Mathematics + Psychology = An Important Equation

"Of course you don't see as many girls in research – they're simply not good enough!"

This is the response the 22-year-old Petra Taylor received from her professor when she asked him about her observation that few women seemed to conduct mathematical research. For as long as she could remember, Petra had loved reading and learning from other people's ideas about mathematics and also thinking of new ideas herself. Although she had heard such stereotypes before, this professor's statement stuck with her. One of the most important figures in her life was telling her that her hard work may amount to nothing. Why? Because as a woman, she could not possibly have interesting research. While working on her next few projects, the young Petra Taylor began to doubt the quality of her ideas and her research, even after graduating high school as Berlin's top mathematics student. What if it wasn't interesting enough? What if the public did not respect it?

Petra Taylor was born and raised in Berlin, where schools are more focused on traditional academics than the typical school in the United States. Her parents always encouraged her to pursue the subjects she loved, and her passion was always mathematics. As she grew older, she also grew to love the subject even more. However, she also encountered doubts about achieving her goal of becoming a professor of mathematics.

From elementary through high school, Petra would often find herself afraid of raising her hand to ask questions. She would worry about how her question or comment might reflect on her intelligence or her understanding of the material. As others around her—primarily boys—were brave enough to ask questions, she began to believe they must therefore be smarter. While she should have felt more comfortable asking questions, following the example of her male classmates, she instead found her confidence eroding with each new question.

In time, however, Petra would realize her questions were no different than those of the boys who asked confidently, and her ideas were often times better than theirs. She would realize that she had unconsciously accepted the stereotypes on girls' capabilities in mathematics.

Today, Petra Taylor is 46 years old and a professor at the Thayer School of Engineering at Dartmouth, one of the best engineering graduate schools in the United States. She appears distinguished with short brown hair and brilliant blue eyes and speaks

with a slight trace of her German heritage as she sits next to me on a couch at the Baker Library in Hanover, New Hampshire. She was kind enough to meet with me, an eleven-year-old girl who shares her love of mathematics.

"Asking questions does not reflect a lack of intelligence in the present, but rather determines how much you will continue to learn in the future," she explains. This was the crucial lesson Professor Taylor learned to break out of her cycle of doubt when she clearly analyzed her mistaken conclusions. Deep reflection allowed her to overcome the doubt placed in her mind by her own teacher – the belief that girls are not good enough to conduct research in mathematics.

From that moment, she focused on developing her confidence and proving the absurdity of this stereotype.

"Psychology is a very important part of learning mathematics. Confidence plays a major role in our ability to learn and enjoy mathematics," Professor Taylor says. With enough confidence in yourself, you are able to improve faster and become comfortable with making mistakes and learning from them. Fortunately, Professor Taylor's subsequent mentors helped her develop this open and flexible mindset.

For instance, one of her most memorable mentors taught her there is no such thing as failure. If she couldn't solve one problem, she could always solve another. His encouraging and optimistic approach to mistakes taught her both to embrace them and to feel comfortable making them. With this newfound view of mathematics, Petra felt freer to experiment with her hypotheses, which led to many of her important discoveries—in both mathematics and in herself. Embracing your mistakes is the key to major improvement. However, the reason this experience meant so much to her was because her mentor not only cared about her as a mathematician but also cared about her as a person. When she arrived in the United States, she did not know anyone or where to stay. This mentor helped her find and move into a new apartment, and also invited her to conferences where she was able to meet new colleagues.

With encouragement from her mentors, Professor Taylor earned her PhD from the Technical University of Berlin when she was twenty-six years old. Her research interests include complex analysis, geometric function theory, discrete groups, and the mathematics of medical imaging. Her love for mathematics and openness to questions gives her complete confidence in her work, and this has played a major role in her own classroom environment. She extends this approach to her own students—building their confidence so they feel comfortable learning through their mistakes in the classroom.

Professor Taylor makes an effort to get to know each student personally to help them improve faster. By giving students a chance to ask questions through surveys before class, they become more comfortable asking additional questions during class. She uses group activities that allow student to get to know their classmates so they feel comfortable asking questions in front of each other. She brings out the best in her students and builds their confidence by showing them things they might have not known they were capable of. Through her powerful approach, Professor Taylor ensures that her students are able to build their confidence without experiencing the doubt she herself had to overcome. She changes the atmosphere in her classroom by transforming doubt into confidence through the combination of mathematics and psychology.

As a mathematician, Professor Taylor understands that psychology is an important variable in the overall equation.

About the student:
My name is Maxine Park and I am a 6th grader at Crossroads Academy in Lyme, NH. I really love math, especially geometry (which I am taking right now), and number theory. I have been the winner in my school for the AMC-8 and Mathcounts competitions. I also tutor math for 4th grade in my school. In my free time, I enjoy reading psychology books and I am fascinated by the way people make decisions in everyday life. I also love fencing and playing the piano. I have performed in venues such as Carnegie Hall in New York City and Boston's Symphony Hall, and enjoy contributing through music to retirement homes, hospitals, and fundraisers. I hope one day to become a mathematician or social psychologist (or both).