Problem sets and other deterrents for women

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James Trefil and Sarah Swartz, authors of "Problems with problem sets" (PHYSICS TODAY, November 2011, page 49), cite the approximately equal numbers of men and women in high school physics courses and the far fewer women than men who earn physics bachelor's degrees as evidence that "the root of the problem in physics lies in the undergraduate experience." I don't think that's at all clear from the evidence cited. The authors' interpretation assumes that equal numbers of women and men in high school courses indicate equal interests in pursuing physics degrees. That assumption is unjustified.

Students enroll in high school physics for a variety of reasons. In Texas, where I teach, physics is required for the courses of study followed by a large majority of Texas students. Even when physics courses are optional, as is the case with our second-year courses, students often sign up because they need them to get into a competitive college or because they want to study medicine, architecture, engineering, or some other major that requires physics and they want to start learning it in high school. The presence of those students may well mask a gender imbalance that already exists in high school or at the start of undergraduate studies. Indeed, according to the American Institute of Physics research that Trefil and Swartz cite, only 32% of high school students who sign up for AP physics are women. Thus much of the disparity is already evident before the physics students have opened their first college physics text.

I teach my students that in order to solve a problem, you first must clearly identify it. In that spirit, I think more research is needed before we lay the blame on "the undergraduate experience."

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Well done to James Trefil and Sarah Swartz for raising the issue of the effect of problem wording and context on the performance of women in physics.

Laura McCullough (http://uwstout.academia.edu/LauraMcCullough) has done some interesting work in this area, too, including reworking questions on the force-concept inventory to bias them toward women. Women tend to prefer contexts that are beneficial to society, or at least nondestructive. In a high school textbook I coauthored, I modified the traditional plane-drops-a-bomb question to a plane drops a food-aid parcel. Small change, big effect. Furthermore, in my work with students from disadvantaged backgrounds, I find that issues that tend to affect predominantly women from advantaged communities also affect men from disadvantaged backgrounds. Presumably, that is at least in part because many of these students, male and female, lack exposure to the contexts and general knowledge assumed by textbook authors and instructors.

Swartz asked, "What is a banked curve?" I once wrote a question about a boy kicking a soccer ball into a pond for a class of South African students for whom English was the second language. Some students asked me, "What is a pond?" In South Africa, questions involving snow and icy roads are unimaginable. For children from deep rural areas, bungee jumping, spacecraft, and slam dunks are incomprehensible.

So-called context-rich questions often require students to read long sentences containing a great deal of explanation of the context. For speakers of English as a second language, such questions are harder than questions that are short, direct, and simply written. Students may fail because they cannot extract the physics from the lengthy question statement. In a physics course I once taught for Zulu-speaking students, I devoted a whole class session to helping them do that extraction, with the assistance of an applied linguist. I am convinced that problem wording and context have a great influence on nontraditional students' willingness and ability to do physics.

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James Trefil and Sarah Swartz raise an important issue in physics education—the underrepresentation of women in physics. They particularly focus on the nonproportional decline of women—as compared with men—between high school physics and an undergraduate physics degree. In their article, Trefil and Swartz present important data clearly showing that the percentage of women in physics is particularly low; the authors argue that there is no obvious reason why physics should do worse than other fields, such as mathematics. They deduce from the data that the cause of the decline is women's undergraduate physics experience. Although the authors do not claim to have found a full explanation as to why the percentage of women declines so much, they hypothesize that gender bias in textbook problems might be a contributor—that is, that textbook problems assume prior knowledge more likely to be possessed by male than female students.

Unfortunately, the authors do not offer any research or data that support their hypothesis. That might have been fine for an opinion piece, but we are disappointed to see such extensive speculation in a PHYSICS TODAY article. Physics education research is not different from other research: Claims must be backed up with data and studies. Instead, Trefil and Swartz offer examples from unnamed sources—five from a "popular university physics text" and two from a "popular calculus textbook"—that are supposed to support their claims. Unfortunately, no study results are offered that would illuminate whether there are actually any gender differences in understand-

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