorndike (Thorndike, 1940). Below is tabulated the change in IQ on retesting over a period of several years. The IQ's are based on individual testing of 1,167 pupils in three well-known elementary schools in New York City.

Change in IQ	Number of Cases	Change in IQ	Number of Cases
50	2	0	176
45	3	− 5	166
40	7	−10	123
35	11	−15	80
30	15	−20	21
25	45	−25	8
20	60	−30	4
15	105	−35	6
10	154	−40	1
5	179	−45	1

In two of the schools mentioned above there was not a significant gain in IQ, but in one the mean gain on retesting was 6 points. On the whole, it will be seen from this tabulation that there is a change of 20 IQ points or more in 16 per cent of the cases.

In a study carried on by Harold M. Skeels and Marie Skodak, it was found that illegitimate children, if placed early in good foster homes, do very well mentally; in fact they exceed the average status of children for the country as a whole. These results are tabulated below:

IQ DISTRIBUTION FOR FOSTER CHILDREN IN CONTINUOUS STUDY*

IQ	First Test	Second Test	Third Test
155-159	0	0	1
150-154	1	1	0
145-149	0	2	2
140-144	5	1	3
135-139	6	3	3
130-134	6	9	3
125-129	20	7	17
120-124	19	11	8
115-119	20	11	21
110-114	17	31	25
105-109	13	21	21
100-104	12	20	15
95- 99	12	8	10
90- 94	3	9	4
85- 89	2	4	5
80- 84	3	1	1
Number	139	139	139
Mean	116	112	113
Median	116	111	112
Standard Deviation	14	13	14
Mean Age	2 yrs., 3 mos.	4 yrs., 4 mos.	7 yrs., 1 mo.

*Data from Skodak in 1942

It will be noted that there are no feeble-minded children in this group and very few children who could be classified as below average. On the other hand, there are several bright children and the whole picture of mental development is favorable.

Some years ago, under Station auspices, an experimental nursery school was set up in the Iowa Soldiers' Orphans' Home at Davenport. Two groups of preschool children were matched; one group was placed in the new school, while the other was allowed to carry on without scholastic attention (Skeels, 1938). The study shows that 3 children attended the preschool 104 weeks or

more; 18 children attended the preschool 52 to 103 weeks; 14 children attended the preschool 26 to 51 weeks; 24 children attended the preschool 1 to 25 weeks.

By the end of 4 months there was some deviation in the general IQ patterns. In the period of residence from 200 to 399 days, the preschool children gained 4 points in IQ, while the control group lost 1 point. For 400 or more days of residence, the preschool children gained 5 IQ points and the control group lost 5. For children under 80 IQ, preschool attendance did not make much difference. However, for those children whose IQ's were 80 or above, it was found that, with 400 days of residence, the preschool children maintained their status, while the control children lost 16 IQ points. A slight regressive tendency cannot explain the differential shift in the matched groups of children; the reliability of the tests was the same for both groups. Similarly, in vocabulary, general information, social competence, personal adjustment, and motor achievement, the experimental group tended to depart increasingly from the control, the departures being favorable to the preschool group.

Subsequently, Edna Lee Pegram (1940) in a master's thesis re-analyzed the Binet IQ changes in the Davenport orphanage children, utilizing the statistical methods of covariance. She arrived at these conclusions:

> "The control children who had been in residence 400 to 599 days and the preschool group of comparable residence were 4.9 IQ points apart in adjusted final mean in favor of the preschool children, and the control children who had been in residence over 600 days were 18.6 points lower than the preschool group with longest residence.
>
> "The results which were obtained in the reanalysis were in general trend similar to those obtained in the original study. In some comparisons the gains of the preschool group and the losses of the control group were larger when re-evaluated in terms of individuals."

III. Some Implications

We may wonder why there has been so much controversy about findings of this type. It would appear that there is no need for conflict. Hereditary factors are linked with cultural and social phenomena in a complex manner: as yet we know very little about the organic bridge. We know certainly that vocabulary is not inherited as such, while the quality of the growing nervous system is in part inherited. We have to differentiate between potentiality

and actual delivered mental power, for it is only the latter that can be measured by mental testing. We know too that the validity of the intelligence quotient does not depend upon its constancy. If children do go up and down in their relative mental ability, this is something a test should discover and measure. Clearly a test which failed to be responsive to such changes would not itself be a reliable or valid measure.

It is possible, too, that test makers and test publishers become conservative because they have a large vested interest in the enterprise. For a long time, test makers, buttressed by minor psychological studies, were convinced that only slight changes could occur in IQ's and that these changes were only a function of test unreliability. It may be said, however, that up to the time of the major Iowa studies the essential data were lacking; no one else, for example, had followed through in a longitudinal study of what happens to presumably low-grade children, prior to the time of the Skeels-Skodak study.

That there are more than theoretical outcomes to this type of work is indicated by the concern of state administrations for the welfare of dependent children. If one holds strongly to the hereditarian view, this will begin to show up in social administration. A comparison between the recommendations in two states, Massachusetts and Iowa, indicates this practical outcome. In Massachusetts:

> "It is also desirable to investigate thoroughly the hereditary and social background of the child. Special attention should be given to the search for evidence of mental disease, intellectual inadequacy, severe emotional instability, general economic incompetency and shiftlessness, pronounced alcoholism, epilepsy, diabetes, syphilis, hemophilia, exposure to tuberculosis and congenital abnormalities present in other members of the family but recessive in the child." (Spencer, p. 15, 1935).

In Iowa:

> "Our placement policy, then, is based on the belief that any child who is born without physical defects or abnormalities has every possibility of developing normally, provided he is given adequate physical care, sufficient mental stimulation, and the emotional security that comes from feeling that he belongs and matters to some one.
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> "Barring physical and organic defects a child in an adequate home and community will develop at least normal intelligence. The same child, placed in an inferior home and given few outside experiences, will probably not reach as high a level as he would under the more favorable circumstances.

"His traits of character and personality will be those called forth by the environment and by the example you set. If he has a bad temper, it will be because he has learned he can get what he wants by it, not because his great-uncle Ned on his mother's side had one. If he enjoys music, it will be because someone has made it a pleasurable experience for him, not because his grandmother played remarkably well on the parlor organ. You will be surprised to find your own family's traits, good and bad, appearing in a foster child.

"However, we have no intention of discounting the importance of heredity or of suggesting that all children are born with equal potentialities for growth, either mental or physical. We do believe that all children who are medically and physically normal have a sound heredity which will permit development within the normal range. We feel that this is true for either own or foster children, whether the parents are of so-called high or low social levels.

"Defective children are not placed in foster homes, no matter how excellent the social history may appear to be. For this reason it is safe to say that people adopting a child take no greater chances than those having their own children. In many ways they take less chances, since major defects such as birth injuries, physical abnormalities, and organic defects are ruled out." (Iowa Board of Control of State Institutions, 1941).

While the Massachusetts and Iowa policies outlined above are strongly opposed in principle, we need not conclude that, over the years, the two populations of children will differ from one another. I predict that a follow-up study, based on substantial samplings in these two states (preliminary evidence for the Iowa children has already been cited), will show the foster children to be above average in intelligence, character, and vocational success. Furthermore, the children of these children should assume cultural roles consistent with that of their parents or of their foster grandparents. The main divergence as between Massachusetts and Iowa children will not be found in a comparison of these samples; it will appear in the population of children rejected in Massachusetts (because of poor family history), but accepted in Iowa. These Iowa children should not depart significantly from the rest of the sampling. But illegitimate children in Massachusetts, who by the imputations *of heredity alone* are denied the privilege of foster care, will constitute an inferior crop; for reasons that may not be hereditary, they will seem to validate a hereditarian thesis. A child deprived of milk because his mother dislikes it will develop physical deficiencies that are not gene-carried.

In short, in this branch of science, as in any other, there is no need to fight, but only to find out. The time has come for a calm and concerted study of the problem of intelligence in all its practical, technical and social implications. I am happy to report that almost every child research center in the country is now proceeding along this line.

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Literature Cited

Iowa Board of Control of State Institutions. 1941. The Children's Division: Adopting a Child.

Jennings, H. S. 1930. The Biological Basis of Human Nature, W. W. Norton and Company, New York. p. 229.

Messenger, Virginia M. 1940. A Longitudinal Comparative Study of Nursery School and Non-Nursery School Children. University of Iowa, Unpublished Doctor's Dissertation. Pp. viii, 270 ms.

Pegram, Edna Lee. 1940. A Study of Environmental Stimulation Re-evaluated in Terms of Changes Made by Individuals. University of Iowa, Master's Thesis. Pp. 29 ms.

Skeels, Harold M., Updegraff, Ruth, Wellman, Beth L., and Williams, Harold M. 1938. A Study of Environmental Stimulation: An Orphanage Preschool Project. Univ. Iowa Stud., Stud. in Child Welfare. 15, No. 4, Pp. 175.

Spencer, Harvey. 1935. Adoption of Children. Bull. Mass. Dept. Ment. Dis. 19: 14-17.

Stoddard, George D. 1939. Some New Light on Human Intelligence. Calif. J. Secondary Educ. 14: 490-494.
1940. Intellectual Development of the Child: An Answer to the Critics of the Iowa Studies. School & Soc. 51: 529-536.
1941. On the Meaning of Intelligence. Psychol. Rev. 48: 250-260.

Thorndike, Robert L. 1940. Retest Changes in the IQ in Certain Superior Schools. The Thirty-Ninth Yearbook of the National Society for the Study of Education. Intelligence: Its Nature and Nurture. Part II. Original Studies and Experiments. Bloomington, Ill.: Public School Publishing Co. Pp. xviii, 409. (p. 351-361).

Wellman, Beth L. 1940. Iowa Studies on the Effects of Schooling. The Thirty-Ninth Yearbook of the National Society for the Study of Education. Intelligence: Its Nature and Nurture. Part II. Original Studies and Experiments. Bloomington, Ill.: Public School Publishing Co. Pp. xviii, 409. (p. 377-399)