

The Myth of Gender Neutrality

Melissa Dancy

Western Carolina University, Cullowhee NC

dancy@email.wcu.edu

It is well known that women are underrepresented in physics. The prevailing view is that there is a “leaky pipeline” of female physicists which has led to a focus on providing mentors and increasing the opportunity for girls to experience science. The assumption is that the numbers of women in physics can be increased by integrating women into the existing structure. Although it may seem reasonable, women are making only small gains in participation levels [1]. In this paper, I explore the idea that there is no leaky pipeline. Rather, the environment is fundamentally “male” and women will never be equally represented until fundamental changes are made in both our educational system and in the cultural assumptions of our physics community.

In the *Structure of Scientific Revolutions* [2], Kuhn describes and asserts that there are paradigms under which a scientific community operates. Someone working within the paradigm makes certain assumptions and fails to question those basic assumptions to the point that he or she is not even aware they exist. Although many views within the paradigm may not hold under scrutiny, the paradigm still holds and is very difficult to change as the prevailing forces will work to maintain it. The targeted poster session, *Considering Data from a Broad Perspective: What About Including Social and Economic Factors in Physics Education Research?*, which included this paper, was in many ways, an attempt to examine some of our community's basic assumptions in an effort to see more clearly the paradigms in which we operate.

I chose to tackle the issue of gender. My goal was not to fully answer the question of why there is gender bias in the educational system, nor was it to offer a solution to the problem. Rather, I wanted to propose that the issue is much deeper than most assume and to provide some seeds of thought.

What gender bias? I don't discriminate in my classroom and neither do my colleagues.

While the vast majority of teachers believe in equality and do not intentionally discriminate in their classroom, our system

is still fundamentally biased. I'll illustrate this with some examples from assessment that show that gender bias can and does exist even when something appears on the surface to be gender neutral.

The SAT is designed for colleges “to help estimate how well students are likely to do at its school” [3]. Women earn higher grades in college [4]. If the test was achieving its goals, women would have higher SAT scores. But men get higher scores on both the verbal and the mathematical sections. There is an obvious bias here since the test clearly does not fulfill its purpose with respect to the sexes. So what is going on?

Before 1972, women outscored men on the verbal section of the SAT. In 1972 questions were added referring to science, business, and practical affairs. Questions referring to human relations, arts, and humanities were eliminated. According to ETS they did this to create “a better balance for the scores between the sexes.” [5] Since then, men have scored higher than women. It is interesting that the gender gap is so easily manipulated by the test makers. After a careful study of the SAT, Rosser [5] stated that “Test makers could easily construct a test on which one sex nationally scored as much as 50 points better than the other... This change would be accomplished solely with items that could pass through ETS's current screening process.” The

framing of the questions does matter and can favor one gender of the other.

There is also evidence [6] that girls are less likely to take risks and guess at the right answer. Since the SAT penalizes for incorrect guesses, girls leave more questions blank. Also it appears that timed tests and multiple-choice tests favor boys. So although the SAT may look gender neutral on first glance, it may test for gender as much as it does for aptitude.

Laura McCullough [7] has found similar context dependency with the Force Concept Inventory. She created an alternate version of the FCI in which the situation of the questions was altered to be more feminine. For example, the war-like image of a bowling ball falling from airplane was replaced with a flying eagle dropping a fish. The response patterns of males and females changed. The FCI can be manipulated to change the difference in performance between the sexes WITHOUT changing any of the physics tested.

Considering PER from a Radicalized Gender Perspective: A Research Example

Men consistently outperform women on the FCI. The reason for this gap is not understood. Suppose we take a radical view of gender in physics and ask a question that is outside of our paradigm. Does the FCI actually test more than just knowledge of physics concepts? Could it also be testing for gender? If so, what is the mechanism?

I asked this question and came up with the following hypothesis which was partly inspired by Clark Chinn's talk, *Knowledge, Belief, and Understanding in Learning Science*, at the winter 2003 AAPT meeting, in which he showed evidence of the divide between what students understand and what they believe. Could it be that males, inclined to operate within a hierarchy are more willing follow authority, even if they don't believe in it? Women, inclined toward cooperation and negotiation, may keep their

beliefs rather than accepting authority. Therefore, women may score below men because they answer based on what they believe, rather than what they are told. Men give the answer they are told to believe.

In collaboration with Timothy McCaskey and Andrew Elby the hypothesis was tested. The study is more fully described in McCaskey's paper, *Effects on Assessment Caused by Splits between Belief and Understanding*, which also appears in this proceedings. In short, after taking the FCI, students were asked to go back and indicate which answer they really believed and which answer they thought a scientist would give. As we predicted, women reported a split between their beliefs and what they thought a scientist would believe much more often than men. Also as we predicted, women were more likely than men to answer based on their belief. While supportive of the hypothesis, this splitting did not account for the gender gap.

Our result was very exciting because it was based on an idea that was outside the mainstream. Yet, our predictions were confirmed. Thinking from a different perspective (as radical as it may seem) gave an interesting and surprising result. It appears that the FCI may not be equally valid for both men and women. We have also shown that there is a gender effect that goes beyond simple context dependence.

Eliminating Bias/Educating Women

Before our system can be changed to truly encompass both genders it is essential that we understand that there is no such thing as a neutral stance. That is, a neutral stance is actually a stance for the prevailing view. In this case, the prevailing system works to favor men so any teacher or classroom that does not actively and deliberately work toward a more encompassing environment will unwittingly contribute toward gender bias.

So where do we go from here? The following is from the book *Women's Ways of Knowing* [8].

*In considering how to **design an education appropriate for women**, suppose we were to begin by asking, simply: What does a woman know? Traditional courses do not begin here. They begin not with the students' knowledge but with the teacher's knowledge. The courses are about the (dominant) culture's questions, questions fished out of the "mainstream" disciplines. If the student is female, her questions are unlikely to intersect with the culture's questions, since women, paddling in the by waters of the culture, have had little to do with posing (its) questions or setting (its) agendas. – P. 198.*

Sixteen years before the *Women's Ways of Knowing* book was published, William Perry published his influential book [9] outlining epistemological development in the college years. Despite being based entirely on Harvard men, it is often looked to as a guide to all students. *Women's Ways of Knowing* provides us with an analysis of women, reporting on the results of interviews with 135 women about their views on knowledge and learning. Goldberger said about their work [10],

*Our interviews with women uncovered salient themes (missing or deemphasized in Perry's theory) related to the experience of silencing and disempowerment, lack of voice, the importance of personal experience in knowing, connected strategies in knowing, and resistance to disimpassioned knowing. Such themes suggested to us that **there are hidden agendas of power in the way societies define and validate and ultimately genderize knowledge**; the stories women told depicted a variety of different ways women understand,*

accommodate, and resist societal definitions of authority and truth. -pg. 7

The full findings of the *Women's Ways of Knowing* analysis are too extensive to summarize here. However, their description of two flavors of procedural knowing seems particularly relevant to our discussion. These two views are summarized in the table below but anyone with an interest in these issues is encouraged to read the full description in the book itself.

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| Connected Knowing (Associated with Women) |
| A view of knowledge characterized by trying to embrace new ideas, asking what in someone else's experience led them to their point of view, listening to others, using self-insertions or projection in the good sense, and the mode of learning is personal. |
| Devalued and discouraged in traditional education. |
| Separate Knowing (Associated with Men) |
| An adversarial stance toward new ideas, look for flaws in reasoning, demand empirical justification, requires self-extrication or weeding out of the self, benefit from partnership with friends willing to behave as enemies |
| Dominate mode of instruction |

The dominate educational system values a way of making sense of the world that involves argument, the defense of ideas, and competition. Not all people learn well or enjoy this mode. Many women find physics to be an innately hostile and unpleasant field precisely because our community operates so strongly in a separate knowing mode. This devaluing of a connected way of knowing can also undermine the confidence of women. As Goldberger states [10],

There is an implicit message that reaches us all, men and women, as we move through the American educational system and the

workplace: If you want to succeed in this world, you can not let emotions and personal considerations cloud your thought. You must toughen up and learn to think like (white) men. This message has affected the way (white) women in our society evaluate their intellectual potential.- pg. 9

PER generally supports connectedness in learning. Unfortunately, as my fellow presenters discussed [11][12], PER itself is at odds with the educational system so the reforms of our community are not being adopted large-scale.

Conclusion

The point is that we need to be AWARE of who we are, ACKNOWLEDGE the advantages that our social and political positions give us, and ACT to empower those who are socially and politically disadvantaged relative to ourselves.[13]

There is pressure to not be political, to not ask hard questions about the very nature of our social system. Yet, these questions are important to ask. We live within a system that integrates society with economics, politics, and education. Too often, we fail to see the connections between these arenas because we falsely believe the larger issues have no bearing on what we personally do or because we feel too much comfort ignoring them.

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References/Notes

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- [3] www.collegeboard.com
- [4] www.awis.org/statistics/Data_from_Women.html
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