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I'VE GOT A SECRET: MATH ANXIETY

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I have taught high school mathematics for 23 years and have also instructed undergraduate mathematics at the university level as a sessional lecturer for 18 years. One of the courses I have taught is Math 101, a degree requirement class for general arts and elementary education. In my first time teaching this class as a six-week summer course, I asked my wife (an elementary school teacher) who I might find in this group. She told me to expect a significant number of "middle-aged female elementary school teachers" taking this as their final requirement for their degrees. (Over the years, teachers here have been required to have a degree to teach, with many taking evening and summer courses.) When I came home from the first class session, my wife asked me who was in the class. Amazed, I said she had been correct. There was an extraordinarily high number of "middle-aged female elementary school teachers"-how did she know? She paused thoughtfully and said, "Be kind. They are terrified."

My curiosity piqued, I asked the students their feelings. My wife was right. They were terrified. Repeated teaching of this course, with the same experience each time, led me to interview three female elementary school teachers in depth, and resulted in 'I've Got a Secret: Math Anxiety'.

The Study

Alice, Barb and Chris (not their real names) are elementary teachers each with over 20 years of teaching experience. All three women are highly intelligent, articulate, and painfully aware of their limitations in mathematics; however, they have become equally aware of their strengths in teaching mathematics within the constraints of grade level or concept level.

Chris remembers doing "really practical problems" in arithmetic with her grandmother, which were "fun." Chris adds that after arithmetic math "was never practical. I had this idea, you kind of just memorized it, answers came from the air, or God knows what. I never figured it out." Alice found mathematics after arithmetic limited in applicability and the subject seemed impersonal. She felt no "bond" with mathematics, saying, "it was not something I was particularly interested in." Barb also saw no meaningful application; math to her was merely being given an assignment, and then "they (the math teachers) sat down." There was little connection between the math's symbolic language and the real world. "You get to a test and it all looks like Greek to me," said Alice, "They're just things that float in the air. You get through it, and repress it for life." It was apparent that, once past the arithmetic stage, and into the more abstract aspects of the mathematics stage, these women no longer saw the applicability of what was expected. Alice states that "if you don't pass this, you don't get your year - well, do you know what that would mean? I mean, that has got to be the ultimate, the ultimate embarrassment, personal failure."

Math Anxiety

That they had received poor teaching was a strongly-held conviction by all three women. Alice believes her difficulties with math began when, as a "gifted student," she was involved in a pilot project where, "we literally had to teach ourselves." Barb describes her teachers as "very, very poor math teachers ... I don't remember any teaching." Chris wonders if she had good teachers, would it answer for her the question, "Whether I am really learning disabled in math, or stupid, or what? Looking back I don't think my teachers knew how to teach math."

Teachers alone are not responsible for any emotion underpinned by qualities of fear and dread in mathematics, an emotion that has been referred to as mathematics anxiety. Perhaps changing classroom practices to textbooks and curricula that encompass more issues that are relevant to adult daily working, living, or story plots that capture human interest would reduce math anxiety for students.

Preparing for the Interviews

Over the course of one week, Alice, Barb and Chris, three "math anxious" primary level female teachers, were interviewed concerning their perceived math anxiety. The first two interviews took place at the home of the interviewer and the other in the individual's classroom after school. The interviewees determined these places. Each interviewee was told that the interviewer had a genuine interest in knowing more about math anxiety. They were also told that a transcript would be made and that they were guaranteed anonymity. The interviews developed from general conversation led by the interviewer. Each interview lasted approximately 20 minutes.

The three interviews turned out to be one with a person I knew well, one with a person I knew not as well, and one with a person I did not know. All three women had a genuine concern to analyze their math anxiety, to understand it better, which ultimately made the interviews flow-because they actively participated. The introspection involved appeared to be a useful exercise for all three women and all expressed their appreciation of the invitation to express their thoughts and views on math anxiety.

The reason for selecting female primary teachers was through a desire to narrow the research; to hear what they would say about their anxiety 'then and now'; to hear what impact math anxiety had on their career choices and how it affected their careers; and to see if any of these women believed that their math anxieties were directly related to gender. I was interested in what insights I could glean concerning math anxiety as a high school math teacher. The interviewees understood the objectives and what would be done with the data collected and the resulting transcripts. Each participant received a copy of her interview plus a summary of the themes found in the interviews.

Alice's, Barb's and Chris' Stories

Math has often been treated as a solitary subject - one relegated to working in relative personal isolation. Alice described that as an adolescent, you feel alone in your shortcomings and "you run around trying to hide it." Barb said she would "never think to ask (the teacher) anything." While students working in groups could help address these concerns, the role of the teacher in reducing math anxiety would not diminish.

A supportive teacher who provides a healthy classroom climate is crucial to developing positive attitudes toward mathematics. Ensuring acquisition of prerequisite skills, teaching for understanding and using math when teaching other subjects are among suggestions for preventing math anxiety. Also, the creation of a climate where it is acceptable to both question and make mistakes might help take the fear out of mathematics. A healthy climate that allows for errors and questions might have negated the kind of embarrassments and traumas described by these women.

Events and feelings from elementary school days are subject to vivid recall. These memories, are continually linked to attitudes

to mathematics and teachers. Alice, Barb and Chris expressed clear memories of specific happenings - not usually successful - with learning, or lack of it, and teachers. Alice remembers not knowing what to do in the pilot program; Barb remembers a World War II veteran, shell-shocked, shuffling, non-verbal teacher, with mouth agape; and, Chris still remembers the embarrassment of being told that a younger boy in another class could do something in math that she and the rest of the girls in her class were unable to do.

Conversely, good experiences are vivid memories, as are good teachers. Alice recalls the "best teacher in the whole world" as an applied statistics teacher in university, who was positive and supportive and made math make sense. Barb remembers more of the contrast between her math teachers and her other teachers. Chris remembers a university professor who tutored her - free - all summer so she could pass her test. When she did, they both cried. Chris still keeps in touch with her. Mathematical success appeared to be influencing the career choices for these women.

Math avoidance maybe seen as a "cause as well as a symptom" of math anxiety. Math avoidance leads to limiting careers to those that neither require mathematics training nor its use. All three women acknowledged that careers were, to some degree, determined by their avoidance of mathematics courses out of necessity or fear. Alice avoided grade twelve physics, which did not allow her entrance into any careers that require physics. Barb found that Teachers' College was the only admission she could get without grade 12 math. While she feels she would still have selected education as a career, she would likely have attended a different college if she had math. Chris would have chosen architecture had she not avoided math in her British education.

Fears of the tests in mathematics seemed to be part of the avoidance aspect of math anxiety. When Alice had to do a math test, she took her fifty percent with relief. Chris panicked when she had to do a mastery test and achieve ninety percent to pass. Barb couldn't figure out how or why "other kids managed to pass." There appeared to be a general fear of contact with mathematics, including classes, homework, and tests.

An important concern regarding math anxiety, is whether female elementary teachers pass their anxiety on to their students, particularly female students. Is gender bias the reason for math anxiety and would remedial math programs alleviate anxiety and break the cycle? Or does math anxiety beg attention across gender?

Having acknowledged math anxiety, the three female elementary school teachers indicate they are not only comfortable teaching mathematics but often empathetic with students and indicate they are better than average at teaching math. They seemed eager to break the cycle of poor attitudes generating poor attitudes and provide their pupils with positive experiences in learning mathematics. They all stated, however, that they have a limit to what they are able to teach in mathematics, and generally, the delineation is high school. Alice will not work in high school because she feels she does not have the background in mathematics; Barb says she would be a "basket case" if she had to teach high school math; and, Chris says she is happy teaching elementary math because she knows her skills are above those of her students. Alice, Barb, And Chris had found their 'comfort zone' for teaching mathematics. In response to the constraints math anxiety places on teachers' comfort zones, all three women suggest that for those who must teach mathematics, methods courses or support groups would be of minimal help.

Barb believes she has become a particularly good math teacher and suggests that part of the reason is that her initial insecurity about teaching math caused her to work and prepare extra-carefully for it. She believes she is creative in her math teaching and not bound by the textbook sequence. She also finds that she never gets frustrated when students "don't get it." She just approaches their difficulty from another angle. Alice believes she is a more empathetic teacher, and she is careful to teach children the "system" of mathematics - the prerequisite knowledge base needed for future mathematics. Chris is careful to attend workshops to make her a "better" math teacher. She says it is important to make children think and consider all possibilities. These teachers, while displaying residual effects of math anxiety, are quite confident within their "comfort zone."

If one was searching for a connection between gender and math anxiety, it was not evident in this study. Much has been made of the connection between women and math anxiety, but the only difference between male and female math anxiety may be that females are more likely to report it, perhaps, because it is "safer" for women to admit to math anxiety than for men.

Not once did any of these women suggest that they did poorly or avoided mathematics because of the fact that they were female. It does seem, though, that math anxiety takes its place permanently if nothing is done to modify it. Alice says, "Math anxiety stays with you forever: It's that little bit of you that thinks that you've fooled the world. But if anybody dug deep

enough, they'd find you are really stupid in math. It is sort of always playing 'I've got a secret'."

"Today I know it exists," states Alice, "it's an avoidance thing is what it is. But at least I recognize it for what it is. Unfortunately, I think when you are an adolescent it's a very personal thing, but I believe now if I worked on it now I would get it... ." Barb sees her math anxiety as a habit, an attitude. "Like smoking -it was really cool-now I'm stuck with it. It's no longer useful. Same with math, it's no longer useful to me at all to be a dunce at math. But I'm stuck with it to a certain extent." Barb has stayed clear of situations where her math anxiety would show but today she states, "I think it is unthinkable to kids now to let opportunities pass by them like I did." Chris concludes, "I think I'm still math anxious, but it's not quite as bad." She has joined the new mathematics committee and "it hasn't been too bad but once in a while we have these activities we have to do and I've felt like a real nincompoop."

There appears to be no definite origin for math anxiety. Some argue biochemical brain differences; some behavioral responses; and, good teaching seems to be able to eliminate it. Perhaps the first step for educators is to become more aware of math anxiety and its relevance to good teaching. Eliminating math anxiety may reduce the secrets students keep about their lack of mathematical prowess and may open more doors in the future.

Math anxiety exists. The typist who worked on the final copy of this paper attached a sticky note that said, "Oh yeah! Can I ever relate! Particularly the comment about 'fooling the world'. I feel like a closet dummy!"

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