

August 2021

GEORGIA PATHWAYS

M A G A Z I N E



Wireless Electric Auto Charging

Oak Ridge National Laboratory

Soft Skills Redux

The Technology Association of Georgia Education Collaborative (TAG-Ed) strengthens the future workforce by providing students with relevant, hands-on STEM learning opportunities and connecting them to Technology Association of Georgia (TAG)

resources. Formerly the TAG Foundation, TAG-Ed is a 501(C)(3) non-profit organization formed by TAG in 2000. Later, the organization's name was re-branded to TAG Education Collaborative to facilitate our role as the leaders for K-12 STEM education in Georgia.

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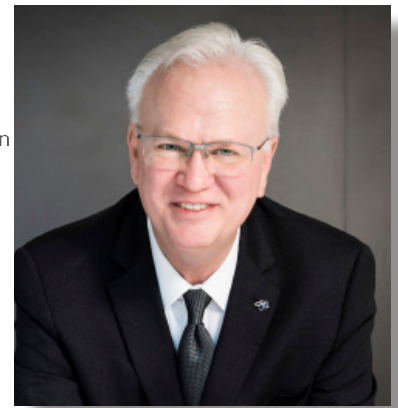
Equitable, Inclusive, Effective

RICHARD C. LARSON / MIT

Data Visualization

DR. SPOERRI

Welcome to the August issue of Georgia Pathways Magazine.



The innovation economy never stands still. All day and night, it reshapes the contours of competition and alters the dynamics of the workforce. While this makes for an exciting and creative ecosystem, it also brings intense disruption. Keeping up with change is often a challenge--especially for educational, training, and career development programs. As the technology races ahead, the human aspects often lag behind.

At TAG and TAG-Ed, our interest in technology is rooted in our commitment to the success of people, both young and mature - students pursuing knowledge, employees building skills and managers creating value in a hyper-competitive marketplace. We're here to guide members through this transformation so they can thrive, and we don't do it alone. This issue of Georgia Pathways includes an article on soft skills (communications, personal appearance, collaboration, compromise) that will certainly be valuable in the coming weeks.

The process of building and rebuilding our work environment and in some small measure, ourselves, is at the forefront of our minds. Recently, I was honored to join a panel discussion on "Capacity Building - Physical Infrastructure to Support Human Infrastructure." Thanks to Science for Georgia's Amy Sharma for inviting me to speak and introduce Georgia Lieutenant Governor Geoff Duncan. He's a strong supporter of up-skilling and STEM education, which are vital components of his Partnership for Inclusive Innovation (PIN).

The topic of capacity building is critical because we face a shortage of skilled tech talent. In Georgia, the unemployment rate for

tech workers is -3%, which means there are many more good-paying jobs open than there are qualified workers. By 2027, the shortage of tech workers in the nation will exceed six million. It's time for continued action to fill the skills gap.

Education and training are critical in this effort. TAG has awarded \$185,000+ in scholarships over the past 10 years, and earlier this year, TAG-Ed held its first virtual STEM Day with more than 80,000 students participating across Georgia. TAG-Ed also launched Pathways to Leadership, a career development program for young professionals. Applications to join our first cohort are open through the end of August and in December we'll have our Day of Code, supporting a global movement reaching tens of millions of students.

Working together with our partners and leaders in the tech community, we're making solid progress today, educating and building a technology workforce for tomorrow.

Larry K. Williams
President
TAG / TAG-Ed

Larry K. Williams serves as the President and CEO of the Technology Association of Georgia (TAG) and President of the TAG Education Collaborative (TAG-Ed). TAG-Ed's mission is to strengthen Georgia's future workforce by providing students with relevant, hands-on STEM learning opportunities by connecting Technology Association of Georgia (TAG) resources with leading STEM education initiatives.

Hands-free: Wireless charging system advances electric vehicle convenience

By Stephanie G Seay / ORNL

Consumer buy-in is key to the future of a decarbonized transportation sector in which electric vehicles largely replace today's conventionally fueled cars and trucks. Oak Ridge National Laboratory scientists have for several years now steadily advanced a wireless charging technology that can make powering an EV just as easy, or easier, than filling up a car with gas. The researchers are now nearing the completion of a new system to charge EVs while they're in motion.



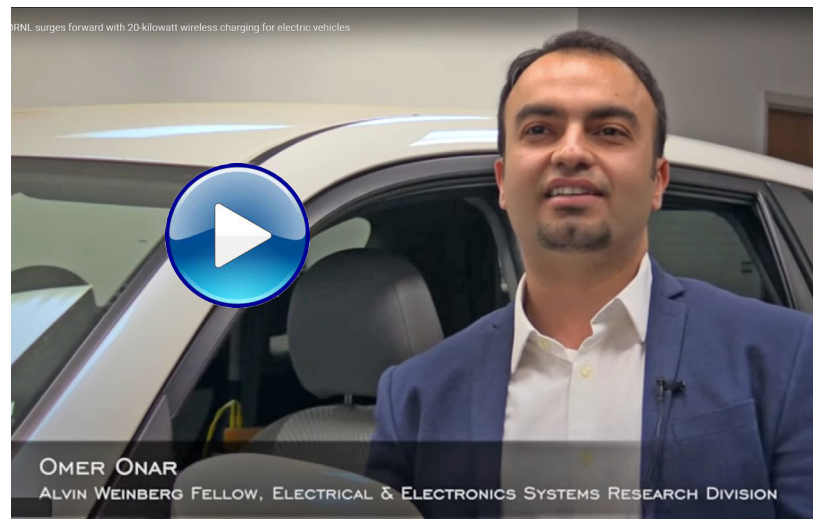
Electrifying transportation is at the top of the list for solutions to decarbonize the American economy. The transportation sector is the largest source of greenhouse gases in the nation, with cars and light trucks alone accounting for 60% of emissions. The Department of Energy has supported a range of research to make EV ownership more convenient and less costly for consumers, including the goal of a 15-minute or less charge time.

With custom magnetic coils, silicon carbide-based power electronics, and novel controls and shielding technology to handle stray emissions, ORNL scientists have proven that their system can wirelessly charge both a light-duty passenger car across a six-inch airgap and a medium-duty delivery truck across an 11-inch airgap at the 20-kilowatt level at greater than 92% power transfer efficiency — on par with a wired system. Power can even flow in both directions, enabling vehicles to serve as energy storage.

The researchers have successfully demonstrated a 120-kW wireless charging system with 97% efficiency, and are planning to install higher voltage systems, up to 270-kW, on passenger vehicles to meet or exceed the 15-minute charging goal.

The research is supported by the DOE Office of Energy Efficiency and Renewable Energy's Vehicle Technologies Office. The systems are built and evaluated at the National Transportation Research Center at ORNL, the only DOE-designated user

facility focused on performing early-stage research and development in transportation technologies. The medium-duty vehicle wireless charging demonstration was held at the new Grid Research Integration and Deployment Center, or GRID-C, at ORNL, which combines multiple electrification research across the vehicle, buildings, and grid space.



The researchers now have a finish line in sight for a system called dynamic wireless charging in which vehicles are automatically energized while rolling over specially equipped roadways. The researchers will make use of a new, one-of-a-kind test bed at GRID-C to evaluate the dynamic wireless charging system and to support research on how the technology will smoothly integrate into the nation's power grid.

“Once you get to these higher power levels to enable fast charging, you especially don’t want people handling the heavy cables typically required,” said Burak Ozpineci, who heads ORNL’s Vehicle and

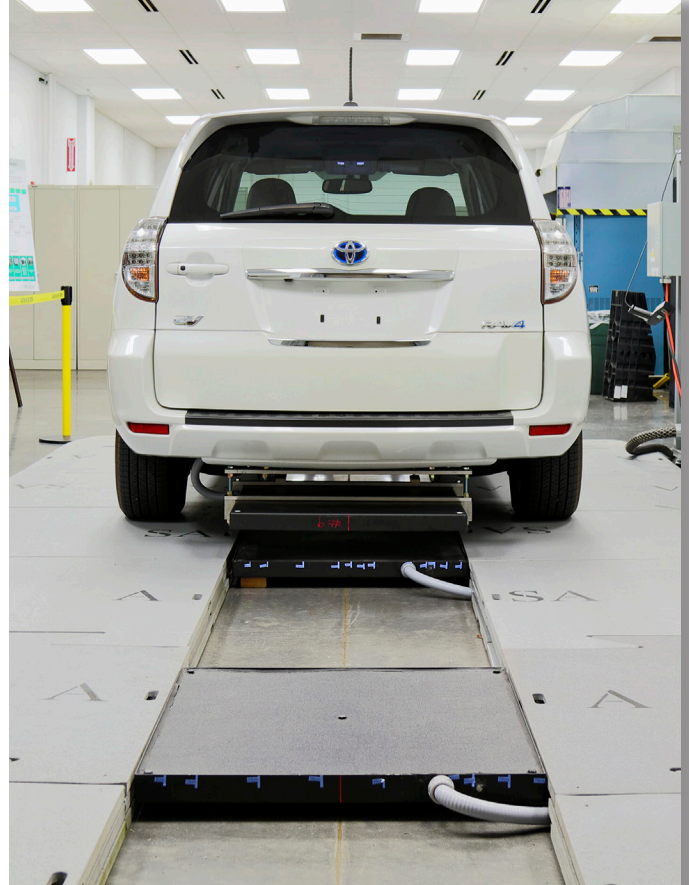
Mobility Systems Research Section. “With wireless technology you wouldn’t have to remember to plug in your vehicle at home, and it’s always topped off. You just park it in the garage and it’s done. The same with charging pads at workplaces or at extreme-fast wireless charging stations.”

“Now we want to take it a step further. What if you have an EV and never have to worry about having enough of a charge to go anywhere you like? We can accomplish that with dynamic wireless charging,” Ozpineci said.

With dynamic charging, for instance, some highway lanes or even on- and off-ramps would be embedded with charging pads, and your car is charged as you drive it over the coils. You would exit and enter the highway with the same battery charge.

Dynamic charging can also reduce the grid impact resulting from the peak demand of overnight charging in homes or at charging stations, Ozpineci said. Instead, that demand for EV charging would be level and allow for better grid stability.

ORNL’s dynamic charging goal is for a 200-kW system that can quickly charge vehicles at highway speeds. The economics look good. Installing dynamic charging on heavily traveled roadways means the cost of the system would be spread across many users, bringing the cost of ownership down.



Oak Ridge National Laboratory’s 20-kilowatt wireless charging system features 90 percent efficiency.

Convenient charging could even encourage the adoption of electrified semi trucks, said Veda Galigekere, who leads the Electric Drives Research Group at ORNL. Once the dynamic system undergoes full evaluation at GRID-C, it will be tested at the American Center for Mobility in Michigan.

The success of ORNL’s wireless charging technology relies heavily on researchers’ broad expertise in power electronics, control systems, electrical engineering and electromagnetics. A key development in the evolution of the ORNL wireless tech was the creation of a polyphase magnetic coil coupling design that allows for much higher power density in smaller coils.



Oak Ridge National Laboratory researchers demonstrated on Feb. 27 a 20-kilowatt, bi-directional wireless charging system on a medium-class hybrid electric delivery truck. Credit: Brittany Cramer/Oak Ridge National Laboratory, U.S. Dept. of Energy

The design encompasses a three-phase system that features rotating magnetic fields between layers of coils.

Even at the 300-kW level, the ORNL coil design has a much smaller footprint than currently available wireless charging technology due to that higher surface power density. The ground-based coil is about the size of an extra-large pizza, while the coil on the car is about the size of a small or medium pizza, said Omer Onar, who leads the lab's Vehicle Power Electronics Research Group.

Another important challenge in the work is resolving the issue of stray electromagnetic emissions around the coils.

ORNL is developing advanced shielding technology to control those emissions and the heat they can produce. The solution uses nano-crystalline materials together with aluminum to create a magnetic-metallic hybrid shielding technology that dampens emissions. The technology has been validated up to the 50-kW level already, Onar added.

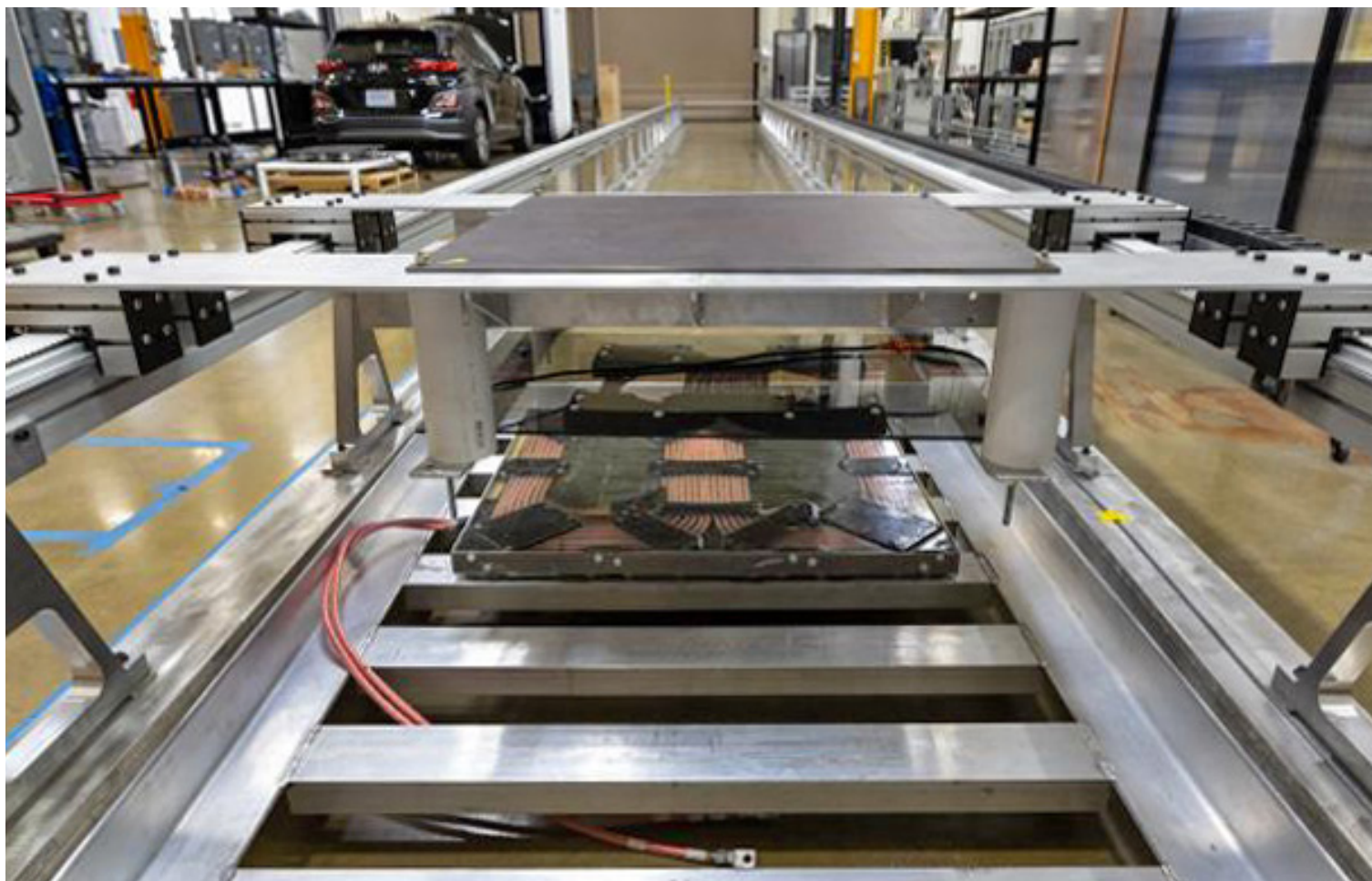
Automatic charging of vehicles resolves a major stumbling block for consumers who are hesitant to buy an electric vehicle. While consumers are increasingly aware that the newest EVs offer a lot of power, they also worry about whether they can get where they're going with currently available charging infrastructure.

“If you can charge wirelessly at home, at work, and even when you’re on the way, you never have to think about charging your car and you eliminate range anxiety,” Ozpineci said.



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UT-Battelle manages ORNL for the Department of Energy’s Office of Science, the single largest supporter of basic research in the physical sciences in the United States. The Office of Science is working to address some of the most pressing challenges of our time. For more information, please visit energy.gov/science.



The dynamic wireless charging test bed at ORNL accelerates an innovation that will charge electric vehicles while their being driven along specially equipped roadways. Credit: Carlos Jones, ORNL / U.S. Dept. of Energy



Soft Skills Redux

Heading Back To The Office and Classroom

By Wayne Carley

“It’s time to dust off those soft skills in preparation for the workplace”.

Soft Skills Redux

Going back - you're either going to love it, or hate it. I've talked with both and the vast number of early retirements speaks volumes. Poling shows strong feeling across multiple generations, with younger employees looking forward to the social interaction and work place environment. Older professionals above 40 seem to be less excited in general and very mature pros in their late 50's and up are crunching the numbers to make a decision.

Either way, heading back into the old office, cubical, work-station, lab, conference room, classroom or where ever home was in 2019 will require us to brush up on our soft skills as well as our appearance. Either this is an exciting time to go shopping or discovering the horror that we don't fit into any of our "work clothes" anymore.



A degree, technical skills diploma may get you an interview, but these soft skills will get you the job and corporate America continues to struggle with finding the combination.

You'll likely see these "soft skills" popping up in job descriptions, next to demands for technical qualifications. Employment experts agree that tech skills may get you an interview, but these soft skills will get you the job—and help you keep it:

Communication skills (language arts; the A in STEAM)

This doesn't mean you have to be a brilliant orator or writer. It does mean you have to express yourself well, whether it's writing a coherent memo, persuading others with a presentation, collaborating in the conference "face to face" or just being able to calmly explain to a team member what you need. Professional personal expression will always be in demand and though we may have cut people some slack on Zoom, it just will not fly in the office.

Personal appearance and manners

Casual Fridays at work were great but may be a thing of the past depending on the adjusted policies our employer decides upon. Pajamas are certainly "out" at work and we will not be able to just click "camera off" when the boss wants to speak with us.

People like to work with or do business with people who look and act professionally. It usually garners a sense of trust and respect as you represent your company or department with new clients or long existing ones who may be taking a second look at this business relationship. It's hard to be taken seriously if you look like you just rolled out of bed and are wearing what you wore yesterday, which can be said for many over the last year as we actually did just roll out of bed and slap on a shirt or blouse over our PJ bottoms.

Dressing professionally signals that you have your stuff together and are organized, serious, motivated and ready to provide the highest level of service. If your clothes are clean, pressed, and professional, it shows that you went the extra effort to represent.

Reputation: While we would like to think that everyone is judged solely on their performance, the truth is that you will be judged on your appearance, as well. You don't need to have an expensive wardrobe, but you will want to dress professionally and appropriately for your job or industry you are in or pursuing. *"Dress for success".*

Teamwork and collaboration

Employers want employees who play well with others—who can effectively work as



part of a team. “That means sometimes being a leader, sometimes being a good follower, monitoring the progress, meeting deadlines and working with others across the organization to achieve a common goal,” says Lynne Sarikas, the MBA Career Center Director at Northeastern University. It starts in elementary school.

Flexibility and Adaptability

These skills are especially important for more- seasoned professionals to demonstrate their value and motivation and to counter the (often erroneous) opinion that older workers are too set in their ways. This is a vital soft skill regardless of age.

To succeed in most organizations, you need to have a passion for life-long learning and the ability to continue to grow

and stretch your skills to adapt to the changing needs of the organization and technology. This has never been more true than right now during our “transition”, back to the world.

On your resume, your cover letter and in your interview, explain the ways you’ve continued to learn and grow throughout your career. This is just as important for teachers as they pursue new positions. It’s been said in business - adapt or die.

Problem solving (the engineering method)

If you are headed out to one of the thousands of new positions to be filled, be prepared for the “how did you solve a problem?” interview question with several examples. Think of specific examples where you participated in solving a tough business or group problem.

Solutions are what employers are looking for, and a problem solver has high value no matter the industry.

Be able to explain what you did, how you did it, how you involved others and what the outcome was—with real, measurable results. What class in middle school teaches this?

It may seem like employers are desperate for anyone to join their team right now, but don't be fooled. They may seem desperate today, but in six months, you just might be easily replaced.

Critical observation (if you want to be an exceptional employee)

It's not enough to be able to collect data and manipulate it. You must also be able

to analyze and interpret it and then apply it. What story does the data tell? What questions are raised? Are there different ways to interpret the data? What are the applications? Instead of handing your boss a spreadsheet, give them a business summary and highlight the key areas for attention, and suggest possible next steps. (language arts once again)

Conflict resolution

Most of us have enjoyed “conflict avoidance” this past year, not having to look that person in the face in the hall or break room. That's probably about to change. Conflict resolution is not always the responsibility of human resources or your boss, but often yours personally, within your working group.



The ability to persuade, negotiate and resolve conflicts is crucial if you plan to be successful in any career. Most teenagers, for a variety of reasons, do not yet have well developed skills in this area. You need to have the skill to develop mutually beneficial relationships in the organization so you can influence and persuade people.

Of course this should be a required class in school, but it's not. The skills to deal with daily conflicts at home and school and ultimately work are either ignored and allowed to fester into bigger problems or passed off to management who can't help but notice your inability to deal with it.

For those of us going back into the office environment, we too will need to revisit our conflict resolution skills. Going a year without having to sit down face to face and "work things out" makes even the most skilled resolvers a bit rusty and off our game. Whatever resources you've used in the past for this purpose should still be available and relevant as conflict and resolution haven't changed much.

Win, win

Be able to negotiate win-win solutions to serve the best interests of the company and the individuals involved. When it comes to soft skills, show—don't tell. Demonstrating these soft skills may be more difficult than listing concrete accomplishments like \$2 million in sales or a professional certification, but

it is possible to persuade your teacher, parent or employer that you have what it takes to resolve a conflict through negotiations, personal responsibility, and compromise.

"I'm a confident, professional woman. Trust me."



Susan P.
Software Engineer on
a casual Friday.

To demonstrate communication skills starts with the obvious. Make sure there are no typos or grammatical error in your homework or work-work.

On a resume, instead of stating, “Great oral and written communication skills”, explain how you persuaded your teacher or boss to change their position, policy or procedures that benefited the group or organization.

Be able to verbalize how you would handle or handled conflict resolution between employees, clients, family or classmates.

Language arts may be the most obvious place to start, but every environment you can name will require these soft skills, and your competence will speak volumes to those you interact with at home, school or work.

You only get one chance to make a good first impression.



“Welcome home”



FINGERPRINTS EXERCISE



Bias

By Peter J. Sherman

“Don’t be eaten by it. A more complete understanding.”

Are you more likely to be eaten by a cow or a shark?

How many muscles are in the trunk of an African elephant?

Your fantasy baseball player with a .335 batting average had no hits in the last three games. Should you keep him in the lineup, or replace him with a .250 hitter who had four hits in the previous game? And what in the world do these questions have to do with bias?

How people answer these questions will affect the quality of their decision-making and shows whether they have fallen for a bias trap. Despite our best intentions, we all fall prey to various forms of bias that interfere with good decision-making.

Fundamentally, bias means that a person prefers a certain idea and possibly does not give equal consideration to other ideas. Common examples include our expectations of others, planning for the future, how we communicate, and decisions about our life. There may be a good chance we are going to be wrong about all of these from time to time.



Many of these traps stem from the fact that people don't carefully process every piece of information in every choice they make. Instead, we rely on mental shortcuts known as heuristics. These allow us to make decisions in the face of uncertainty or when extensive analysis is too time-consuming.

Nearly all decisions are biased, and this is what enables us to make so many decisions in a day, from choosing what we want for breakfast to deciding to press the brakes when we approach a red light. Human brains are wired to make these decisions to save time and even save our lives. This frees us to spend time on higher priorities and more complex problems. But biases also can harm us. They can creep in and distort our thinking if we blindly rely on them.

Although there are dozens of types of biases, they tend to fall into four main categories.

1. Overconfidence bias is the tendency to believe you are more certain than you really are about a given situation. Psychologists have shown that human beings are systematically overconfident in their judgments. Overconfidence has been blamed for the sinking of the Titanic, the nuclear accident at Chernobyl, the loss of Space Shuttles Challenger and Columbia, the sub-prime mortgage crisis of 2008, and the Deepwater Horizon oil spill in the Gulf of Mexico.

We tend to assume that the accuracy of our judgments or the probability of success in our endeavors is more favorable than the information would suggest. When there are risks, we alter our read of the odds to assume we'll come out on the winning side. When we feel too confident in our understanding, we don't spend enough time or money acquiring more information or running further analyses.

Experienced professionals and senior decision-makers who have been promoted based on past successes are especially vulnerable to this bias because they have received positive signals about their decision-making abilities throughout their careers.

For example, a newly hired senior project manager with a successful track record of completing projects on time, within scope and under budget might feel extremely confident in their ability to easily excel in new projects, even if the tasks pose a unique scope and different complexities. This manager might approach these projects without assessing the new challenges and working to address them.

This overconfidence occurs in every industry as well as the classroom and at home. Thinking thing through is our best friend, and avoiding a costly failure or misspoken word can drastically impact our wellbeing,

Decision making is a STEM skill:
"The Engineering Method"



2. Confirmation bias is the tendency to look for information that supports a preconceived notion and reject information that casts doubt on the desired outcome. This has happened frequently over the last year regarding our decisions about Covid vaccinations, election results, racial tensions, policing, science and so on.

Have you ever blindly believed what you heard on social media or the Internet, only to discover you were seriously wrong? If so, you've been swayed by confirmation bias.

This is the ultimate decision-making trap, and it becomes even harder to avoid when individuals face pressure from bosses or peers. For example, a friend or family member tells you about something someone said on an important issue.

You trust them, so it must be true. You then take a few minutes to look deeper into the topic or comment to find that their source of information is completely unreliable or distorted and in some cases a complete lie. We then feel foolish about our blind support and hope the consequences are not damaging to ourself or others. (the science in STEM)

It's happening as we speak world wide on every topic imaginable. In some cases the costs are life threatening.

3. Stereotyping involves one's perception of another person based on a generalization of that individual's gender, ethnicity, personality or other factors, without having actual information about the person in question.

This bias starts with humans' automatic



tendency to categorize individuals or objects to make sense of the world. Categorization provides order and predictability that we can rely on to guide our interactions with others. However, it also can lead us down paths we regret.

For example, if you assume all Gen Zers don't like to work in groups, all baby boomers are technophobes, and all millennials have a sense of entitlement, you will easily misjudge a valuable employee, neighbor, or coworker.

Stereotypes also can represent positive opinions. For example, if your warehouse manager is a retired military commander, he might assume that all veterans have a strong work ethic, are disciplined and respect authority. If he sees these as ideal qualities for new hires, he might push human resources to only consider veterans for open roles. Although these characteristics may very well be true of many veterans, other individuals may have these qualities too.

4. Sunk-cost bias is the tendency to escalate a commitment to a failing course of action if one already has invested a great deal of time, money and other resources that are not recoverable.

Project Leap Frog was supposed to be a game changer for Universal Fulfillment Inc. It was going to seamlessly integrate 53 legacy computer systems into a single, user-friendly platform within five years and at a cost of \$250 million. Five years and \$500 million later, the project still is inoperable. An internal assessment by the engineering and information technology teams indicated a low probability of success, which still would take another three years and \$150 million of investment.

Despite the cost overruns, delays and prognosis, the CEO fumed at the suggestion of abandoning the work. He felt that they'd already spent \$500 million, so there was no turning back.

The CEO was emotionally attached to the effort. If people behaved rationally, they would make choices based on the marginal costs and benefits of their actions and ignore sunk costs.

How to outsmart bias traps

All of these biases regularly skew decision-making — even when the best data, experience and logic are available. In addition, more than one bias can exist in a given situation, which makes avoiding these traps even more difficult. But once you're aware that these traps exist, you can use a variety of tools and techniques to effectively mitigate your biases.

First, you should embrace scientific thinking. Regarding a project of assignment you are responsible for, I recommend following a disciplined process in order to -

- Carefully observe and understand the current situation
- Describe it in an objective, fact-based and timely manner
- Form a hypothesis or prediction about the probable, although not necessarily desired outcome
- Conduct experiments or tests on the effectiveness of the project
- Observe changes and review data constantly, start to finish
- Make a realistic conclusion.

Regarding all of the bias's discussed, consider these questions:

- What are we missing from our current understanding of the problem, issue, topic or person? Where are our blind spots?
- Do we have the right, accurate source of information from a trusted source? Is it reliable data?
- Are the issues really symptoms of something else? Is the problem clear?
- How much time have we spent looking at this from a “non-bias” perspective?
- Have I done all that I can to make sure my decision, attitude or participation is validated in fact?

Psychology Today reports that the average person makes 35,000 decisions per day. Most are non-consequential. However, a portion are decisions that require more objectivity, and you should be mindful of recognizing biased decisions and avoid them when possible. And, in case you're still wondering:

- Cows kill four times more people than sharks.
- The African elephant has 100,000 muscles in its trunk.
- Keep your top baseball player in the lineup. Looking at only a handful of games is statistically too small.



Forensic DNA preservation

Best method for gut microbiome samples

Microbiology

noun

mi·cro·bi·ol·o·gy | \ ,mī-krō-bī-ä-lə-jē

Definition of microbiology

: a branch of biology dealing with microscopic forms of life

Example:

After completing his Ph.D in mycology and plant physiology, Brock worked for a few years in the pharmaceutical industry, specializing in microbiology and molecular biology.

Microba Life Sciences, leaders in precision gut microbiome science, have demonstrated the superiority of their sample preservation method against others, with a robust, peer-reviewed study.

The company's scientists conducted one of the most rigorous studies to date to evaluate the performance of five room temperature faecal preservation techniques, finding a method designed for preserving forensic DNA outperformed other commonly used faecal preservation methods. Using metagenomic analysis, the study highlighted the FLOQSwab in an active drying tube as the top method when compared to four other faecal preservation techniques.

Microba Co-founder, leading microbiologist and senior author on the paper, Professor Philip Hugenholtz, explained that it was critical for microbial communities to be accurately and reproducibly preserved for important advancements in medicine to be made from gut research.

Gut microbiome

Gut - digestive tract

Microbiome: a community of microorganisms such as bacteria, fungi, and viruses that inhabit a particular environment and especially the collection of microorganisms living in or on the human body

“Interest has been increasing in the gut microbiome as a marker for the diagnosis and treatment of a range of human diseases over recent years,” he said.

“This means that researchers must be confident that their sampling method will provide accurate, stable and reproducible results for gut microbial communities.”

Senior Scientist and lead author, Dr Alena Pribyl, explained that the alternative could lead to researchers chasing false leads or missing key biomarkers. “Very few studies have critically assessed faecal preservation methods at the species-level using metagenomic sequencing, despite the importance of getting this first step right in a gut microbiome study,” she said.

For this comprehensive study, the company compared both microbial species and functional profiles from five room temperature preservation methods to the commonly accepted best practice of flash freezing samples.



Six replicates from five different individuals were used for each method, for a total of 180 metagenomes.

“This is the largest study to assess both the technical and compositional reproducibility of various room temperature microbial preservation methods, and we found that not all methods are able to accurately preserve faecal microbial communities.” Dr Pribyl explained.

“While the FLOQSwab in an active drying tube outperformed other methods, we also found two of the methods resulted in unpredictable outgrowth of facultatively anaerobic species, such as *E. coli*.

“We therefore recommend against the use of these methods for room temperature storage.”

The scientists further evaluated the best performing method at different storage temperatures to determine its range of use, finding that it accurately preserved microbial communities at temperatures ranging from -20°C to 50°C for up to four weeks.

“This study shows the importance of rigorously evaluating faecal preservation methods,” Professor Hugenholtz said.

“It also shows that the FLOQSwab in an active drying tube is an excellent option for gut microbiome sample preservation, especially where faecal samples need to be collected and transported across long distances.”

Forensic Science

Forensic scientists collect, preserve, and analyze scientific evidence during the course of an investigation. While some forensic scientists travel to the scene of the crime to collect the evidence themselves, others occupy a laboratory role, performing analysis on objects brought to them by other individuals.

Still others are involved in analysis of financial, banking, or other numerical data for use in financial crime investigation, and can be employed as consultants from private firms, academia, or as government employees.

In addition to their laboratory role, forensic scientists testify as expert witnesses in both criminal and civil cases and can work for either the prosecution or the defense. While any field could technically be forensic, certain sections have developed over time to encompass the majority of forensically related cases. Forensic science is a combination of two different Latin words: *forensis* and *science*.



Equitable, Inclusive, Effective STEM Learning for All

Richard C. Larson

Massachusetts Institute of Technology



“The beautiful thing about learning is that nobody can take it away from you.”

– B.B. King

Imagine that every high school classroom in the US – urban, rural and suburban -- has access to a Team of world-class STEM teachers. These video-recorded teachers partner with today’s in-class teachers in a “Teaching Duet,” a new active-learning pedagogical model. Students would come to class wanting to engage, eager to learn, then seeking to apply their new knowledge.

The imagined class opens with the in-class teacher showing on a large screen Segment #1 of a downloaded video STEM lesson, taught by a Team teacher -- credentialed, superlative, engaging. This virtual teacher provides not a traditional chalk-and-talk content-delivery lecture but rather an energetic, professionally produced presentation of a given STEM topic, complete with demonstrations, scientific history and arguments supporting the results.

This video teacher then challenges the class to a related active-learning exercise. After a challenge is given, the in-class teacher turns off the video and engages the class in high-energy active learning for the next five or so minutes. Once the class achieves the learning objective, the teacher turns back on the Team Teacher video for segment #2 of the lesson. This back and forth teaching duet continues for the entire class time. The in-class teacher’s role is just as important as ever, not for lecturing content but for facilitating student active learning, deepening their engagement/understanding, and teaching them to learn how to learn.

We advocate an inclusive national effort to design and create a full set of Teaching-Duet lessons for all high school STEM classes. These lessons would be available free of charge via Open Learning to all high schools in the U.S.

The quality of what students experience in the classroom would no longer be limited by their ZIP code: urban, rural or suburban! Consider the educational boost possible to many economically disadvantaged students.

All students can learn from world-class highly diverse teachers – yielding full equity in delivery of STEM education.

Student engagement should grow significantly, and their STEM-related academic performance should improve dramatically. Our MIT BLOSSOMS program (<https://blossoms.mit.edu>) is an illustrative working prototype of the types of Teaching-Duet STEM lessons we describe.

Our present STEM education system needs major innovations. The evidence ranges from statistical to episodic:

U.S. math students rank #31 of 64 countries given the highly respected PISA test. Within the U.S., the gap in performance between top and bottom performing students is widening.

Baltimore HS student fails all but 3 classes over 4 years, ranks near the top half of class.



Minor tweaks will not achieve major improvements. It's time to teach STEM at scale, national scale. In current mode,

teaching in our schools has remained a craft profession, a single-person work style essentially unchanged from the Middle Ages. Despite their Internet access, teachers' activities remain craft-like, since the education systems in which they work do not support what we propose -- multi-jurisdictional scaled effectiveness and efficiencies.

To allow our ideas to happen, current STEM education stakeholders need to support its goals and objectives, and to co-invent many of its details. Current STEM teachers can become advocates since, under our proposal, no in-class teacher loses a job; they will be trained to adopt a pedagogy that supports active learning. For years, the MIT BLOSSOMS Teaching-Duet lessons have been welcomed on the web sites of the two largest teacher's unions in the U.S.: National Association of Teachers and American Federation of Teachers.

We should learn from union leadership what attributes of the proposed new Teaching-Duet system would be important for them to become advocates for and co-inventors of change. For instance, if they were to choose, they could play a major role in STEM teacher training directed towards the new active-learning pedagogy and curriculum.

Financing: Our Teaching-Duet proposition should receive substantial bi-partisan support at the Federal level in Washington, DC, where quality STEM education is advocated by all. The program is also

likely to be supported by industry leaders such as IBM, Microsoft and Amazon, for many years backers of strong STEM education. Upfront production and training costs will be substantial, in the many tens of millions of dollars, but downstream educational benefits to our nation should be orders of magnitudes greater.

"Even now, at 82 years old, if I don't learn something every day, you know what I think? It's a day lost." 2007.

B.B. King (1925 – 2015)

Let's not have any more lost days ...

To understand more about this topic, refer to these links:

<https://www.nationalacademies.org/news/2021/07/science-education-should-be-national-priority-new-report-calls-on-federal-government-to-encourage-focusing-resources-on-high-quality-science-for-all-students>

https://hechingerreport.org/proof-points-rural-american-students-shift-away-from-math-and-science-during-high-school-study-finds/?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+HechingerReport+%28Hechinger+Report%29

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<https://idss.mit.edu/staff/richard-larson/<rclarson@mit.edu>> For over 20 years at MIT, Professor Larson has led various secondary and tertiary technology-enabled education initiatives.

Teaching Visual Learners with Data Visualization

by Dr. Spoerri

Visual learning tools are being used more and more in today's classrooms because of their proven effectiveness in helping students understand complex concepts. Some studies have shown that 65% of us are visual learners, and that visual aids can improve learning by up to 400%.

Recently, Dr. Anselm Spoerri of the School of Communication and Information at Rutgers University presented an ACRL/Choice webinar: Teaching Visual Learners with Data Visualization—Delivering an Active Learning Experience for Engineering Students.

In this webinar, Dr. Spoerri emphasized the importance of selecting the right display format to make data patterns visible.

“It’s all about being able to tap into the perceptual capabilities of the viewer so that they can gain insights into the data sets,” he said. Dr. Spoerri outlined key data visualization design principles:

1. Interactivity

When the user interacts with the data, the display gets updated instantaneously. The New York Times delegate calculator is a great example.

2. Immediate Feedback

This function is essential for supporting interactivity. Immediate feedback allows the user to instantly extract meaningful information from the visualization.

3. Linked Displays

To explore a large information space, such as 5 – 10 data variables, multiple displays are needed to show subsets of the data space. Linked displays enable the user to explore how one selection in one display plays out in another display. An example is a stacked scatterplot.

4. Overview > Zoom + Filter > Details-on-Demand

This three-pronged approach is also known as Shneiderman’s mantra. The



overview allows the data to be seen all at once. The user can then interact with that data with zooming controls and filters to focus in on a specific aspect of the data. Finally, the user can mouse over a specific item to get details-on-demand.

"Instant feedback"



5. Dynamic Queries

This principle is related to interactivity, immediate feedback, and the ability to filter. For example, when a user specifies a query in a parallel coordinates display, instantaneous feedback is shown as the query is being executed.

6. Focus + Context

With a very large data space, it's important that the user is able to see the overall context when zooming in on specific data.

A fish-eye distortion is a good example of this principle in action.

7. Animate Transitions

This design technique makes it easier for viewers to assimilate changes in data. The transitions are animated, rather than just showing the beginning state and the end state. Bubbles and motion charts achieve this.



8. Increase Information Density

The goal here is to pack in as much data as possible. “Leave no pixel behind,” says Dr. Spoerri. With a treemap, the user gets a big picture of the hierarchical structure, and is able to zoom in and explore the data in more detail.



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