*Heredity, Environment, and Educational Policy**

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Professor Cronbach accepts some but by no means all of Professor Jensen's empirical conclusions. In the following review he indicates some research that bears on their points of disagreement. Cronbach suggests that such distinctions as Jensen's dichotomy between "Level I" and "Level II" abilities over-simplify the many dimensions of individual differences, and he disagrees with the educational policy he feels is implied by Jensen's recommendations for education. Beyond this, Professor Cronbach poses a more basic question—"Intelligence for what?"—a question of the compatibility of current social aims of schooling with long range changes in our social and technological structure.

Professor Jensen is among the most capable of today's educational psychologists. His research is energetic and imaginative. In the present paper, an impressive example of his thoroughness, I am sure every reader has had my experience of encountering valuable information in areas where he thought himself *au courant*. Unfortunately, Dr. Jensen has girded himself for a holy war against "environmentalists," and his zeal leads him into over-statements and misstatements. Rather than list the points where Dr. Jensen and I agree, and those where we diverge, let me begin with an integrated statement of my view on the major themes.

I do not doubt that performance—intellectual, physical, or social—is developed from a genotypic, inherited base. The organism, as it evolves prenatally and post-

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natally, incorporates energy and information. What the person does with an experience, and what it does to him, depends on physical structures that were laid down during the previous years, or days, of his existence. Human development is a cumulative, active process of utilizing environmental inputs, not an unfolding of genetically given structures (Caspari, 1968).

The genetic populations we call races no doubt have different distributions of whatever genes influence psychological processes. We are in no position to guess, however, which pools are "inferior." Such a comparison is not meaningful, except in terms of the probability that the member of the group will be able to cope in some specific way with some specific challenge, after he has developed for a specified period in some specified environment.

Darwin's catchy phrase, "survival of the fittest," has misled hereditarians for a century. A genetic factor that has survival value in one environment is detrimental in another. Whatever the individual's genotype—barring gross defects—there are environments in which he will develop so as to function well and others in which he will develop poorly. For another genotype these effects may be reversed. There are many possible educational and developmental environments. At any age, the person is the phenotypic product of his genotype and his experiences to date; this phenotype may make him unready to profit adequately from the treatments now established for persons at that age. He might, however, be well equipped for some other series of educational procedures we could devise.

The phrase "improve the environment," born of the enthusiasm of the Social Darwinists, has misled environmentalists for two generations. Environments cannot be arrayed from good to bad, rich to poor. The highly stimulating environment that most of us think of as "rich" promotes optimal growth for some persons and may not be suitable for others. Environments can be varied along many dimensions, and the optimum with respect to each dimension depends on the person's phenotype at a given time. We think of the infant as deprived when he has nothing to gaze upon but a blank ceiling, but nothing is gained by making the environment so richly patterned that he cannot direct his attention. The pattern that holds attention varies with his age and his past experience (Fantz, 1961). An information-laden environment is rich, in some sense; but the right amount of redundancy and of detail depends on the learner's maturity. Conditions that make more information available may create an overload and so impair learning (Wicklegren and Cohen, 1962). How much stimulation is optimal, how much assistance, how much external monitoring and reinforcement, how much pressure for excellence, how much of the conceptual, and how much of the concrete—

these depend on the state of the individual and indirectly on his genotype. The optimum might be genetically determined; one can imagine, for example, metabolic differences that would make some children more impulsive than others and hence in need of a more calming environment. But the present state embraces biological structures, habits, attitudes, and meaning systems that are the residue of a long series of transactions. Some of them are transactions of genetically-determined structures with the environment, but more are transactions of the phenotype at a given moment with the environment of that moment.

There *has* been too much blithe optimism about our ability to improve the intellectual functioning of the slum child and the retarded child. Programs of compensatory education seem to have had no reliable and lasting effect. It may have been a sound political decision to launch massive compensatory programs, if only as a token of public concern. But far more was promised that we know how to deliver, and the hectic effort has drawn energies away from the needed basic, objective research. We need to clarify the aims of the programs and the hypotheses on which the experimental programs operate; this will move us beyond argument as to whether disadvantaged children can be helped, toward tested, workable plans (Hess & Bear, 1968).

There are two ways in which altered environment can be helpful, and these have been confused. One is to provide an optimal *maintenance* environment. That is how we promote the best growth of a plant; we select its planting spot, fertilizer, and so on to fit its requirements and maintain them throughout its life. This is likewise our way of overcoming the deficiency of the PKU child; we modify the environment by means of a special maintenance diet. The other is to provide a special environment for a brief *intervention* period, in the hope that the person will be brought to normal readiness for the conventional environment so that the special treatment can be discontinued. Remedial intervention can supply needed skills, alter habits, and overcome many physical defects. Which of the two lines of attack is suited for the problem of inaptitude for the existing educational environment is in part an empirical question.

But much of the decision rests on little-recognized policy issues. The intervention treatment intends that pupils placed in it shall ultimately complete the regular program of socialization and be indistinguishable as a group from those who did not need special treatment. I am sympathetic with the objection of Gordon and Wildenson, quoted by Jensen, that it is wrong-headed to try to make the slum child fit the middle-class stereotype, as child or adult. But education must have a clear idea of its intended product. If we are to bring these chil-

dren to a self-respecting adulthood, we must define for them a prospective role that has at least as great a value, to the individual and to society, as the middle-class model of industry, articulateness, social and cultural concern, and self-regulation. No one protesting against middle-classness has gone on to describe a possible, viable society in which large subsegments of society have radically different orientations and functions.

Today's discontent is a clamorous crisis that distracts us from a quieter, yet more ominous crisis—the bankruptcy of long-range social planning. Lacking visions of what society might become, we are training people for a *status quo* that is already vanishing. The schools are committed to training people for production, responsibility, creation, and leadership. The intervention programs seek to offer that way of life to all. But the fact is that automation, centralization, complexity, and abundance already have created a society where most people work less and less, while the manager and the professional work 50 to 70 hours per week. Huxley's beehive *World*, where a few highly educated persons, conditioned to self-denial, carry the productive burden, is already the American way of life. It is against that world—where the uptight Alphas are the slaves—that our brightest youth are protesting. The time has come for far less concern with the total man-years of education produced by our system, and for intensive and sober concern with the capital question, "Intelligence for what?"

It is hard to see how evidence on heritability provides a base for social policy. It is surely humane policy—without regard to questions of heritability—to facilitate birth control. It is inconceivable that we will scale welfare payments to penalize the child in a large family. I hope it is inconceivable that data on heredity—whether of the individual or the group—will persuade us that some children should be taught concepts, some taught rote verbal associations, and some taught how to change tires. Jensen seems to argue that the disadvantaged should be taught by rote methods. But the cut-and-dried answers that can be learned by rote are not the answers that one needs if he is to cope with a changing world and to live an appreciative and expressive life. The proper and necessary strategy is to find alternative means of bringing all children as far as we can toward self-fulfillment. Under our present conception of the good life we cannot set goals of entirely different character for different pupils. It is regrettable that Jensen says little about the policies he would expect us to follow if we accepted his empirical conclusions.

On the scientific side, it is vital to break away from such stereotyped terms as "intelligence" and "learning ability." There is a spectrum of performances,

ranging from crystallized, overlearned routines to fluid information-processing, often referred to as *g* (Cronbach, 1969). Fluid ability is measured in tests like the maze, the matrix or figure analogies, block design, and embedded figures; Jensen's "Level II" abilities involve it. Crystallized abilities are diverse and specific: spelling of *-gn* words, handling of subjunctive clauses, etc. In schools as they now are, success is best predicted by taking inventory of the relevant crystallized abilities with which the pupil starts the year. The verbal "intelligence" test succeeds as a predictor primarily because it reflects concrete achievements. A child with average fluid ability and low crystallized ability is likely to do poorly; we have never succeeded in devising a mass educational program in which such a child is likely to achieve average success. Analytic ability should be a resource on which education builds, and as of now it is not.

Because learning abilities are plural, they are not adequately conceptualized by Jensen's Level I-Level II system. Many processes contribute to effective learning; some are under conscious control or trainable, and some not. Which processes are required depends on what is being learned and what kind of instruction is employed. At times, striking differences in "ability" can be overcome very simply. Lower-class children are inferior in paired-associate learning, according to many studies—no doubt the task would have a fairly substantial heritability (H) index.[1] But simply coaching the lower-class children to make up "meaningful" associations for the word pairs brought them up to the middle-class rate of learning. This finding, coming from Jensen and Rohwer (1965), seems to contradict what Jensen says in this paper. It is at least possible that on the Glassman "Level II" task (recall of objects that can be conceptually clustered) the lower-class children could overtake the middles if made aware of the usefulness of analysis. Indeed—stop the presses!—a brand-new study seems to demonstrate cleanly that very simple instruction does overcome initial weakness on the Glassman task (Moely *et al.*, 1969). Capability is not at issue when a child does not call upon an ability he possesses.

As to heritability, there is less here than meets the eye. The term, though standard in genetics, is mischievous in public discussion, for it suggests to the unwary that it describes the limit to which environmental change *can be* influential. Not so. The H index describes a certain population, having a certain gene pool and having developed in a certain range of environments. (There are some

[1] Heritability is "a population statistic, describing the relative magnitude of the genetic component (or set of genetic components) in the population variance of the characteristic in question." (Jensen, p. 42). Cf. Jensen pp. 42-43 for a formal definition of the term—ed.

treacherous assumptions, well explained by Huntley, 1966; the most critical of these is that environments are distributed at random over the various genotypes. But even if one made alternative assumptions, the H value would surely remain above 0.50, and it is hard to see how moderate changes in the index would alter one's social policy.) A phenotype that is 100 percent heritable is not affected by the variations among existing environments. But introduce a "mutant" environment, and H will change; this is exactly what happened in the case of PKU—a direct genotype-phenotype link was broken. Likewise, note the report of Osborne and Gregor (1966) that a certain type of spatial test has an H value of 0.89, alongside the finding (Brinkmann, 1966) that as soon as someone made an effort to train for this kind of ability, scores were increased by large amounts. The influence of environment on a trait with high H is also dramatically apparent to the American Fulbrighter of average height who finds large numbers of today's Japanese youth towering over him. Pool the heights of 1940 Japanese and 1970 Japanese in a single calculation, and H will be quite a bit lower than it is in either group alone. In most cultures mental-test scores show similar generation-to-generation gains attributable to environment.

Attention should be directed to Jensen's remark that environment does not affect stature above the level that includes "minimal daily requirements of minerals, vitamins, and proteins" (p. 60). But that is the point. Nutritional science now tells us to include certain chemical substances in the diet; these give heredity something to work with. You do not increase stature two inches in a generation just by providing more and more rice. You do not increase mental ability just by providing more stimulation. Analytic research will in due time specify the needed ingredients in an educational diet.

The heritability index of 0.80 is impressive, but it is less discouraging than Jensen implies; environments of the sort we now have can improve ability, if we can choose the environment to fit the individual instead of relying on fortuitous correspondences. A brief technical sortie will put a new light on the index of 0.80. Think of an "expected IQ"—the hypothetical average IQ of a thousand persons having identical genes, who have been assigned at random to environments. Assume that all IQs are "true" scores, perfect measures. Starting with Jensen's H value, the correlation of individual IQ with expected IQ, over the population, is $(0.80)^{1/2}$. The standard error of estimate for individual IQ is approximately $[200(1—0.80)]^{1/2}$ or 6.3. Hence persons having the same genes are distributed over an IQ range of more than 25 points. With run-of-the-statistics cases and within the range of present environments, the individual who draws an

environment fitted to his genotype develops an IQ some 6 points better than the expected IQ for that genotype, and 12 or more points better than does one who is unlucky in the draw. If an effect of this size could be brought under control and applied population-wide, it would surely be economically and culturally beneficial.

It is necessary to deal summarily with a number of aspects of the paper. I have detected substantial distortions in Jensen's report of some research, and I must therefore warn the reader against accepting his summaries. Selective breeding studies are a case in point; Jensen says that "maze learning ability" can be bred (p. 30). But Anastasi, interpreting the same data, emphasizes that the superiority of the selected stock was *not* due to any superior "learning ability" (1958, p. 91). In fact, some of the studies were carried out precisely to demonstrate that breeding selects on particular temperamental traits that facilitate learning under one condition and impede it under others. The maze learning superiority of the Tryon strains was specific to one kind of maze under one kind of incentive. I particularly invite the reader's attention to John Paul Scott's eloquent attack on the idea of a general inherited learning ability (see Rosenblith and Allinsmith, 1966, pp. 54-57), since Jensen cites Scott as if Scott endorsed such an idea (p. 30).

Jensen is severe with studies that encourage the belief that the retarded and the disadvantaged can be helped. He is right to be critical of many of the studies that claim positive results. He could well have cited the Zigler-Butterfield (1968) demonstration that simple increases in motivation for the test account adequately for most reported before-and-after differences in preschool children. He could justly have been more severe in disposing of the Rosenthal-Jacobsen study—which purports to find evidence that giving the teacher mental-test data biases the teacher's handling of the pupil. He gives excellent advice (pp. 96 ff.) on the design of evaluative studies. So far, so good. But when he cites the Wheeler study of a gain in IQ following the opening of the Tennessee hills to the modern world, around 1930, he goes out of his way to say, "The decline in IQ from age 6 to age 16 was about the same in 1940 (from 103 to 80) as in 1930 (from 95 to 74)." More accurately, the 16-year-olds declined from 95 at age 6 in 1930 to 80 in 1940. These adolescents were dropping behind the norm group, most likely because their schooling was not up to that of the norm group. Jensen notes (p. 17) that Bloom summarizes age-to-age correlations of mental-test scores. It seems to me that, having introduced this source, Jensen was obligated to disclose that Bloom gives these data an interpretation opposite to Jensen's. Bloom sees the gains from year to year in test scores as random and unpredictable, hence due to external

events and not inheritance. (This is one of several alternative interpretations that fit the data.)

There is plentiful evidence that late blooming occurs, i.e., that some persons rise dramatically in their relative position even as late as adolescence. To label these important effects as a "regression" effect (p. 99) neither explains nor diminishes them. There is a trivial regression effect, arising from sheer error of measurement on the earlier test; but most reports on large IQ changes indicate that the relatively low initial status was confirmed by several tests. Whenever prediction is imperfect because something has really happened between pre-test and post-test, there is some tendency for regression toward the mean, but that is no more than a paraphrase of the obvious: likely events happen more often than rare events.

Jensen accuses writers on education of underplaying or denying the role of heredity. Some of this bias does exist, but Jensen is unfair. He does not quote the writers in psychology and education who do devote space to heredity. And he does not see that, in writings for educators, it is pointless to stress heredity. The educator's job is to work on the environment; teaching him about heredity can do no more than warn him not to expect easy victories. Heritability of individual differences is not his concern. Even if, after education, rankings in ability were to correlate *perfectly* with some measure on the pupil's ancestors, the educator ought to be providing the best possible instruction he can for every pupil he faces. To be sure, the educator who makes policy has to decide, in allocating resources, whether to put more resources on the laggards or on the leaders, but this decision has to be based on a judgment about utilities. The same considerations enter this judgment, whether we assume zero heritability or perfect heritability.

Let me be telegraphic in disposing of some further reservations. Jensen states that "while fluid intelligence attains its maximum level in the late teens and may even begin to decline gradually shortly thereafter, crystallized intelligence continues to increase gradually with the individual's learning and experience all the way up to old age" (p. 13). I do not believe there is adequate evidence to offer a conclusion as to the trend of fluid ability with age. On another point, Jensen protests that we should not "reify *g* [general intelligence] as an entity" (p. 9), but it seems to me that he does so, especially as he begins to insist that it is a "biological reality" (p. 19). Fluid ability is demonstrated through a complex set of acts: attending, analyzing, encoding, transforming, etc. The process is not unitary even though the processes tend to be acquired through the same activities

and, so, to be correlated. Later Jensen concurs in Zigler's criticism of "unbridled environmentalists" in whose writing "the concept of capacity is treated as a dirty word" (p. 29). But "capacity" *is* a dirty word, incapable of being given meaning and overwhelmingly capable of confusing discussions. It and all words like it refer to nothing but an expectancy under present circumstances. Intellectual capacity is continually being expanded by technological devices. Perhaps Zigler and Jensen will protest that the computer has not really increased man's mathematical capacity (though he now can solve in a day problems that once took a lifetime). Do they not admit that the long-ago invention of a spoken language increased "capacity"? And if so, where can they draw a line?

Jensen does not present clearly the important concepts of covariance and interaction (pp. 38 ff.). Covariance exists whenever persons of a certain genotype experience anything other than a random selection of the environments; nothing about matching "good" environment to "good" heredity is implied. Interaction exists when a difference in treatments produces one difference in outcomes in persons of one genotype, and some other differences in outcomes with a second genotype. Jensen offers as an example of interaction the possibility that genetically different individuals will gain different amounts of weight when given the same number of calories. "Their constitutions cause them to metabolize the same intake differently" (p. 40). This is a poor example. One might paraphrase to say that Jensen thinks children who inherit good *g* "metabolize exactly the same environmental intake quite differently"—but his calculations take *that* as a main effect of heredity.

Finally, Jensen denies that there is severe deprivation in the home of the slum child (p. 61). I am no authority in these matters, but I have heard descriptions—e.g., of small girls locked into an apartment to keep them from the dangers of the street—that seem to qualify as severe deprivation. Bronfenbrenner (1967) asserts that the presence of severe deprivation in Negro homes is "an unwelcome but nonetheless inexorable reality." In addition to "the indifference and hostility of the white community," he believes that the child-rearing practices of American Negroes are "stubborn obstacles to achieving quality and equality in education" (p. 910). Jensen himself defines brilliantly a large part of what a child must learn before he is ready to participate effectively in presentday schooling (p. 7); the Negro child is often not given that training (Hess & Shipman, 1965).

It will be apparent that Dr. Jensen and I agree on many fundamentals. With regard to policy, we both believe that every intervention program has to stand on its demonstrated merits. I would not ask that it "raise the IQ," but I would

ask that it raise readiness for schooling or promote intrinsically valuable achievement. We both urge that new kinds of instruction be devised to fit diverse patterns of ability. One goal of instruction, in my opinion, should be to develop fluid ability and conceptual learning ability. The undoubted significance of heredity must not deter researchers from trying to design procedures that will do this. Impossible things are happening every day.

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