basis of his colleagues' observations on experimental cats, the term rebound aptly describes the reconstitution process, with stretched fibers shortening, thus diminishing the previously expanded ventricular space. Within a short time scar tissue forms, constructed from the glial cells that pack between the nerve cells. "The reconstitution of the mantle," report Epstein and his colleagues, "does not result in the reformation of lost elements, but rather in the formation of a glial scar and possibly a return to function of the remaining elements."

Lorber claims that his observations on the dramatic recovery of severely affected young children imply that "clinicians shouldn't give up in the face of an apparently hopeless case; a shunt operation at an early stage has a good chance of producing a normal individual." In mild cases, or ones that develop slowly and late, Lorber takes a different approach. Citing the example of the mathematics student and others like him, he proposes that perhaps the surgical knife should be stayed, "because a shunt operation makes an individual forever dependent on surgical care, and in any case many of these subjects can lead perfectly normal lives." The difference is between the acute and chronic conditions.

These statements are certain not to go unchallenged, partly because there is a multiplicity of opinions about appropriate treatment of hydrocephalus and partly because it is Lorber who is making them. Lorber is no stranger to controversy. Just a few years ago he caused a storm in the medical world by suggesting that it is not always medically right to administer extensive treatment to some infants with spina bifida. His experience had taught him that the consequences in some severe cases were simply not tolerable, either to the patient or to the immediate family. This position continues to be hotly debated, but Lorber's ideas are beginning to receive favorable consideration, particularly in the United Kingdom (see 12 September 1980, p. 1216).

What of the Lorber approach to hydrocephalus? "His attitude is based on many years of clinical experience," says Gerald Hochwald of New York University Medical Center, "and it contains a certain amount of value." Thomas Milhorat, a neurosurgeon at the Children's Hospital in Washington, D.C., voices strong support for Lorber, in spite of many differences of opinion. "I'm glad there's a John Lorber," says Milhorat; "he could be more moderate in the way he expresses things, but a moderate view would not emerge if someone were not speaking out strongly."

As to the question "Is your brain really necessary?" Lorber admits that it is only half serious. "You have to be dramatic in order to make people listen," concedes the tactician. Bower's answer to the tongue-in-cheek question is this: "Although Lorber's work doesn't demonstrate that we don't need a brain, it does show that the brain can work in conditions we would have thought impossible." Bower occasionally complains that Lorber's style is less scientific than it might be. He concedes, however, that "there are still many questions to be answered about the human brain, and it has to be admitted that Lorber's provocative approach does make you think about them."—ROGER LEWIN

Math and Sex: Are Girls Born with Less Ability?

A Johns Hopkins group says "probably." Others are not so sure

Throughout history there have been very few women mathematicians, and this trend continues today. For example, when Edith Luchins, a mathematician at Rensselaer Polytechnic Institute, and Abraham Luchins, a psychologist at the State University of New York at Albany, asked mathematicians to list five famous contemporary women mathematicians, many could not. When Ravenna Helson, a psychologist at the University of California at Berkeley, set out in the 1960's to study creative women mathematicians, she reported that there were so few that she did not have to sample them—she could study all of them.

Since creativity in mathematics seems to be a talent, like musical or artistic ability, the question has been, why are there so few outstanding women mathematicians? Some researchers have said the answer lies in nurture rather than nature. Mathematics is viewed as a "masculine" field of study, and girls are discouraged from developing their mathematical abilities. But Camilla Benbow and Julian Stanley of Johns Hopkins University question this theory. They have evidence that extraordinary mathematical talent may be less prevalent in girls than in boys. The differences between the abilities of girls and boys are so striking, they say, that it is hard to imagine that they are entirely due to socialization. By sticking their necks out in this way, Benbow and Stanley seem to be asking for an attack. But, says Stanley, "We want our data out in the public domain so they can't be ignored."

The data are from Stanley's mathematics talent searches, the Study of Mathematically Precocious Youth. From 1972 to 1979, Stanley and his associates conducted six talent searches, looking for 7th and 8th graders who scored in at least the upper 2 to 5 percent in standardized mathematics achievement tests, such as the Iowa Tests of Basic Skills. They found 10,000 children, 43 percent of whom were girls, and invited them to take the mathematics and verbal portions of the Scholastic Aptitude Tests (SAT). Those who did extremely well on the math portion were encouraged to take accelerated mathematics courses at Johns Hopkins. (Benbow and Stanley discuss their data on page 1262 of this issue.)

Stanley contends that the math SAT serves as an aptitude test when given to 7th and 8th graders because they have not been formally taught the principles that underlie the math problems. If they can do the problems, they must have unusual abilities.

In 1980, the Johns Hopkins group expanded its talent search and changed its eligibility criteria. Any 7th grader who scored in the 97th percentile or above in any standardized achievement test—whether the high score was in a math section or a verbal section or was a combined score—was invited to take the verbal and math SAT's. The researchers found 10,000 such students, making the total tested thus far 20,000.

Every year, the Johns Hopkins group has found that the girls and boys do equally well on the verbal SAT's but the boys do significantly better on the math SAT's. For example, more than twice as many boys as girls had math scores greater than 500. The greatest differences were between the top-scoring girls and boys. And in every talent

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search, the student with the highest math score was a boy.

"We began our talent searches to find gifted children. We had no expectations of sex differences," says Benbow. "We were surprised to see the differences in 1972 [the year of the first search] and we were really shocked when we saw them again in 1973." One possible explanation is that the talent search is somehow failing to reach the best girls. But, Benbow finds, "We have a better sample of girls than boys." Benbow also reports that girls who were invited to take the SAT's said they like math. "These are not girls with math anxiety," she says.

Jane Armstrong, of the Education Commission of the States, Denver, has results that, she thinks, confirm those of Benbow and Stanley. When the commission tested nearly 1800 high school seniors, the boys did significantly better than the girls in math, and this difference did not disappear when the number of math courses the students had taken was accounted for. The kinds of problems in which the boys excelled were those that tested reasoning, not computational or spatial visualization abilities. Armstrong says that the boys' higher scores seem to be due to a group of very bright boys who do so well that they pull up the boys' averages. "I definitely agree with Stanley that these are hard-core sex differences," she says. "A lot can be accounted for by socialization but it won't take care of all the differences."

Many take issue with this interpretation, of course. Mary Gray, a mathematician at American University in Washington, D.C., who is active in the Association for Women in Mathematics, says she cannot see on what basis Armstrong, Stanley, and Benbow draw their conclusions. Too little is known about the development of mathematical reasoning ability and how to test for it to jump to the conclusion that these sex differences are genetically based rather than solely a result of social factors.

Elizabeth Fennema, a member of the education department at the University of Wisconsin in Madison, says, "I think they [the Johns Hopkins group] are on darned shaky ground when they draw conclusions about genetic differences." She and Julia Sherman, a psychologist at the University of Wisconsin, find no differences in boys' and girls' spatial visualization abilities. Spatial visualization, which includes picturing how objects will look after they are rotated or folded, is widely assumed to be correlated with mathematical reasoning ability—although some mathematicians, including Gray, disagree.

At Johns Hopkins, the researchers believe that social factors probably play some role in causing the talented girls to do less well on the math SAT's than the talented boys. Therefore, Lynn Fox, Diane Tobin, and Linda Brody of Johns Hopkins are looking into the backgrounds and upbringing of these students, asking such things as what toys the children played with, whether the mother or father helped them with their math homework, and what aspirations the parents have for their children. In addition, they want to know whether the talented boys and girls differ in test-taking strategies. Maybe the girls are less willing to guess at answers, for example. Yet, says Tobin, it is not clear whether they are asking the right questions or, even if they do see sex-related differences in the children's upbringing and behavior, what these differences mean.

Although fewer girls than boys qualify for the accelerated math courses at Johns Hopkins, even fewer girls enroll in them—and those who do tend to drop out. When Fox questioned the talented girls, she found that many declined to participate in the accelerated classes because they were afraid of being labeled "different" by their friends. They also said that the accelerated classes were dull and that the talented boys were "little creeps."

Fox, concerned that social factors may at the very least be preventing the talented girls from reaching their potential, tried to make the accelerated classes more appealing to girls. She organized an all-girl accelerated class taught by a woman and featuring talks by scientists on research involving mathematics and bearing on both social and theoretical problems.

At first, the results seemed encouraging. More girls who were invited participated and fewer dropped out than in the mixed-sex classes. But in the long run the all-girl class has been disappointing. The girls, now sophomores in college, are doing no better in math and are taking no more math courses than the control group of girls who were not invited to participate in the special class. "The girls may need constant intervention," Tobin speculates.

Although Stanley, Benbow, Tobin, and others at Johns Hopkins tend to think that the differences in ability they see in the very talented students also extend, in a less dramatic form, to average students, others are not so sure. "What their study means for women at large is very problematical," says Fennema. "There is no way that their data can explain why women do not take math in college and do not go into math and science professions."

"As a woman, I don't want to think there is something about us that does not allow us to do math like the men do."

Certainly, says Patricia Casserly of the Educational Testing Service in Princeton, New Jersey, the Johns Hopkins results do not mean that high school girls cannot score as well in math achievement tests as the boys. Although high school girls generally score lower than boys, there are some schools where the two sexes consistently score equally well. Casserly has studied 20 such schools in the past 8 years. These are a diverse group of public schools drawing students of widely differing backgrounds. Nonetheless, they share common features. For example, the teachers have science, math, or engineering backgrounds rather than backgrounds in education and they communicate a love of and enthusiasm for mathematics. Bright students are grouped together in math classes, the teachers place more than usual emphasis on reasoning, and the teachers counsel students.

But if there are genetically based differences in mathematical abilities between males and females, it may be more difficult for women to study math and it may be one reason why so few women receive Ph.D.'s in math. Benbow believes that socialization is a factor in women's math achievement but that it is not the only factor. Women, she says, would be better off accepting their differences and working to encourage girls to achieve as much as they can than to constantly blame their lesser achievements in mathematics solely on social factors. Tobin agrees with Benbow but admits that she finds such a view somewhat disconcerting. "As a woman, I don't want to think there is something about us that does not allow us to do math like the men do," she says.

—GINA BARI KOLATA