

The Impact of Hard Work and “Scratching” for Ideas

Jamesina J. Simpson

As a violinist, I learned early in life that Mozart was one of the most brilliant composers of all time. However, it took me much longer to learn what made Mozart particularly successful:

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 [3, p. 56].

In fact, Mozart worked so intensively 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” [1].

I find this information about Mozart so refreshing! Whenever my self-confidence is low or some fear of the unknown sets in, either in my career or outside of work, I try to remind myself of all of the hard work Mozart put into his compositions. Then, I try to mimic his efforts by

- 1) cultivating a growth mindset
- 2) building grit
- 3) nurturing creative thoughts.

In the following sections, I have summarized a few thoughts and ideas that I have acquired over the years about each of these actions. While teaching

EDITOR’S NOTE

Prof. Jamesina J. Simpson, University of Utah (Salt Lake City, Utah, United States), presents the three principles at the base of her work and career: “cultivating a growth mindset,” “building grit,” and “nurturing creative thoughts.” These principles can be a guide for young women starting a career in the academic world.

Prof. Simpson has received several research and teaching awards, including a 2010 National Science Foundation Faculty Early Career Development Award, the 2012 IEEE Antennas and Propagation Society (AP-S) Donald G. Dudley Jr. Undergraduate Teaching Award, the 2017 Santimay Basu Medal from the International Union of Radio Science (URSI), and the 2020 AP-S Lot Shafai Mid-Career Distinguished Achievement Award. She is currently serving as the chair of Commission B, “Fields and Waves,” of the U.S. National Committee for URSI and as a track editor for *IEEE Transactions on Antennas and Propagation*.



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and leading research projects as a professor at the University of Utah, I regularly spend time on these processes to overcome obstacles and persist in my career.

CULTIVATING A GROWTH MINDSET

The inventor of the IQ test, Alfred Binet, wrote the following summary in his book, *Modern Ideas About Children*:

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 [4].

Here in the United States, it is often common to consider an IQ score the limit of a person’s unchangeable intelligence. However, Binet considered an IQ level more of a starting point rather than an endpoint. So instead, what could be more important than a high IQ?

Dr. Carol Dweck summarizes in her book *Mindset: The New Psychology of Success* that people tend to have two types of mindsets. People with a fixed mindset tend to believe that their qualities are carved in stone and that they must prove themselves over and over. On the other hand, people with a growth mindset tend to believe that they can cultivate their strengths through hard work. People with both types of mindsets are capable of great accomplishments. However, people with a growth

mindset tend to enjoy the process and their work more, whereas those with a fixed mindset are often stressed out from repeatedly trying to prove themselves. As a result, I often ask myself in various situations if I am cultivating a growth mindset or a fixed mindset. Which mindset I tend to have often appears to depend on the circumstances. As a result, I often must consider how I can shift my thinking to more of a growth mindset.

Fortunately, through the process of helping my two children learn to play the violin via the Suzuki method, I have learned that the Suzuki method is as much about cultivating a growth mindset as it is about learning to play the violin. For example, through the Suzuki method, I am helping my daughters overcome challenges. When one of them 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. Likewise, when students are stressed about writing journal articles about their research findings or if they are just experiencing writer's block, I have them start by just sending me a very simple outline, which I incrementally ask them to keep expanding until the article is basically written.

There is also a second very helpful idea I have learned from the Suzuki method. When a concert is approaching, according to the advice of their Suzuki violin teacher, my children practice performing their recital pieces three times every day for a month ahead of time. What this does is help shift the performance into the subconscious part of the brain, so that their performance becomes automatic. This shift is what allows them to reliably perform in a concert without making a single mistake, even when a part of the brain may be distracted by the audience and nerves.

After observing how much this recital preparation has helped my children, I now take the time to plan and write down everything I intend to do and say (even every word) during each

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lecture period of every class I teach. Even though I don't plan to read from a script during the lecture period, planning the lesson out in such detail has helped me to better organize and deliver the course material. It also helped me to make high-quality video lectures for my introduction to electromagnetics course (<https://utah.instructure.com/courses/684846>) and my numerical electromagnetics course (<https://utah.instructure.com/courses/726806>). Unfortunately, this process takes several hours of planning per lecture period, which seemed quite unmanageable at first (and I do not recommend this approach early on for assistant professors). However, ultimately the outcome has been worth the effort. I am now much more comfortable delivering interactive lectures that include active learning. I enjoy teaching more, and my course evaluations are some of the highest in the College of Engineering at the University of Utah.

BUILDING GRIT

Mozart's hard work paid off because he had high levels of two key ingredients: an immense level of perseverance (i.e., the ability to overcome setbacks to conquer an important challenge) as well as strong passion (i.e., the ability to become obsessed with a certain idea or project for a long period of time). High levels of these two qualities 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 (including pure talent, IQ score, SAT score, and even having a growth mindset) [2].

So, how can we build grit into our careers and other endeavors? I believe that learning about the challenges and disappointments that successful people have experienced while working toward their own goals is very helpful. This way, when we reach an obstacle ourselves, it does not seem as though we are the only ones to encounter a setback or that we are unfit to overcome it. Books like *Fantastic Failures: True Stories of People Who Changed the World by Falling Down First* [5], which I recently discovered and am currently reading to my children, are very helpful. If you know of other such books for adults or children, I would be very interested in hearing about them.

I also believe that if we learn how to build grit into one area of our lives (e.g., learning to play the violin), it will be easier for us to build it into another area (e.g., debugging computer code until it works). At least, I believe that learning to play the violin as a child ultimately helped me to develop one of the world's most advanced computer models of electromagnetic wave propagation in the global Earth-ionosphere waveguide [see Figure 1(a)–(c)]. My students and I are currently advancing and utilizing these models to study space weather hazards to electric power grids (for preventing blackouts), locate airplanes that have crashed into the ocean, and help develop a ground-based GPS, to name a few applications.

NURTURING CREATIVE MOMENTS

As a student, I was often in awe of my Ph.D. advisor. He regularly came up with new and exciting research topics. At the time, I did not fully understand how he could repeatedly conceive of novel and interesting ideas. Since then, I have learned that a lot of his concepts just came from having decades of experience, which I lacked at the time. I also learned, though, that he read a lot and from a wide variety of sources. Years of experience will take time to acquire, but all of us can read

extensively to build our knowledge base. I have also since learned that our ability to create new ideas may be improved by using some strategies and techniques.

Twyla Tharp argues in her book *The Creative Habit* that creativity is not a magical act of inspiration; it is the result of hard work and dedication [1]. Even just taking the time to follow a “ritual of preparation” may help spark ideas. For example, Beethoven often started 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.

Beethoven was not developing ideas out of thin air, however. For example, he would often “scratch” for ideas. “Scratching is what you do when you can’t wait for the thunderbolt to hit you” [1]. We can scratch for ideas by reading, having conversations with coworkers or even strangers, examining previous works by others, and immersing ourselves in nature. In the case of Beethoven, he was an avid bird lover and would obtain musical motifs from listening to birds. Similarly, as just one example, in the engineering world, butterfly wings have inspired metamaterials for manipulating light.

I believe the biggest challenge people have for nurturing creative moments is to find a low-stress period of time to dedicate to this activity or, rather, to make time for it by prioritizing it in our lives. There are always issues that we must deal with at work each day: emails to respond to, looming deadlines, and so on. However, taking time to develop creative thoughts is important for ourselves, our work, and ultimately, society as a whole.

CONCLUSIONS

I hope you find it as uplifting and motivating as I do to learn that we can develop a growth mindset, build grit, and employ strategies to become more creative. We can use these tools to actively work toward our goals in all areas of our lives, but particularly in our careers. We can also help others (students, peers, children) understand that they, too, can reach their goals while also enjoying the process more if they understand

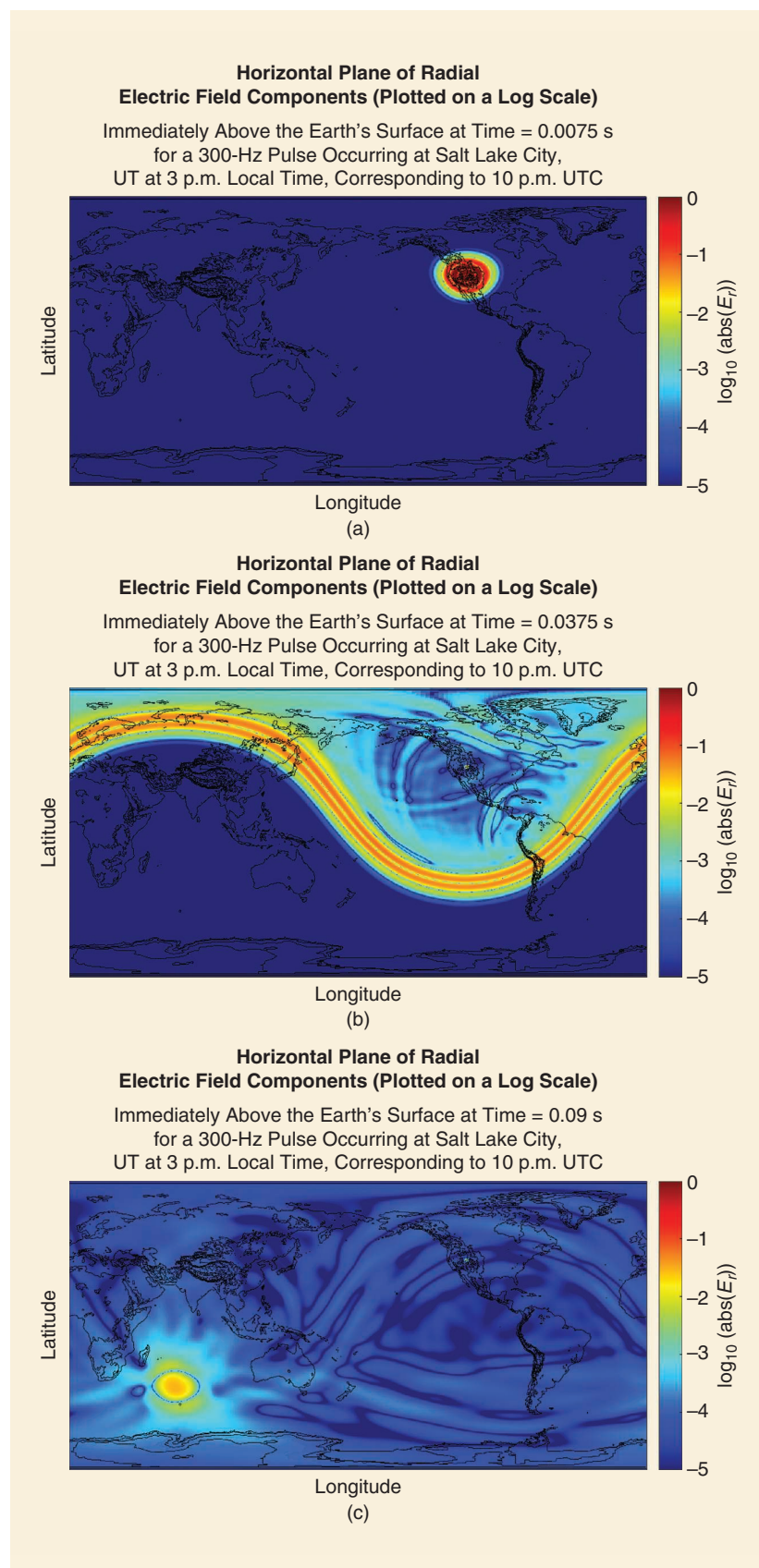


FIGURE 1. Three snapshots of global electromagnetic wave propagation away from a transmitter located at Salt Lake City, Utah, at three moments in time: (a) 0.0075 s, (b) 0.0375 s, and (c) 0.09 s.

that their capabilities are not fixed, that even very successful people must overcome obstacles, and that there are ways to become more creative. This is, for me, what makes my career as a professor very rewarding: mentoring the next generation of engineers to help them reach their goals while also developing and creating new engineering ideas that may help society at large.

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MEASUREMENTS CORNER

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