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**Gender, Science Anxiety, and Science Attitudes:
A Multinational Perspective**

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I. SCIENCE ANXIETY¹

In 1977, I recognized the phenomenon for which I coined the term “science anxiety”: a debilitating interaction of emotion--fear, with cognition--science learning. It often manifests itself as a crippling panic on examinations in science classes, but it is distinct from general test/performance anxiety. Students suffering from science anxiety tend to be calm and productive in their non-science courses, including their mathematics courses.

The Science Anxiety Clinic. I was co-founder and co-facilitator, with the Loyola University Counseling Center, of the first Science Anxiety Clinic. Techniques developed in the clinic reduce science anxiety by blending three separate approaches: science skills learning, changing of students’ negative self-thoughts, and desensitization to science-anxiety-producing scenarios. I

* The views expressed in this paper are those of the author and do not necessarily represent those of the United Nations.

¹ Footnotes are in italic superscript; endnotes are in ordinary superscript.

have described the science anxiety phenomenon, its causes, and its remedies in *Science Anxiety*:

science such as physics as a sign of their inability to succeed in those areas. These attitudes work as negative feedback, reinforcing science anxiety, and the cycle perpetuates itself. The phenomenon is international³. Comprehensive references for gender in science and mathematics education, including science anxiety, can be found in Hake and Mallow: *Gender Issues in Science/Math Education (GISME)*⁴.

The first binational project. While I was studying science anxiety and trying to reduce it in the United States of America, a group of Danish female physics teachers, under the rubric “Piger og Fysik” [Females and Physics] were doing similar work, especially with regard to female students⁵. Using the Science Anxiety Questionnaire and interviews with students, we established that gender-related science anxiety was a multinational phen⁶

The questions included feelings about science and its relationship to the student. A good number of the questions were designed to assess student attitudes across the range from the traditional view of science, *empiricism*, which places facts outside of theory and emphasizes prediction and validation of theory as determined by facts, to *radical constructivism*, which claims that all knowledge is determined by gender, culture, and politics, and questions the existence of facts in the common sense of the word. Most modern science teachers tend to be *moderate* constructivists in their pedagogy. They believe in facts, but know that learners construct knowledge, in which facts play an important but not exclusive role. The role of constructivism in science education has been the focus of ongoing debate¹². Thus, a special concern is the possible influence of various forms of constructivism on attitudes of both females and males toward science.

Correlations between science anxiety, science attitudes, and gender. We administered the full 84-item attitudes/anxiety questionnaire to various groups at Loyola University Chicago: physics students, non-science students, pre-health students, education students, and Chicago Public School (CPS) science teachers taking classes at Loyola's Center For Science and Mathematics Education. Data from a study of 500 students have been analyzed, and correlations found between science anxiety, attitudes toward science, and gender. Females scored significantly higher than males on "inherent bias against women," whereas males scored significantly higher than females on "negativity of science toward the individual." Males who believed in "subjective construction of knowledge" and/or in "negativity of science toward the individual" expressed science anxiety. Females who believed in "negativity of science toward the individual" (*not* just women) expressed science anxiety.

We subsequently administered the questionnaires to 1000 participants from various Loyola student populations and Danish institutions of higher education. Analysis of the data from this larger study is nearing completion. The science anxiety component of the questionnaire has been analyzed for acute science anxiety⁵. In comparison to our earlier studies in the 1990's, we found a closing of the "anxiety gender gap" and the "anxiety national gap," but not in the way we might have hoped. The proportion of science anxious females in the United States of America has remained stable near 90%, while the proportion of Danish females and Danish and American males has increased. Possible causes include changes in curriculum and requirements before and at the university, increased permission for males to admit anxiety, and possible as-yet unknown changes in both cultures. Any of these and others should be the subject of further investigation.

Interviews. We then carried out interviews with small subgroups from each population. Interview discussion questions were based on those in the questionnaires, and, like the former, designed to investigate females' and males' attitudes toward and anxiety about science. An excerpt of the interview questions in our newly published results¹³ appears in Table 3.

⁵ I am grateful to Ann Mallow for her assistance in the data analysis.

Table 3. Interview questions—excerpt. There were 16 questions, and each group chose to answer which and as many as it wished.

How many of your teachers in science have been male? Female? How has that affected you?

Do they teach differently?

What causes of anxiety in science can you identify?

Why do you think gender differences exist in subject choices?

Do you experience anxiety in any subjects or situations?

Some people have suggested that there are no such things as objective facts and that science is simply constructed from the personal opinions and subjective beliefs of scientists. How do you feel about this particular viewpoint?

Some people have suggested that science is inherently hostile and biased toward women. How do you feel about this particular viewpoint?

Some people argue that science is one way of describing the natural world among others to be considered as well; for instance, astrology, creationism/intelligent design. What is your opinion of this?

We were able to draw a number of conclusions:

a. While we did observe differences in responses from students in different courses of study, we observed no arguments across a gender divide in our interview groups. Nor did we

IV. FURTHER OBSERVATIONS

First, our studies and those of others⁶ have confirmed that there is work still to be done to level the gender playing field. To a great degree in the United States of America, gender disparity in the sciences has markedly decreased, although the proportion of female students is still low compared to their proportion in the university population. Physics continues to lag behind the other sciences, with about 20% of its students female, but this number is growing. Some physics departments such as ours at Loyola University Chicago have 30-40% females. Active attention to gender issues seems to be an important factor in this increase.

Second, the evidence that science anxiety reduction methods work for both genders, as well as across cultures continues to be encouraging.

Finally, it is clear that many issues are multinational⁷. Therefore, it is important to create and strengthen international forums on gender, science, and technology.

V. A NEW STUDY: TEACHERS' ATTITUDES

We have begun a study of the attitudes of Danish and American instructors of the students in our binational study. They will be given the interview questions and asked to provide written responses. We will then interview them individually to discuss their responses, compare them with those of their students, and elicit their suggestions for implementation of new strategies for effective science pedagogy.

Endnotes

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3. Tobias, S., Urry, M., and Venkatesan, A., "Physics: For Women, the Last Frontier." *Science* 296, 1201 (2002).
4. Hake, R.R. and Mallow, J. V., *Gender Issues in Science/Math Education (GISME): Over 700 Annotated References & 1000 URL's*.
Part 1 - All References in Alphabetical Order. [<http://www.physics.indiana.edu/~hake/GISME-5t-Part1.pdf>];
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