LETTER

Reply to Crespi: Gender similarities, culture, and mathematics performance

We appreciate Crespi's comments (1) regarding gender similarities in developmental dyscalculia and the biological basis of mathematics performance. We did not include developmental dyscalculia in our review (2), which focused on whether there are gender differences in average mathematics performance and at the level of the talented and mathematically gifted. Crespi's points (*i*) provide additional data supporting our conclusion of gender similarities in math performance and (*ii*) agree with our questioning of the validity of the Greater Male Variability Hypothesis. If males display greater variance in mathematical performance, then there should be an excess of males not only at the high end of the distribution, but also at the low end. Yet Crespi concludes that there is no gender difference at the low end of the distribution.

Crespi goes on to argue that we conflated biology with determinism in our statements about cultural factors contributing to the gender difference in math performance. That was not our intent. Our argument was that cultural factors, not immutable biological factors, underlie the gender difference in mathematics performance. Of course, not all biological factors are immutable. And, certainly, biology is necessary for the development of mathematical skills; one needs a brain to learn math. Mathematical skills may show substantial heritability, as Crespi claims, but that does not mean that the gender difference is heritable or based on "hard wiring" of the brain. Modern neuroscientists, in fact, emphasize the phenomenal plasticity of the human brain, which allows it to be shaped by experience (3, 4). Even if gender differences have been found in the effect on math performance of transcranial magnetic stimulation of a brain region, (*i*) this finding has not been replicated to our knowledge and (*ii*) the effect may not be due to hard wiring of the brain, but rather to different experiences for males and females that result in slightly different brain functioning. Popular authors such as Gurian (5) make this error of inference, saying that girls and boys approach mathematics problems differently because of brain differences, not environmental forces, not understanding that different environmental experiences are registered precisely in the brain. Research, for example, shows that both teachers and parents, perhaps unintentionally, encourage girls and boys to use different strategies in solving mathematics problems (6).

Crespi may be right that understanding the genetic and neurodevelopmental underpinnings of math performance may be useful in the design of optimal environments for math learning, but there is no evidence that one environment will be optimal for all girls and another, different one, will be optimal for all boys.

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