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Some Thoughts for Teachers on Mathematics Anxiety

By **Lorelei R. Brush**

My purpose in this article is to look at what research has to say to teachers about the development of mathematics anxiety and avoidance, looking specifically at opportunities for teachers to reduce anxiety and encourage more students to continue their study of mathematics beyond the minimal requirements in high school. The research in this instance is a look at students' responses on instruments that are used to measure mathematics anxiety. One of the best of these tests is the Mathematics Anxiety Rating Scale (MARS) constructed by Frank Richardson and Richard Suinn (available through the Rocky Mountain Behavioral Sciences Institute, Fort Collins, Colorado.)

The MARS has a list of ninety-four situations each of which must be rated from 1 to 5, where a 1 means you feel no anxiety when placed in the indicated situation and a 5 means a great deal of anxiety. The list includes such situations as preparing for a mathematics test, being watched while adding up a column of figures, doing a division problem, and adding up the dinner bill when you think the waiter made an error. Essentially you are asked to place yourself in the situation and imagine your reaction.

In analyzing the responses of high school and college students to the MARS, I have found that the ninety-four situations break down into two groups, calculations and experiences involving evaluation by others. The first group, doing calculations or solving problems, generally arouses little anxiety. Students report that they may dislike the attention they are forced to give to the details of an arithmetic calculation, and they may be frustrated by having to check their work, but they rarely feel anxious about numerical problem solving. It is to the second group of situations that

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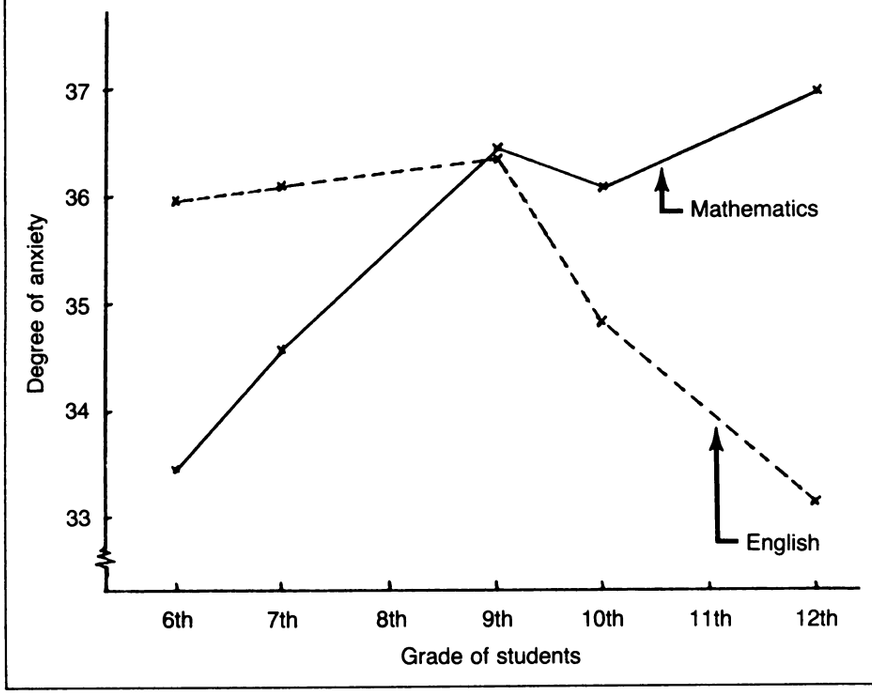
Fig. 1

Self-ratings of amount of anxiety experienced by students in situations involving mathematics and English. The range of possible values for each is 12 to 60, with a higher number representing more anxiety.



students react with anxiety. They do not like any facet of the preparation, waiting for, and taking of mathematics tests. Many also get anxious when they think they will be called on in class or are forced to do something mathematical that other people will watch or evaluate.

Are the responses of students in other subjects comparable? Mathematics and English make a good comparison. For the data on English, students are asked to complete the MARS and also to rate their anxiety in English-oriented situations. In my observations of the responses of students, from sixth grade through college, I have found a clustering of the situations encountered in English that is very similar to the one in mathematics. That is, students do not mind the processes of writing, spelling, reading, or working on grammatical exercises nearly as much as they dislike (and feel anxious in) situations that require evaluation of their work by others.

The data in figure 1 show that students' anxiety in mathematic situations is increasing from the sixth to the twelfth grade. At the same time their anxiety about the English situations is decreasing (especially in high school). Are there changes in the teaching of mathematics and English that occur during this time that might be responsible for the changes in the level of anxiety of students?

In the sixth grade—where English classes involve spelling tests, grammar exercises, short reading assignments followed by a page of questions testing comprehension, and one-page book reports—students are even more anxious about English than about mathematics. In the succeeding years, however, English increasingly becomes a study of literature and there are more opportunities for students to express their own ideas. At the same time, mathematics becomes more and more tied to a lecture model of course presentation, with frequent graded assignments and regular tests. While English is de-emphasizing evaluation situations, mathematics is focusing more on them.

Although the preceding paragraph is a gross simplification of a complex process, it tells a tale whose essential features are correct: the nature of the studies of English and mathematics differs more and more as the age of the students increases. In fact, more than simple frequency of evaluation is changing within the design of courses. Some of the other kinds of changes can be described by evaluating additional data from students.

In the study that produced the graph in figure 1, the author investigated the development of attitudes toward English and mathematics in about 1500 students from three New England school systems (one urban, one suburban, one rural). The findings show that there are many features of mathematics as a subject matter that students observe, dislike, and find increasingly anxiety-provoking as they get older:

(a) mathematics gets more difficult (more abstract) fairly early on in school;

(b) students spend more and more time learning what is already known and less and less time contributing their own ideas;

(c) after arithmetic, the everyday uses for the material learned in class seems limited; and

(d) working with numbers does not seem to contribute to a better understanding of oneself or of society; the subject seems very impersonal.

Almost the opposite can be said of English:

(a) this subject seems to get easier;

(b) students spend more and more time contributing their own opinions;

(c) reading and writing look useful as skills that will help people get good jobs; and

(d) the substantive literature of the field deals precisely with the understanding of one's self and of society, and in a way that is personally satisfying.

Based on these observations, the obvious question is, What implications do they have for the way in which the subjects might or should be presented? In teaching mathematics, it would seem that teachers could ease

the perceived difficulty of the subject by—

- choosing explanations that maximize understanding,
- organizing lesson plans to ease the transition into new topics,
- extending such clear invitations for lots of questions about tough points that students would find the subject no more difficult than English or history. Good teachers already act this way, but by regularly reminding themselves that students may well be having a hard time and that they can make it easier for the students, teachers may find it easier to keep plenty of explanations coming when patience is wearing thin.

The students' perception that they contribute little to the subject matter of mathematics is true in the sense that the outer reaches of mathematical understanding are beyond the ken of most high school students. Actually students are contributing little that is new to our understanding of American history or English literature. It is solely in their *belief* that their writing and ideas are new and creative that they call the humanities more open than mathematics. What would happen to their attitudes toward mathematics if assignments that forced them to be creative were given? For example, many people feel that discovering patterns in numbers or equations or graphs is a challenging way to use one's own ideas. For young children, being asked to figure out the associative and commutative principles of addition or multiplication can generate excitement. For older students, deriving structure from series of equations or graphs can be inventive. I am suggesting, in other words, that students' perceptions of the nature of mathematics may well be based on their classroom experiences and be limited by a teacher's constricted view of ways to teach mathematics. Including tasks and activities that require student creativity seems a meaningful way to expand students' ideas about the nature of mathematical thought.

A part of the expansion of students' experiences might also involve a widening of the kinds of issues addressed in typical mathematics textbooks to encompass more that adults might deal with in every day life or on the job, and with issues or story plots that capture human interest. For example, I had a very successful term of teaching statistics to students who hated mathematics by organizing a series of data gathering efforts where the class had to figure out why mothers bought particular kinds of cereal for their families, what made a good teacher from the students' perspective, and why all of them hated mathematics. In addition to being topics of personal interest, the projects required that students work together gathering and analyzing the information. One of the end results was a set of students who felt like a team, who had solved problems of personal interest, and who had come to enjoy this part of mathematics as they never thought they could.

By describing these possible actions on the part of mathematics teachers, I am saying that students' attitudes toward the field may be changed and improved, that changes in classroom practices can reduce mathematics anxiety, and that such a reduction accompanied by encouragement on the part of the teacher will lead more students to enroll in mathematics courses beyond those required. I do not wish to imply that mathematics teachers are solely or even substantially the causes of mathematics anxiety and avoidance in students. There are features of mathematics that make it hard to take for most people. Furthermore, some students will receive even the most inspired teaching in a negative manner and some influences of society at large impinge upon the study of mathematics in the form of its stereotype to the public and thwart the best of teachers' efforts. On the other hand, knowing about the prevailing attitudes of students and of society, keeping them in mind, and preparing one's classes to fly in the face of those attitudes is a possible and potentially rewarding endeavor that can significantly diminish the mathematics anxiety experienced by so many students and former students today. ■