Women in Radio Science

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Early Career Representative Column

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In this joint column, it is our great pleasure to put Prof. Jamesina Simpson in the spotlight. On the occasion of the triennial General Assembly and Scientific Symposium (GASS) of URSI in August 2017, Jamesina was awarded the Santimay Basu Prize (Figure 1). This prize is awarded to a young scientist who has made an outstanding contribution to research that furthers the understanding of radiowave propagation in random media and its applications for the benefit of society. The award takes into account the excellence of the research, the merit of the candidate in achieving his or her results, and the efforts required to accomplish the research. The Santimay Basu Prize was presented to Prof. Jamesina Simpson with the citation, “For advancing three-dimensional finite-difference time-domain (FDTD) solutions of electromagnetic wave propagation within the global Earth-ionosphere waveguide applied to space weather, remote-sensing, and very-low-frequency propagation.”

Jamesina (Figure 2) obtained her PhD in Electrical Engineering from Northwestern University in Evanston, Illinois, in 2007. Her dissertation was on “3-D Finite-Difference Time-Domain (FDTD) Modeling of Impulsive Electromagnetic Propagation in the Global Earth-Ionosphere Waveguide below 30 kHz.” Her PhD advisor was Prof. Allen Taflove, a very inspiring and encouraging supervisor. From August 2007 to June 2012, Jamesina was a tenure-
track Assistant Professor in the Electrical and Computer Engineering (ECE) Department at the University of New Mexico. In July 2012, she joined the ECE Department at the University of Utah as an Associate Professor. Her research lab encompasses the application of FDTD to modeling electromagnetic phenomena at frequencies over 15 orders of magnitude (~1 Hz to ~600 THz). In particular, Jamesina’s group has pioneered the most advanced three-dimensional Maxwell’s equations FDTD models of global electromagnetic wave propagation within the Earth-ionosphere waveguide. These models have been applied to a variety of applications, such as remote sensing of oil fields, geolocation, hypothesized electromagnetic earthquake precursors, remote sensing of localized ionospheric anomalies, Schumann resonances, and space-weather effects on the operation of electric power grids.

Besides being an excellent researcher, she is also an excellent educator, as for example indicated by the IEEE Antennas and Propagation Society Donald G. Dudley, Jr., Undergraduate Teaching Award presented to her in 2012. In this column, she reflects on her own years in college and the supervision she received from Prof. Taflove. She identifies three factors (cultivating a growth mindset, building grit and enhancing creativity) that (would) have helped her overcome challenging times, and how this has become part of her professional and personal life.

Alfred Binet, the inventor of the IQ test, wrote the following summary in his book, Modern Ideas about Children [1]:

A few modern philosophers...assert that an individual’s intelligence is a fixed quantity, a quantity which cannot be increased. We must protest and react against this brutal pessimism....With practice, training, and above all, method, we manage to increase our attention, our memory, our judgment and literally to become more intelligent than we were before.

In the United States, it is common to consider an IQ score the limit of a person’s unchangeable intelligence. Binet considered our IQ level more of a starting point rather than an end point. As an educator, this is a refreshing thought! Essentially, the sky is the limit for any student who enters my office or class. I can help them to achieve more than they may have ever thought possible.

Some people remark how “lucky” my PhD advisor, Prof. Allen Taflove, is at graduating women PhD students who go on to become professors (still rather rare in electromagnetics (EM) today). I argue that it is not luck at all. I believe it is because Prof. Taflove holds a growth-personality mindset (more on this below), and because he gives students unending encouragement and support. These attributes at least certainly helped me to achieve more than I ever thought possible while in his lab.

At the time that I started studying EM at Northwestern University as an undergrad, I had zero knowledge of Maxwell’s equations, the foundation of my current research area today (computational EM). Further, at the time I was only in the School of Engineering because I was supposedly “good in math” and I didn’t know what else to pursue (veterinary science, my previous interest, was out because I had nearly fainted while observing a surgical operation on a dog). I had never considered graduate school, and unfortunately I had just earned a 2.7 GPA during my first quarter following a difficult transition to college life.

Looking back, I feel there were three key factors that helped me to get back on track after that challenging quarter. These factors have also helped me in my career. Had I been able to understand these three factors earlier, I believe I would have overcome difficult times more often and more easily (such as whenever a paper or proposal is inevitably rejected!):

Reflections on Personal Development

Jamesina J. Simpson
1. Cultivating a growth mindset

2. Building grit

3. Enhancing creativity

Cultivating a Growth Mindset

I grew up learning to play the violin through the Suzuki method (Figure 3). Although I knew I wouldn’t pursue music professionally, I continued to play into college. Years later, I would finally realize all the benefits I had gained from it. For example, when I recently started to teach my children to play violin, I learned that the Suzuki method is more: I realized it is as much about playing the violin as it is a philosophy for life.

Through the Suzuki method, I learned how to help my daughter overcome challenges rather than just give up. When she balks at learning a new passage in a song because it’s “too hard!” I help her to break up the passage into much shorter segments (even of just three notes). After mastering all of the shorter segments, she can piece them all together and surprise herself by suddenly playing the entire passage.

In fact, the more I learned about the Suzuki method, the more I realized that I am cultivating in my child what author Dr. Carol Dweck calls a “growth mindset”[2]. When an obstacle is overwhelming, we can try to break it up into more manageable portions in order to make progress and still work towards our goals. As another example, to be able to reliably perform in a concert without making mistakes we should practice our performance piece exactly as we will play it in a concert at least three times a day for several weeks, so that much of the performance becomes automatic. The list goes on. In other words, there is always something we can do to help make hard things easier.

In her book, Mindset: The New Psychology of Success [2], Dr. Carol Dweck summarizes two general mindsets that people tend to have. If you have a fixed mindset, you believe that your qualities are carved in stone, and that you have to prove yourself over and over. On the other hand, if you have a growth mindset, you believe that you can cultivate your abilities through hard work.

I believe that by exercising and strengthening my growth mindset over the years through Suzuki training and through other means this has helped me immensely in my studies and in my career. When I earned a C in my advanced math class in that freshman year, instead of thinking “I’m not good at math,” I remember thinking that I needed to find a better way to learn that material. Later, in graduate school, I ended up earning A’s in much more advanced math classes. In my career, when my teaching scores were not as high as I had hoped, I worked hard at learning, tweaking, and improving my teaching style each time around. My teaching scores inched up, and I have since earned teaching awards and have been listed in the top 15% of teachers college-wide at the University of Utah. It’s rewarding to look back at how far I’ve come since being scared to death of my first teaching assignment!

Building Grit

Although I grew up playing classical music on the violin from a young age, only recently did I learn more about what made Mozart successful [2, p. 56]:

Mozart labored for more than ten years until he produced any work that we admire today. Before then, his compositions were not that original or interesting. Actually, they were often patched-together chunks taken from other composers.

Indeed, Mozart worked so hard that “by the time he was twenty-eight years old, his hands were deformed because of all of the hours he had spent practicing. That’s the missing element in the popular portrait of Mozart” [3].

In other words, Mozart had high levels of two key ingredients: a high level of perseverance (e.g., the ability to overcome setbacks to conquer an important challenge), as well as strong passion (e.g., the ability to become obsessed with a certain idea or project for a long period of time). High levels of these two ingredients resulted in Mozart having a high score on the “grit scale,” developed by author Angela Duckworth. It turns out that having a high level of grit is
a better predictor of success than just about anything else (pure talent, IQ score, SAT score, etc.) [4].

I believe I started to build perseverance when I had to practice my violin every day for years on end, starting at a young age. I probably further gained perseverance when I started running track and cross country in high school, and later trained for a marathon four years ago. Knowing how to work hard in one area makes it easier to work hard in another area.

In my career, passion and perseverance have helped me to develop one of the world’s most advanced electrodynamics models of EM wave propagation in the global Earth-ionosphere waveguide. My students and I are currently advancing and utilizing these models to study space-weather hazards to electric power grids (preventing blackouts), locate airplanes that have crashed into the ocean, and help develop a ground-based global positioning system, to name a few applications.

Enhancing Creativity

As a student, I was always in awe of my PhD advisor. He always came up with more and more ideas. At the time, I understood that to come up with new ideas you at least must have a broad and thorough knowledge of prior art so you can find ways to improve and build on past accomplishments. However, I was not aware that our ability to create new ideas can be strengthened using various strategies and techniques.

In the book The Creative Habit, Twyla Tharp [3] argues that creativity is not a magical act of inspiration. It’s the result of hard work and dedication. In some cases, following a “ritual of preparation” may help spark ideas. For example, Beethoven would start each day with a morning walk, during which he would scribble into a small sketchbook the first rough notes of whatever musical idea entered his head.

We should not think that Beethoven was developing ideas out of thin air, however. We might improve our ability to be creative after a ritual of preparation by “scratching” for ideas. “Scratching is what you do when you can’t wait for the thunderbolt to hit you” [3]. You can scratch for ideas by reading, having conversations with coworkers or even strangers, examining previous work by others, and by immersing yourself in nature. For example, Beethoven was an avid bird lover, and would get musical motifs from listening to birds. Similarly, in the engineering world, butterfly wings have inspired metamaterial structures for manipulating light.

I never thought of myself as an especially creative person, but I’m starting to complete the exercises in Tharp’s book to help give myself ideas on how I might improve my ability to create. I also know I should make time for scratching for ideas even during the busiest of times (which can be challenging while raising two small children).

Conclusion

I’ve never taken an IQ test, and I don’t feel the need to find out what it is. I find it much more uplifting to know more about the growth mindset, grit, and strategies to become more creative. Not only can I continually work to improve, adapt, and tweak my own capabilities, but I can help students, my own children, and other people understand that they, too, can succeed in challenging majors, careers, or whatever other endeavors they may embark upon. This is, to me, what makes my life and career rewarding: having meaningful work in which I may help individuals in my life, while also developing and creating new engineering ideas to potentially help society at large.

References