INTELLIGENCE: The Hundred Years' War

The brain's most crucial output — intelligent thoughts and actions — is an elusive subject of study, yet critical policy decisions may depend on answers to the question of whether environment or heredity determines mental ability.

BY JOHN H. DOUGLAS

Should parents and educators attempt to teach "slow" children how to reason or should they restrict teaching to simpler tasks the children can easily master? Upon some tacit answer to this question ride most of the important decisions in education — from funding a massive "Head Start" program to "tracking" slow learners off to trade schools. Behind each answer lies a century of bitter fighting over what intelligence really is and whether it is determined primarily by heredity or experience. This academic Hundred Years' War (dating to publication of Francis Galton's *Hereditary Genius*, in 1869) may now have reached another turning point as both sides draw up new battle lines.

On the side of heredity, one man, Arthur R. Jensen of the University of California at Berkeley, continues to dominate the discussion. It is important to understand why this is so, for whatever acceptance the hereditarian argument currently enjoys is due largely to Jensen's own energy and personality. As one book reviewer put it, "No one who reads Jensen's papers can fail to recognize a facility with the literature which is shared by few of his critics." Right or wrong, Jensen's ideas are presented with a clarity and power seldom matched in academic writing, much less that of psychology.

This point is worth keeping in mind, for Jensen has now launched a new challenge to the IQ "environmentalists." Having decided that further analysis of the results of conventional IQ tests will contribute little more to a theory of general intelligence, he has developed a strictly mechanical test he hopes will point to the neurological processes underlying intelligence. The discovery of such processes, he hopes, may provide the basis for determining just *how* heredity affects intelligence.

Jensen's apparatus measures the reaction time (RT) required for a subject to remove his or her finger from a "home" button when one of several lights goes on and the movement time (MT) required to push another button to turn off the light. The basic idea behind this machine — that the faster a person can react the faster that person may be able to think — is hardly new. In 1901, four years before the invention of the first reliable IQ test, Columbia University psychologists tried to see if RT was related to college grades. The abject failure of their experiment (a slight negative correlation was found) cast a pall over the whole subject for a quarter century.

Later experiments with reaction times did establish a strong correlation between RT and IQ, but written tests had by then already become accepted as practical indicators of academic success. Now, says Jensen, the time has come to revive the technology as a research tool, but not as a reliable intelligence test. (Daily fluctuations of an individual's reaction time make RT a poor spot-check on IQ, although Jensen believes the fluctuations reflect actual variations in a person's mental alertness.)

Having used his apparatus on a variety of people, from institutionalized retardates to his own graduate students, Jensen believes he can offer the first tentative hints of a theory of intelligence based on neurological processes. He presented the theory in an invited address at the latest annual convention of the American Psychological Association (SN: 9/9/78, p. 181) and discussed it at length in an interview with SCIENCE NEWS.

Jensen found (as had others before him) that as the number of lights that might flash was increased, a subject's RT increased as the *logarithm* of the choices presented. Yet other researchers had also found that the time to retrieve an item from a memorized list varies *linearly* with the size of the list. Jensen concludes that the brain's "wiring" system must be different for the two processes, as if retrieving a letter in memory involves scanning one neurological pathway, while deciding on a response to a choice involves stimulating a hierarchy of neurological circuits.

In either case, speed of execution would depend on how quickly groups of neurons could fire, relax, and fire again. Such repeated on-off behavior is the basis of what Jensen calls his "neural oscillation model" of intelligence: The rapidity with which a person's brain cells can fire would determine reaction time and thinking speed and, in turn, be determined by heredity.

If the broad outlines of such a model were eventually confirmed — and Jensen is the first to admit the theory is neither proved nor completed — the argument over heredity versus environment would be moved to a whole new ground. Understanding more about the neurological basis of the thinking process would presumably ease the task of predicting how much a person's intelligence could be manipulated. Up to now the discussion was centered on estimates of "heritability" — a term technically applicable only to heredity within a single group, not to individuals or to various groups, such as different races.

What hereditarians (including Jensen) have argued is that if one knows how much of the difference of intelligence among members of one group is genetically determined, then one can probably *infer* how much it is between two groups. Moreover, they argue, one can *imply* how much of an individual's ability is genetically determined and how much is open to environmental influence. Over these two points has much scholarly debate and personal enmity been generated.

The two sides in the battle have almost no point in common, even if one adheres strictly to the technical definition of heritability: that portion of variance of a trait (here, intelligence) *in a single group* that is due to heredity, not environmental influence. When different researchers have reviewed the same data, their estimates of IQ heritability range from far below 50 percent to well above 80 percent.

But other researchers will not even go that far. In his book *The Science and Politics of IQ* (Halsted, 1974), Princeton psychologist Leon J. Kamin concludes that the data are so unreliable as to make any conclusion meaningless. Harvard astronomer David Layzer attacked the mathematical method that has been used to calculate heritability (SCIENCE, Vol. 183, No. 4131), charging that important terms are erroneously ignored in the fundamental equation. Widely cited data supposedly collected by the late Sir Cyril Burt have now been exposed as fraudulent by D.D. Dorfman, in the Sept. 29 SCIENCE. And some of Jensen's own data were called into question by University of Illinois psychologist Jerry Hirsch in the Winter 1975 EDUCATIONAL THEORY.

If one next tries to make inferences about individuals or different races from the heritability data, such as they are, a host of new troubles arises. Jensen, for example, argues in his book *Genetics and Education* (Harper & Row, 1973) that different sets of genes may control "Level I" rote learning abilities and "Level II" rea-

Jensen tests his own reaction time on apparatus he says can further IQ research.

soning abilities. Evolution, he says, may then cause one group of people to acquire more Level II genes. But Hirsch argues, in the Feb. 1970 SEMINARS IN PSYCHIATRY, that the number of genetic possibilities may be fantastically more complex: "There may be as many as 400,000 comparisons to be made between any two populations or races," he says.

Meanwhile, in what might be called the "environmentalist" camp, the search intensifies for processes that link intelligence to specific experiences. Again personalities play a crucial role, for many of the researchers involved are as interested in finding ways to *improve* the environment for learning as in finding out about it in the first place. Some studies involve working with groups of slum children to teach basic skills; others involve individual "cognitive therapy" on college freshmen to correct faulty reasoning habits. For obvious reasons, neither type of research is as likely to produce the voluminous statistics of the hereditarian camp.

Probably the best-known program aimed at improving the intelligence of slum children is the Milwaukee Project (SN: 7/10/76, p. 21). A final summary of the 11-year project is due around the end of the year and one of the principal researchers, Howard Garber, discussed the results with SCIENCE NEWS. The project started with 20 experimental families and 20 controls, and now about 15 families are left in each group. (Most of the drop-outs from the program simply moved away.) The experimental group of children received intensive preschool training outside the home, and both groups have been tested and observed until all subjects finished the fourth grade.

At six years of age, the IQ average of the experimental group was 120.7, compared to the national average of 100.0 and the control group average of 87.2. Now, says Garber, at the end of the fourth grade the experimentals average 105 and the controls 85. As for school performance, the experimentals entered school already reading at the first grade level, but their achievement slowly declined over the years until it now stands close to the average of whatever school they are in. The control group entered school at around the Milwaukee average in performance (below the national average) and now also reflect their school average.

Garber shows no hesitation in attributing a real change in learning ability to early environmental intervention. On IQ tests, he says, only one or two children from each group have scores that overlap those of the other group. He also bluntly lays the blame for the subsequent decline of performance on school environment. "The schools have not responded as well as they should have," he says.

But valuable lessons have nevertheless been learned. Says Garber: "We need to look more closely at family structure"; calling a child disadvantaged simple because his or her family is poor is not good enough. Such variables as family stability, mother's literacy, spacing of children in the family and the number of children still at home are also important.

Other community programs have also reported the sort of IQ gains seen in the Milwaukee Project, and these have sometimes been accompanied by commensurate school performance and lower incidence of behavioral problems (SN: 3/5/77, p. 151). The problem in drawing conclusions from such studies, of course, revolves about the question of how much one can infer from studies of children who must go home each evening to an unstimulating environment, possibly a hostile one. A partial answer may come from examination of children reared under much more controlled circumstances — those of an Israeli kibbutz. The children of European Jewish origin raised at home have an average IQ of 105; those of mid-Eastern Jewish origin average only 85. But when children of both groups are raised in a kibbutz nursery, they reportedly emerge with IQs averaging 115.

If careful training in their formative years can help children become "smarter," why can't people of all ages be taught to think? They can, says Arthur Whimbey, author of the book *Intelligence Can Be Taught* (Dutton, 1975), who argues that unless actual brain damage is present, faulty thinking patterns can be changed through "cognitive therapy." He begins with the therapist's traditional introspective approach, encouraging students to think aloud as they solve problems. Alternative approaches can then be pointed out explicitly, rather than telling a student simply that he got an answer "wrong."

What researchers who take this approach have found is that "educationally disadvantaged" children (not necessarily poor children) tend to adopt "one-shot thinking." If they can't find the solution to a problem right away, they guess the answer rather than search systematically for a solution. Such children seem less concerned about inconsistencies, approach problems passively rather than actively, respond in a stereotypic fashion, and (in Howard Garber's phrase) seem generally "insensitive to reinforcement." Carl Bereiter and Siegfried Engelmann of the University of Illinois have developed a preschool program designed to treat such deficiencies explicitly. Whimbey concentrates on college students who still have the same problems.

In an interview, Whimbey said he believes that cognitive therapy for older students should be integrated into regular courses, rather than presented in special "problem solving" classes. He has thus abandoned earlier work in university "skills centers" for current efforts to develop a remedial math course at City College of New York. The secret, he says, is to "have the students actively engaged in the presentation of the material." Only through give and take with each other, he believes, can poorer students learn the step-by-step problem-solving strategies used by better students.

But what is really going on? Does cognitive therapy at any age really improve "intelligence" or motivation or both? Or is the whole vision of intelligence as a single entity measured (albeit imperfectly) by IQ tests too simplistic? Harvard's Jerome Kagan says strongly that if children are motivated enough they will be able to work out their own cognitive strategies and that their success in doing so should be measured in terms of many separate mental abilities, including creativity (SN: 4/23/77, p. 268; 4/30/77, p. 284). From his point of view, the disadvantaged child is one who isn't motivated because experience doesn't lead him or her to *expect* to be able to solve a problem. "Tasks in school are all teachable if the children are motivated," Kagan told SCIENCE NEWS.

Still other researchers point again to poverty itself as the main cause of educational disadvantage. "Poverty breeds pathology," says University of Vermont psychologist George Albee. Poor children are raised with a sense of "powerlessness," which leads to all kinds of inappropriate responses to the world at large. "Only social change is the answer to our problem," he concludes bluntly.

If there is any point of agreement in all this argument, it would be the necessity of treating children more as individuals by offering a more diverse, personalized system of education. "Diversity rather than uniformity of approaches and aims would seem to be the key to making education rewarding for children of different patterns of ability." The quotation could come from any one of a dozen "environmentalist" researchers; in fact, it is part of the concluding statement of Arthur Jensen's most controversial paper on IQ and heredity. But just how one goes about tailoring education to meet the needs of all children depends on the yet-undecided issues of perhaps the most bitter conflict in the history of modern science: the battle over heredity and environment as determinants of intelligence. □