When the University of California at Berkeley announced a project that asks incoming freshmen for the fall of 2010 to voluntarily submit their DNA for genetic testing, the plan quickly garnered national attention and generated heated debate. *The New York Times* carried its account in the May 19 issue­­—and within 24 hours the Center for Genetics and Society (on the West Coast) and the Council for Responsible Genetics (on the East Coast) called for a halt to the project.

One of the plan's sponsors, Mark Schlissel, Berkeley's dean of biological sciences, said he has been surprised by the furor and negative response from some quarters. Schlissel noted that the project had been cleared by the campus institutional review board that assesses risks and benefits to human subjects. After having their DNA analyzed, the incoming students would be given information about three areas of their genetic code that would inform them of their tolerance for alcohol, lactose (in milk), and possible need for folic acid (in leafy greens). The Web site announcing the project proudly proclaimed that "the information Berkeley students will glean from their genetic analysis can only lead to positive outcomes." (According to a recent article at Genome Web, both Stanford and Duke Universities are considering even larger projects with their students.)

Why has this seemingly benign educational and health project become controversial? The answer lies in a better understanding of the social context in which human genetic research is carried out. Direct-to-consumer genetic testing, to which this project is tied, was begun on hotly contested terrain. In the early years, protocols required a genetic counselor or a physician to interpret test results for patients and consumers. In recent years, ancestry testing companies have proliferated, unregulated, often providing wildly conflicting answers about "origins". When it comes to informing subjects about their potential health risks, the terrain is even more controversial. The California Department of Public Health actually stepped in to caution companies to stop short of even seeming to provide implicit medical analysis and advice. Bear in mind that those cases involved consumers who themselves initiated and then voluntarily submitted their DNA samples.

The House of Representatives Energy and Commerce Committee is investigating the claims made by consumer-genetic-testing companies. And as the Council for Responsible Genetics put it in a letter to Berkeley administrators:

"The American Medical Association, the American Society for Human Genetics, and the American Clinical Laboratory Association have all issued strong statements against direct-to-consumer genetic testing and recommended that a genetics expert be involved in ordering and interpreting genetic tests, consumers be made fully aware of the capabilities of genetic tests, the scientific evidence on which tests are based be available and stated so that the consumer can understand it, the laboratories conducting the tests be accredited, and consumers be made aware of privacy issues associated with genetic testing."

The UC Berkeley DNA project is being promoted with the explicit goal of introducing students to a future of personalized medicine, via the analysis of an individual's genes. But one of the most important things we have learned in the last two decades of human molecular genetics is that there is high variability in the clinical expression of even single genes. In lay terms, this means that two people with the same genetic structure can and often do have very different manifestations of the phenomenon under investigation. Two subjects with the identical delta F508 gene for cystic fibrosis can have remarkably different outcomes—one with relatively mild symptoms, the other with debilitating lung problems requiring continuous medical treatment. The same is true for sickle-cell anemia and many other genetic conditions. That means that there are important environmental triggers that can cause the gene to express itself in different ways.

Two people with the same genetic variant can and do have different triggers that shape differential expressions as phenotype. Even a sophisticated and well-read human subject getting the results of a scientific project from a university-approved lab is likely to treat this information not as a complex interactive feedback loop but as a personalized finding of a level of susceptibility. The person could well be motivated to act upon this apparently precise information by reorienting his or her behavior in a certain direction. A planned public lecture by research scientists to explain the findings is hardly a substitute for personalized interpretation from a clinician or a genetic counselor.

Another problem with the project is that it violates the well-established principle of protecting human subjects, namely, by ignoring or trivializing the power/status relationship between the subject of the research and those in charge of the project. More than a half-century of case law has drawn attention to extreme cases, such as research on imprisoned subjects and prisoners of war. But the continuum is long, and far more subtle cases are also covered, as when employers ask employees or lab assistants to participate as research subjects; when professors ask their students to participate; or when doctors ask their patients to enroll in studies with which the doctors are associated or from which they receive compensation. When refusal to participate can have the effect of an increased sense of vulnerability, institutional review boards have routinely flashed a red light.

The Berkeley project falls into this category. Not only are incoming students being asked by faculty members and administrators to participate, but a decision to decline also means that they will not be on the same proverbial page as their fellow students who do participate. In this situation, there is subtle social coercion in the underlying scaffolding of the decision. Moreover, just to underscore the links, the announcement informs students that, among "alternatives to participation," they are free to seek out similar information from private companies such as 23andMe.

Then there is yet another problem. The project announcement acknowledges a 1-percent error rate for such tests. Assuming that 3,000 of the 5,500 incoming students take the test (x 3 would be 9,000 tests), 90 tests would be incorrect, but because data will be anonymized (only the individual tested will have the matching bar code) no one will know whose results are erroneous, not even the lab technicians. One of the ethical dilemmas of research on human subjects is that while anonymization of samples prevents breaches of privacy or unauthorized use of the data, it also prevents follow-up counseling or notification.

There is a strong tendency for molecular geneticists to reduce attitudes toward the world of science into the binary of "for" or "against." That leaves little room for nuanced, engaged critiques.

In the late 1990s, I served as a member of the National Advisory Council to the Human Genome Project and later chaired its Ethical, Legal, and Social Issues Advisory Group. In that capacity, I attended a large national conference in Washington of scientists and policy makers. At one point, a scientist brought the house down with laughter and prolonged applause when he said from the podium something like this: By 2010, when all the Ethical, Legal, and Social Issues people have gotten out of our way, we will have better understood and solved a host of human genetic disorders, provided therapies for them, and harmed no human subjects along the way.

In the early 1990s, articles filled the scientific literature and spilled into the mass media about the discovery of "the gay gene" and then "the obesity gene" and then "the violence gene." In all those cases, pundits predicted the application of this new knowledge to daily life. There was deafening silence from leading geneticists, who should have cautioned the public that these discoveries wouldn't simply and quickly revolutionize policy and practices regarding obesity or violent crimes. Other members of the academic community did counsel caution and suggested integrated approaches to better understand complex behavioral outcomes. It is now common knowledge that reductionist notions of "the gene for" this or that have been almost completely abandoned in favor of a more modest, nuanced understanding of emerging fields of epigenetics and proteomics.

A recent well-publicized ruling on the use of genetic tests highlights the minefields of ethical and legal issues in how genetic tests are used and reported. The Havasupai Indians of Arizona have just received a favorable settlement in their suit against Arizona State University. Scientists had given tribal members the impression that their genetic research centered on susceptibility to diabetes. While some subjects had signed a rather vague consent form that included language covering "other behavioral problems"—the overwhelming majority believed that the work on their stored blood samples would help in their struggles with widespread diabetes. The institutional review board of Arizona State University had approved the research project—even though the researchers were looking at genetic susceptibility for schizophrenia and working on genetic information about migration patterns.

I do not mean to imply that the current Berkeley project has any semblance of a relationship to the Havasupai story on matters of consent, save for where I began: The social context of research on people is delicate. As Schlissel, the Berkeley dean, has acknowledged, we need a full-scale exploration of the scientific and social issues surrounding such research, but we need it long before gene tests are offered to students.

Might a Berkeley freshman get a false understanding of his or her reaction to alcohol, or intolerance for milk, or need for kale? Well, possibly, but that is not the main point. Rather, the substantial intellectual risk is that they'll be institutionally introduced into misunderstanding the precision, interpretation, and historically problematic execution of such research, and the subtle, unexamined undercurrent of coercion in their participation. Until students have a firm comprehension of all those aspects, such projects shouldn't be planned.

Stanford, Duke, and other universities, take note: There are far more sensible and effective ways of introducing incoming students to their classmates and to their college.

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