Creativity and Manic Depressive Illness

We were pleased to see the generally well-done Research News article "Manic depression and creativity," by Constance Holden (15 Aug., p. 725), but we would like to clarify several points about our own and others' research.

1) Creativity of our research subjects was not based solely on "participation in the arts and crafts," but rather on a wide range of vocational and avocational activities assessed over each subject's adult lifetime. We developed a new tool, *The Lifetime Creativity Scales*, for just this purpose, so that we and other researchers could study real-life creativity in general populations, rather than being limited only to activities that are socially recognized as creative or are in particular fields that have traditionally been regarded as creative.

2) Our results suggest that, on the average, it may be the *better-functioning* relatives of manic depressives, and not manic depressives themselves, who carry a particular advantage for creativity. This is an important distinction for at least two reasons. First, it suggests that, in our research sample at least, certain traits associated with liability for bipolar disorder, rather than psychopathology or suffering per se, are conducive to heightened creativity. Second, it suggests that our findings may be of practical relevance, not only to the 1% or so of the population who may develop frank bipolar disorder, but also to the much larger proportion who may carry a genetic liability for the disorder.

3) We *do* have definite hypotheses—genetic and environmental—as to why there may be a link between creativity and liability for bipolar disorder. We have hypothesized that enhanced creativity may reflect a "compensatory advantage" within the families of manic depressives, roughly analogous to the increased resistance to malaria in individuals heterozygous for the gene for sickle cell anemia. We also hypothesize that environmental influences interact with genetic liability for bipolar disorder, such that environmental intervention may not only help to prevent the development of psychopathology but also enable individuals to realize unusually great creative potential.

4) It is misleading to state that "modern science has taken next to no interest in exploring the connection" between creativity and psychopathology. Rather, although there has been a good deal of interest in this possibility, it has until recently usually taken the form of theoretical speculation rather than rigorous empirical research. An important reason for the relative paucity of such research has been the scarcity of funds to support it. We hope that Holden's article will encourage other agencies to join the small number of sources, such as the Spencer and Boston Mental Health foundations, now supporting this pathbreaking research.

DENNIS K. KINNEY
RUTH L. RICHARDS
Mailman Research Center, McLean Hospital,
and *Department of Psychiatry,*
Harvard Medical School,
Belmont, MA 02178

American Education

Mark Crawford's briefing "Education statistics found to be inadequate" (News & Comment, 10 Oct., p. 147) is, for the most part, a commendable report on the recent National Academy of Sciences study of the Center for Statistics. Crawford has brought to the attention of *Science* readers the results of too many years of neglect of the Center that officials of the Department of Education have been pointing out now for some time and that were compellingly documented by the Academy.

The briefing incorrectly states as my own view that "more money is not needed at present." In fact, and on this point I differ with the members of the Academy's panel, I believe that improvements in quality and timeliness are not likely to find support alone but must accompany an expansion of the statistical program itself and that does require more money.

The Executive Branch, Congress, states, educational institutions, and decision-makers in them need a more complete reporting of the condition and progress of American education, one that fills long-standing data gaps about teachers, finance, student achievement, and other policy issues. They should expect, and demand, that such data meet the qualitative standards set out by the Academy.

EMERSON J. ELLIOTT
Center for Statistics,
Department of Education,
Washington, DC 20208

AIDS and the Physician

David Jenness points out in his editorial "Scientists' roles in AIDS control" (22 Aug., p. 825) that the principal tools available to stop the spread of AIDS over the next few years will be information, education, and prevention campaigns. To be effective, these campaigns will require the dedicated efforts of social scientists, public health workers,

and medical researchers. However, another group of individuals is essential to the success of any public education effort dealing with a health issue—physicians practicing in metropolitan and rural communities across the nation.

At least three levels of commitment and communication are needed from physicians if the spread of AIDS and infection by the virus human immunodeficiency (HIV) are to be curtailed. First is the care required by patients with AIDS and by the families and friends of the patients. Second is the need for counseling of sexually active persons about preventive measures for sexually transmitted diseases and about the meaning and significance of infection by the HIV virus. Third is communication with the public at large about the medical and psychosocial aspects of AIDS and about the preventive measures necessary to reduce transmission of the HIV virus. It is at this level that a collaborative effort of physicians, social scientists, and public health workers is most needed. The American Medical Association is preparing, collecting, publishing, and distributing a wide variety of articles and monographs on AIDS and HIV transmission.

The AMA has also initiated a program to help and encourage physicians to become public spokespersons on the health care and societal issues associated with AIDS. This program includes establishing a speakers bureau of concerned physicians in state and county medical societies across the country. Collaboration in this effort by social science and public health groups is encouraged and welcomed by the AMA. Stemming the spread of AIDS and the HIV virus requires the resources of all of us.

WILLIAM R. HENDEE
M. ROY SCHWARZ
American Medical Association, 535 North Dearborn Street, Chicago, IL 60610

Multivariate Analysis

Part of the description of multivariate statistical methods by Peter C. Jurs in his article "Pattern recognition used to investigate multivariate data in analytical chemistry" (6 June, p. 1219) may inadvertently encourage inappropriate use of these methods. In the social sciences, where analyses to discriminate between groups have long been familiar, the lack of statistical sophistication of some investigations has led to dubious procedures that exploit random variation in the data. Chemists should be wary of repeating the error.

Discriminant studies, like multiple regression studies in general, are often pursued in an exploratory way and involve a large number of variables. A common pitfall is underestimating the probability of having arrived at seemingly impressive results solely by chance variation in the sample. Jurs has discussed this issue elsewhere (*1*). He points out in his *Science* article that exploratory discriminant analysis may be of little use unless the number of cases is several times greater than the number of variables, and that consequently it is often necessary to reduce the set of variables considerably by some "objective means." It is in the reduction that inadvertent exploitation of random variation may occur.

One of the major examples described in the article is an attempt to discriminate between two groups of 24 people for which 214 variables were measured. Objective means of reducing this set would be to select a few variables a priori, on the basis of a theoretical model or empirical results from previous studies, or to identify summary composites on the basis of a factor analysis, as Jurs has done in another study (*2*). In this example, however, the variables were selected a posteriori on the grounds of how well