

Running Head: A LEADER'S TOOLKIT FOR SCIENTISTS AND ENGINEERS

A Leader's Toolkit for Scientists and Engineers:

Stretching Beyond Technical Skills

Shana Passonno

Masters in Leadership and Negotiation

Bay Path University

Table of Contents

Abstract.....	3
Introduction.....	4
Literature Review and Background	7
Current Challenges in STEM Graduate Education.....	7
Calls for Reform in STEM Graduate Education.....	9
Model Programs: Teaching Soft Skills in STEM	11
Soft Skills Training in STEM: Identifying Themes for a Pilot Program	13
Frameworks for Analysis.....	13
Emotional Intelligence.....	15
Primal Leadership: Unleashing the Power of Emotional Intelligence; Lab Dynamics: Management and Leadership Skills for Scientists.....	16
Influence: Science and Practice; The Art of Decision Making; Predictably Irrational: The Hidden Forces That Shape Our Decisions.....	19
Getting to Yes: Negotiating Agreement Without Giving In; Getting Ready To Negotiate: The Getting to Yes Workbook.....	28
Difficult Conversations: How to Discuss What Matters Most.....	33
Methods and Context	40
Results, Discussion & Analysis	42
Participant Registration and Attendance.....	43
Overarching Series Results.....	45
Emotional Intelligence.....	46
Persuasion and the Art of Decision-Making.....	49
Developing an Effective Negotiation Strategy	52
Navigating Difficult Conversations	55
Successes and Opportunities for Improvement.....	59
Conclusion	60
References.....	63
Appendices.....	66

Abstract

This capstone paper identifies training gaps in science, technology, engineering, and mathematics (STEM) graduate education, where academic and technical training take precedent over the soft skills highly sought by employers. These training gaps are fueling a growing misalignment between the workforce produced by Universities and the workforce desired by employers. This capstone will investigate the training shortfall from a national perspective, identify critical soft skills sought by STEM employers, research best practices for those skills, and develop a pilot training program for STEM graduate students at the University of Massachusetts (UMass) Amherst. The findings and training modules can be disseminated to STEM doctoral education programs at a broad array of Universities. Although this capstone paper analyzes the skill demands of non-academic employers, soft skills are essential in all career paths and students interested in academic careers will be strongly encourage to participate.

Introduction

The U.S. science, technology, engineering, and mathematics (STEM) graduate education system has been growing steadily, with enrollments climbing from 303,000 in 1975 to nearly 668,000 in 2015 (NACEM, 2018, 26). For decades, research has provided insights about a changing labor market that necessitates an evolution of workplace skills to support it. As the STEM graduate education enterprise doubles, stakeholders question whether the skills imparted appropriately align with those desired by employers. According to Alan Leshner, CEO Emeritus of the American Association for the Advancement of Science (AAAS), “The current system works well for the PIs [principal investigators], institutions, and federal agencies that get relatively cheap labor and churn out lots of papers in top journals. But it doesn’t work well for students, and for many employers.” (Mervis, 2018, *Science*). A focus on research productivity perpetuates an emphasis on “hard skills.” Consequently, STEM job candidates fall short with employers who increasingly focus hiring decisions on soft skills and express frustration about the misalignment between what Universities teach and what employers need (Chamorro-Premuzic, *Forbes*, 2018). In their *2018 Job Outlook*, the National Association of Colleges and Employers (NACE) collected survey data from 201 employer members to identify the key attributes employers look for on students’ resumes (Gray and Koncz, 2017, *nacweb.org*). The top two attributes were problem-solving (83 percent) and ability to work in a team (83 percent), followed by communication skills (80 percent), leadership (73 percent), work ethic (68 percent) and initiative (68 percent) (Gray and Koncz, 2017, *nacweb.org*). Additionally, soft skills are implicated as predictors of job performance and training potential, signifying influence beyond hiring practices (Chamorro-Premuzic, *Forbes*, 2018). Soft skills are being used to predict adaptability, leadership potential, and ability to learn; such judgments have significant

implications for downstream career opportunities and success (Chamorro-Premuzic, *Forbes*, 2018).

Globally, we are dependent on an innovative STEM workforce, and there is widespread concern about increasing employment gaps in STEM fields (Kramer et al., 2014, 3). In the United States, corporate recruiters have expressed doubt that they can fill the 75 percent of occupations that require middle- or high-level STEM skills (Kramer et al., 2014, 3). Initially, experts wondered if not enough STEM graduates were being produced, but data suggests otherwise. In a 2014 report commissioned by the *New York Academy of Sciences* (NYAS), researchers presented a global STEM paradox: “While there are greater numbers of STEM graduates worldwide than ever before, STEM jobs continue to go unfilled” (Kramer et al., 2014, 3). A significant factor in this STEM paradox is a mismatch in skill development. Many STEM graduates lack the basic professional skills (“soft skills”) that are essential for effective communication, critical thinking, problem solving, and teamwork (Kramer et al., 2014, 4). According to Suzanne Ortega, President of the Council of Graduate Schools, “many agree that the way we prepare these graduate students, currently, is too narrowly focused on academic research skills at the expense of developing professional and personal skills valued by employers both outside and inside the academy” (Denecke et al., 2017, 5). The NYAS report reinforces this view, recommending that educators take steps to more strategically align curricula and skill development with workforce needs (Kramer et al., 2014, 12).

This paper makes the following contributions:

- An identification of soft skills valued by STEM employers
- A justification for the inclusion of soft skills training in STEM graduate education
- A literature review of soft skills best practices to inform training strategies
- Frameworks for soft skills training modules to be piloted at UMass Amherst

This paper will validate the necessity of soft skills training in STEM graduate education by analyzing reports from a variety of stakeholders, including private sector employers, non-profit organizations, professional associations, and government agencies who unite in their desire for curricular reform. Additionally, a review of current best practices in soft skills training for STEM students will be conducted. Findings will inform pilot training modules to be designed and implemented for STEM graduate students at UMass Amherst. The information gathered through this study and the resulting training modules have the potential for broad dissemination and can be adapted to serve a broader array of disciplines.

Literature Review and Background

This literature review describes current challenges in STEM graduate education, documents widespread support for educational reform to include soft skills, analyzes model programs, and recommends soft skills topics for inclusion in training modules for STEM graduate students at the UMass Amherst.

Current Challenges in STEM Graduate Education

Throughout their studies, STEM graduate students navigate a tangled web of power dynamics, misaligned incentive systems, and conflicting priorities. The situation is especially fraught for doctoral students, who typically receive a wage (“assistantship”) for conducting research in their faculty advisor’s lab. Faculty secure funds to support research assistantships by competing for grants, largely from federal agencies such as the National Science Foundation and National Institutes of Health. This establishes a transactional relationship between student and advisor and can infuse conflicts of interest into the mentoring relationship. Resulting power differentials can “reduce a student’s ability to comfortably advocate for him- or herself” and graduate students are increasingly reporting mental health issues (NASEM, 2018, 71). Challenges are further exacerbated by an incentive system that promotes and rewards faculty based on research publications and research grants, with little to no value assigned to teaching and mentoring (NASEM, 2018, 16). This creates a culture within U.S. research-intensive institutions characterized by a “mismatch between the incentives that determine the professional priorities of many faculty members and universities and the diverse education and career needs of STEM graduate students” (NASEM, 2018, 16). What emerges is a “system that rewards research output over the quality of education, advising, and mentoring” (NASEM, 2018, 22). With research productivity at the center of STEM graduate education, it is not surprising that

technical training dominates graduate curricula. Dr. Jessica Seeliger, Assistant Professor at Stony Brook University School of Medicine, highlights a conundrum, “As researchers, we are trained to work within a rational and methodical framework” (*Nature*, 2012). Such a stance marginalizes the influence of emotions on decision-making, leaving students ill equipped to recognize and successfully navigate complex situations. As Nick Burnett, Managing Director of Results for Development (USAID) points out, “Employers are often looking for specific technical skills but also soft skills. This is a problem for university graduates. They know about science, but not behaviors needed in the workforce” (Kramer et al. 2014, 13). Cohen summarizes the problem, “If scientists are willing to invest time and effort in learning a new technical skill, why do they not do the same for management and interpersonal skills?” (Cohen, 2012, 10).

In addition to the misalignment of *which* skills are taught to STEM graduate students, there are also criticisms of *how* those skills are taught. First, there is a pervasive assumption that STEM students learn essential skills by observing advisor behavior. Unfortunately, under the current incentive model, students are often observing (and perpetuating) the *wrong* behaviors. According to Dr. Daad Abi-Ghanem, Director of Research and Development at Immunology Consultants Laboratory, “The skills we acquired from watching and consulting our mentors and colleagues typically fall short of what is needed to be a truly great, empowering, and inspiring leader” (*quartyzy.com*, 2017). A second challenge lies in STEM curriculum design and delivery. “The frequent emphasis on rote learning and memorization in STEM subjects often results in graduates who struggle to apply the concepts they learned to the real-life challenges they face in the workplace” (Kramer et al. 4). A strong educational system is one that “combines classroom learning with real-world experiences to provide students with both the technical and personal professional skills they need to succeed” (Kramer et al. 2014, 6).

Calls for Reform in STEM Graduate Education

The U.S. has long enjoyed its international “gold standard” reputation for STEM graduate education. However, increasing concerns voiced by key stakeholders across industry, non-profit, government, and academic sectors press for reform if the U.S. is to preserve its international brand. A 2017 Council of Graduate Schools report states, “U.S. doctoral programs are widely reputed to do an excellent job of preparing candidates to conduct academic research. But the misalignment between the narrow preparation PhD candidates receive and the broad array of careers they pursue has resulted in widespread criticism and calls for reform” (Denecke et al., 2017, 7). Similarly, the National Academies of Sciences, Engineering, and Medicine (NASEM) convened a *Committee on Revitalizing Graduate STEM Education for the 21st Century*, comprised of students, faculty, university administrators, industry leaders, and policy makers, to conduct a comprehensive review of U.S. STEM graduate education and recommend reforms (NASEM, 2018, 1). These high-level initiatives symbolize strengthening alliances and their recommendations have been echoed by experts ranging from economists to recruiters to agency and corporate executives.

Economists studying labor market trends report increasing demands (and rewards) for social skills (Deming, 2017, 1). Deming reports that “between 1980 and 2012, jobs requiring high levels of social interaction grew by nearly 12 percentage points as a share of the U.S. labor force” (2017, 1). In contrast, jobs requiring high math skills but *low* social skills shrank by 3.3 percentage points (Deming, 2017, 1). Certainly, technology and automation have influenced the labor market. However, while computers may replace human labor for routine work tasks, they are ineffective substitutes when human interaction is required. As a result, “people are increasingly being called on to perform more complex thinking tasks that computers still cannot

perform, such as those that involve complex interactions with other humans (whether collaborating, persuading, or selling) or that require solving unexpected problems using expert thinking” (Jerald, 2009, 6). Similarly, *The Future of Jobs Report* commissioned by the World Economic Forum predicted changes in demand for core work-related skills between 2015-2020: “Overall, social skills – such as persuasion, emotional intelligence and teaching others – will be in higher demand across industries than narrow technical skills” (2016, 22). The report revealed a shift as “many formerly purely technical occupations are expected to show a new demand for creative and interpersonal skills” (*The Future of Jobs Report*, 2016, 24). Organizational success is increasingly dependent on team productivity, with “workers playing off of each other’s strengths and adapting flexibly to changing circumstances” (Deming, 2017, 29). Labor market economists predict that individuals who demonstrate these essential skills will experience better job opportunities and higher compensation (Jerald, 2009, 4).

Leaders from industry, education non-profits, and government agencies affirm the *need* for soft skills training and protest their widespread *absence* in current STEM graduate education. A Council of Graduate Schools report found that “employers are looking for candidates with personal skills and attributes such as empathy and emotional intelligence, resilience, and a passion for life-long learning” (Denacke et al., 2017, 15). In essence, organizations seek well-rounded, “t-shaped” employees who possess a broad array of non-research skills in addition to their deep technical knowledge (Denacke et al., 2017, 15). Unfortunately, employers interviewed by the NASEM *Committee on Revitalizing Graduate STEM Education for the 21st Century* reported that many new STEM hires struggle with soft skills like communication, working effectively in teams with members from different cultural or disciplinary backgrounds, mentoring, networking, and leadership (NASEM, 2018, 16). Robert Tjian, former President of

the Howard Hughes Medical Institute, recommends that students be trained to effectively form and engage with teams, manage and motivate others, deliver constructive feedback and understand the impact of emotions (Nurse et al., 2015, 373). As the *NASEM Committee on Revitalizing Graduate STEM Education for the 21st Century* recommends, STEM graduate education “needs to become more student-focused and develop ways to prepare students with a broader range of research and transferrable professional skills” (NASEM, 2018, 17).

Model Programs: Teaching Soft Skills in STEM

A review of existing leadership and management training for STEM graduate students and professionals identified model programs to inform the pilot training program at UMass Amherst. Two model programs were designed and implemented at academic institutions. The third was developed by a husband-wife, scientist-psychologist team, whose decades of professional successes spanning academic and private sectors inspired them to develop a highly acclaimed training program for scientists at Cold Spring Harbor Laboratory, a private, non-profit institution.

The University of California at Davis (UC Davis) created *Leaders of the Future*, a five-month program to help doctoral students develop their business skills and provide them with applied experiences beyond academia, such as internships, job shadowing, and special projects (ucdavis.edu, 2018). The intensive leadership program opens and closes with 8-hour boot camps, with six two-hour workshops spanning the period between. Key topics include communication, leadership, teamwork, business culture, project management, networking, and negotiation (ucdavis.edu). Cornell University created the *Colman Leadership Program*, an intensive 4-day program that teaches graduate students about leadership, negotiation, conflict resolution, teamwork, and the value of diverse perspectives (engineering.cornell.edu, 2018). The *Colman*

Leadership Program covers topics such as self-awareness, group dynamics, team formation, diversity, and leading with and without authority (engineering.cornell.edu, 2018).

In spring 2019, Carl and Suzanne Cohen will offer their eighth annual *Workshop on Leadership in Bioscience* at Cold Spring Harbor Laboratory. This highly interactive four-day workshop introduces the skills needed to effectively manage scientific teams in both academic and industry settings (meetings.cshl.edu, 2018). The workshop incorporates role-playing and uses a variety of interactive exercises to help scientists “gain a solid experience-based foundation in managing others, negotiating win/win outcomes, running effective meetings, selecting the best team members, and setting goals with mentees, direct reports, and teams” (meetings.cshl.edu, 2018). Topics covered include leadership, negotiation, conflict resolution, dealing with difficult people, communication, lab culture, and hiring the best people for your team (meetings.cshl.edu, 2018). For the workshop, Dr. Carl Cohen draws on more than 25 years of biomedical research and management expertise. He has held several positions in academia, including Chief of the Division of Cellular and Molecular Biology and Acting Chair of the Department of Biomedical Research at St. Elizabeth's Medical Center of Boston, as well as Professor of Medicine and Anatomy and Cellular Biology at Tufts University School of Medicine. He has also held executive roles in industry, including Chief Operating Officer of Biovest International and Vice President of Research and Development at Creative BioMolecules. In 2006, he founded Science Management Associates, where he continues to offer interpersonal, management and leadership skills training for science and technical professionals at top 10 pharmaceutical companies, biotechnology companies and research institutions. He and his wife, Suzanne Cohen, a Clinical Instructor of Psychology in the Harvard Medical School Department of Psychiatry for 20+ years,

co-published a roadmap for scientists entitled *Lab Dynamics: Management and Leadership Skills for Scientists* (2012).

Soft Skills Training in STEM: Identifying Themes for a Pilot Program

An analysis of research papers and patents produced over the last 50 years reveals that *teams* (not individuals) are leading the charge for productivity (NASEM, 2018, 16). “If I had one piece of advice to give,” says investigator Thomas Cech, past president of the Howard Hughes Medical Institute (HHMI), “it’s that although you’ve been hired for your scientific skills and research potential, your eventual success will depend heavily on your ability to guide, lead, and empower others to do their best work” (Kidder, 2016). Such bold statements increase the urgency for STEM graduate education to provide training that will help students succeed in team environments. To achieve this goal, the following module topics have been selected for inclusion in a pilot training program for UMass Amherst graduate students:

- Emotional intelligence
- Persuasion and the Art of Decision-Making
- Developing an Effective Negotiation Strategy
- Navigating Difficult Conversations

Frameworks for Analysis

To provide STEM graduate students with a flexible training platform, this series of modular workshops will target soft skills that are highly sought by employers, reference established frameworks in the field, and contextualize content by incorporating real-life scenarios commonly experienced by STEM graduate students. Insufficient skill level, uncertainty and inexperience can reduce one’s willingness and confidence to engage in situations that require strong interpersonal skills. To reduce these common barriers for STEM graduate students, the training modules will present the content using a scientific approach that should feel familiar and

comfortable. The modules will offer a formulaic strategy: (1) explain why the skill is important, (2) offer a framework or structure to teach the main points, (3) offer strategies (“protocols”) for implementing these concepts, and (4) immediately apply the lessons through interactive exercises that simulate common, real-life scenarios faced by the graduate students.

The primary frameworks for the *Emotional Intelligence* module include Goleman’s *Emotional Intelligence* (2005) and his follow-up work with co-authors Boyatzis and McKee in *Primal Leadership: Unleashing the Power of Emotional Intelligence* (2013). In the *Persuasion and the Art of Decision-Making* module, frameworks for teaching heuristics and cognitive biases include Ariely’s *Predictably Irrational: The Hidden Forces That Shape our Decisions* (2009) and Kahneman, Lovallo, and Sibony’s article “*Before You Make That Big Decision...*” (2015). The structural framework for persuasion is adapted from Cialdini’s *Influence: Science and Practice* (2009). The frameworks for the *Developing an Effective Negotiation Process* module include Fisher, Ury, and Patton’s *Getting to Yes: Negotiating Agreement Without Giving In* (2011) and Fisher and Ertel’s associated *Getting Ready to Negotiate: The Getting to Yes Workbook* (1995). The *Navigating Difficult Conversations* module adopts the framework from Stone, Patton, and Heen’s *Difficult Conversations: How to Discuss What Matters Most* (2010). To better understand, contextualize, and refine concepts for *scientists*, analysis also broadly references Cohen and Cohen’s *Lab Dynamics: Management and Leadership Skills for Scientists* (2012). These works were chosen because they contribute *structures* for teaching concepts and subsequent *frameworks* upon which to build *strategies* (“protocols”).

Emotional Intelligence

Daniel Goleman's emotional intelligence research has profoundly influenced the way our workforce recruits, evaluates, and develops its talent. Goleman's findings reveal that, while IQ and technical expertise are stronger predictors of success at lower level jobs, emotional intelligence (EI) competencies are better predictors of success in leadership positions (Goleman, 2005, xv). Goleman shocked many with his claim that "IQ contributes about 20 percent to the factors that determine life success," citing emotional intelligence as a key component among the "other characteristics" (Goleman, 2005, 34). As they hone their technical skills, STEM graduate students often fail to realize that employers *will* expect them to apply their technical prowess, but in roles *away* from the "hands-on" research roles to which they are accustomed in graduate school. Instead of *conducting* the bench work, advanced degree holders will be largely recruited into managerial roles, where they will drive research agendas and direct lower level employees to carry out the experiments. These findings echo the sentiments of employers, who consistently list emotional intelligence among the skills that are highly sought and hard to find.

Before exploring the emotional intelligence framework, graduate students must strongly consider the assumptions and values that influence their decision-making process. As Palmer and Crawford explain, "We live in a culture that privileges the rational mind, while tending to dismiss the somatic, emotional and subconscious aspects of ourselves as irrelevant or counterproductive to intelligence" (Palmer and Crawford, 2013, 6). Scientists favor "logic" and expect they can "think" their way to every necessary decision or solution. However, as Stone, Patton and Heen wisely advise, "Have your feelings – or they will have you" (2010, 85). A scientific audience can appreciate the neurological connections between emotions and reactive (reflexive) responses. The amygdala is part of a reflexive response system, designed to trigger

the protective “fight or flight” response in times of duress; once triggered, there is limited opportunity for control (Goleman et al., 2013, 45). The left prefrontal cortex manages mood and inhibits neurons in the amygdala, enabling a conscious control of actions (Goleman et al., 2013, 45). When a person is upset or anxious, there is high activity in the amygdala and *right* prefrontal cortex, which precipitates a largely involuntary “fight or flight” response (Goleman et al., 2013, 45). In contrast, when someone is calm and upbeat, there is high activity in *left* prefrontal cortex, which inhibits the amygdala and permits conscious control of behavior (Goleman et al., 2013, 45). If graduate students can learn to recognize emotional triggers, they can work to develop strategies that effectively stimulate their left prefrontal cortex and enable greater emotional control of their behaviors.

Primal Leadership: Unleashing the Power of Emotional Intelligence; Lab Dynamics: Management and Leadership Skills for Scientists

In 1973, David McClelland (Harvard) conducted a study to compare “star” managers to “average” managers in order to identify *distinguishing competencies* (Goleman et al., 2013, 35). His research suggested that leader success was not correlated with a single cognitive or technical capability, but rather with four aspects of emotional intelligence: “the drive to achieve results, the ability to take initiative, skills in collaboration and teamwork and the ability to lead teams” (Goleman et al., 2013, 36). Goleman, Boyatzis, and McKee expanded upon this work, formalizing an emotional intelligence framework comprised of four domains: *self-awareness*, *self-management*, *social awareness*, and *relationship management* (Goleman et al., 2013, 38). The *Emotional Intelligence* module introduces STEM graduate students to this four-domain structure, providing guidance and context to begin developing these essential skills. The module

emphasizes a mindset that emotional intelligence competencies are “not innate talents, but learned abilities” (Goleman et al., 2013, 38).

Individuals with strong self-awareness are able to: (1) gauge their emotions and use them to inform decision-making, (2) understand their strengths and limits, and (3) recognize their value, motives, and worth (Goleman et al., 2013, 38). Self-aware individuals tend to follow their passions, which stimulates “good feeling” neurological pathways, assuages feelings of frustration, and makes one more resilient against setbacks and frustration (Goleman et al., 2013, 41). Through their work with scientific professionals across a variety of settings, Cohen and Cohen (2012) have successfully translated emotional intelligence concepts into the laboratory context through interactive exercises, case studies, and role-plays. The authors cite a common deficiency in the profession, “Not only are scientists less likely to be attuned to the dynamics of interpersonal relationships, but they are also less likely to notice and manage their own emotions and reactions.” (Cohen, 2012, 17). They warn scientists of the dangers of such oversight, claiming, “The success of your work and the progress of your career are strongly influenced by your *behavior* and whether you *interact with others* in a productive or antagonistic manner” (Cohen, 2012, 9). In response to an enlightening finding that “scientists as a group have low self-awareness,” the *Emotional Intelligence* module incorporates self-assessment exercises to start students on the essential, life-long journey of self-reflection (Cohen, 2012, 21).

The next step is for students to learn how to recognize and manage their emotions. Cohen and Cohen provide a four-stage construct of self-management that resonates with the process-oriented nature of STEM graduate students. This construct directs individuals to: (1) know what they are feeling, (2) anticipate how their feelings might affect their behavior, (3) consider the potential consequences of their behavior, and (4) decide how to act (Cohen, 2012, 21). It is also

important to understand the common responses to emotionally charged situations. In threatening situations, some individuals tend to retreat, exhibiting passive or ignoring behavior, while others move into attack mode, exhibiting hostile or threatening behavior (Cohen, 2012, 25). Some individuals express themselves verbally, while others send nonverbal cues, such as avoiding eye contact, making facial expressions or displaying open or closed posture (Cohen, 2012, 21). People also differ in how they direct blame. Some internalize blame, or even blaming themselves when it's not warranted; others externalize blame, sometimes blaming others when it's not justified (Cohen, 2012, 21). This training will help students recognize their emotions, identify reflexive responses, and work to act with greater intentionality.

After building a foundation for greater self-awareness and self-management, focus will shift to *others*. Empathy, a core component of social awareness, is the act of taking a person's "feelings into thoughtful consideration and then making intelligent decisions that work those feelings into the response" (Goleman et al., 2013, 50). Empathy supports resonance in the workplace. It strengthens connections between managers and subordinates, team collaboration, cross-cultural communication and employee retention (Goleman et al., 2013, 50). In the module, sample scenarios will help students enact the art of "stepping into another person's shoes" by encouraging them to move beyond limitations imposed by purely rational viewpoints. One useful strategy for navigating emotionally challenging situations is *Going to the Balcony*, as explained by Ury: "Imagine you are negotiating on stage and then climb onto a balcony over-looking the stage. From the balcony you can calmly evaluate the conflict almost as if you were a third party" (Ury, 1993, 38). Finally, relationship management provides a "big picture" perspective that reinforces the critical convergence of essential soft skills, such as persuasion, conflict

management and negotiation, further supporting the topic choices for inclusion in other training modules in this pilot program (Goleman et al., 2013, 50).

Influence: Science and Practice; The Art of Decision Making; Predictably Irrational: The Hidden Forces That Shape Our Decisions

Graduate students in STEM occupy a complex space and they face challenging power dynamics that escalate the importance of skills for persuasion. To provide context and rationale, the *Persuasion and the Art of Decision Making* module introduces graduate students to three common approaches to compliance: push, pull, and reward. In academia, a structural hierarchy places faculty in a position of power over their students. This extreme power differential allows faculty to “push” their demands onto subordinates; persuasion is not necessary to secure compliance. It is important for students to realize that not all organizations exhibit such rigid hierarchical power structures. Millennials are changing workforce dynamics and organizational cultures are evolving to meet the needs of highly individualistic employees (Cialdini, 2001, 72). There is a strong migration toward “flat” organizational structures that minimize hierarchy and delegate greater decision-making to cross-functional teams (Cialdini, 2001, 72). “In such an environment, persuasion skills exert far greater influence over others’ behavior than formal power structures do” (Cialdini, 2001, 72). Additionally, offering *rewards* as a mechanism of persuasion does not guarantee desired outcomes. In his research on social versus market norms, Ariely studied the relationship between effort and compensation. In one simple experiment, Ariely asked participants to form assemblies by dragging circles on the left side of a computer screen into boxes on the right side of the screen (Ariely, 2009, 78). Participants were tasked with completing as many “assemblies” as possible in five minutes (Ariely, 2009, 78). Participants in Group 1 were paid five dollars, Group 2 fifty cents, and Group 3 nothing (“volunteers”) (Ariely,

2009, 78). As one might expect, Group 2 averaged fewer assemblies (101) than Group 1(159) because the monetary value triggered less effort for less compensation, a *market norm* (Ariely, 2009, 78). In contrast, the non-compensated volunteers in Group 3 produced the most assemblies (168) because they were motivated by the mere desire to help, a *social norm* (Ariely, 2009, 78). It is important to teach students about social and market norms, and advise them that “rewards” can lead to unintended consequences, particularly when it comes to motivating behavior in ourselves and others.

Before students can learn to persuade, they must learn some background on the art of decision-making. Many subscribe to a belief that humans operate as logical, rational beings, but “most neuroscientists would agree that 95-99+ percent of our behavior is the result of habits and instincts, along with other unconscious patterns that play themselves out in the background with little or no awareness on our part” (Palmer and Crawford, 2013, 120). In order to accommodate the overwhelming number of decisions we must make on a daily basis, our minds have developed an array of mental shortcuts, called *judgmental heuristics* (Cialdini, 2009, 7). These shortcuts are important factors in persuasion because they often “tell us when to believe or do what we are told” (Cialdini, 2009, 7). Heuristics are essential and often helpful; however, when they fail to produce the correct decision, they can fuel cognitive biases. It is important for students to be aware that such biases exist, and work to understand how such biases might influence their decision-making and the decision-making of others. While there are many named cognitive biases, this training will focus on the following:

Self-interest bias: It is important to be cognizant of situations where the decision maker might stand to gain (directly or indirectly) from the outcome (Kahneman et al., 2015, 34). For example, although doctors deny that gifts from pharmaceutical companies influence their medical

practices, a 2017 study revealed that gift recipients (compared to non-gift recipients) “prescribed 2.3 times more Medicare Part D claims per patient, prescribed medications costing \$50 more per claim, and prescribed 7.8 percent more branded drugs (Wood et al., 2017, *PLoS ONE*). Graduate students in STEM are especially vulnerable to a faculty self-interest bias fueled by an incentive system that promotes and rewards faculty based on research publications and grants.

Affect heuristic: “When evaluating something we like, we tend to minimize its risks and costs and exaggerate its benefits; when assessing something we dislike, we do the opposite” (Kahneman et al., 2015, 35). The affect heuristic is one to be mindful of as strong emotions can be triggered in the defending or attacking of ideas.

Groupthink: While unanimity on a team can be genuine, it can also signal a preference for harmony, conformity, or conflict avoidance. This is problematic because substantive disagreements are essential for solving complex problems (Kahneman et al., 2015, 35). Absence of dissent on a team can be a red flag.

Saliency bias: This bias is characterized by a tendency to refer to a past success story in order to justify a current decision. The danger is that “the analogy may be less relevant to the current deal than it appears” (Kahneman et al., 2015, 35). To guard against a myopic view or misinformed comparison, multiple alternatives should be explored during the decision-making process.

Confirmation bias: Effective decision-making encourages the exploration of a wide array of alternatives. In cases of confirmation bias, individuals favor one hypothesis or solution and then assign preference to evidence that supports it while dismissing evidence that refutes it (Kahneman et al., 2015, 36).

Anchoring bias: “When considering a decision, the mind gives disproportionate weight to the first information it receives” (Hammond et al., 2015, 52). This can cause decision-makers to

place too much emphasis on past events (Hammond et al., 2015, 52). It can also cause individuals to prematurely jump in line with ideas suggested by others before forming independent thoughts. To prevent anchoring bias in student learning, graduate students should be encouraged to explore and develop their own ideas before discussing them with advisors.

Endowment effect or Sunk-cost Fallacy: These terms describe our irrational tendency to overvalue something just because we own it or to continue pursuing a failing endeavor simply because of the time and/or money we have *already invested* (Kahneman et al., 2015, 39).

Overconfidence bias: A tendency to be overly confident in one's abilities can be detrimental, especially when it causes one to overlook key information or warning signs (Kahneman et al., 2015, 39).

Loss aversion: For many, the urge to avoid losses is stronger than the desire to pursue gains; no one wants to be associated with a failed project (Kahneman et al., 2015, 39). This can pose a challenge in workplaces that rely on innovation and companies are working to reframe judgments about failure to encourage creative risk taking.

To help students understand how these biases might surface in *everyday life*, the training module will include a *student-advisor scenario* and invite students to work in groups to identify potential biases at play. While it is important that graduate students learn to be aware of biases, they must also accept that cognitive biases are unavoidable; students cannot *plan* or *will* them away. However, students can adopt strategies to navigate them, such as the *Decision Quality Control Checklist* recommended by Kahneman and his colleagues (Kahneman et al., 2015, 34). For simplicity, the list will be condensed to focus on the biases selected for this training, with a recommendation to reference the original source (Kahneman et al., 2015, 34-40):

1. Is there any reason to suspect self-interest bias?
2. Have the people making the recommendation fallen in love with it (affect heuristic)?
3. Were there dissenting opinions within the recommending team? (signs of groupthink?)
4. Is this decision being overly influenced by past decisions deemed “similar”? (saliency)
5. Have credible alternatives been considered? (confirmation bias)
6. Consider the source (identify anchors)
7. Are the people making the recommendation overly attached to past decisions?
(endowment/sunken-cost)
8. Is the plan overly optimistic? (over-confidence)
9. Is the plan overly cautious? (loss aversion)

There is a common misconception that either individuals are born with a gift for persuasion or they are not. Cialdini debunks this myth, citing more than five decades of research by behavioral scientists seeking to understand “the way certain interactions lead people to concede, comply or change” (Cialdini, 2001, 74). From this research, Cialdini developed a framework for persuasion that “works by appealing to a limited set of deeply rooted human drives and needs, and does so in predictable ways” (Cialdini, 2001, 74). Cialdini outlined six fundamental principles of persuasion, and all will be included in the *Persuasion and the Art of Decision Making* module (Cialdini, 2001, 74):

Liking: “People like those who like them” (Cialdini, 2001, 74). A classic retail example of this persuasive strategy is the use of home-based parties to sell a range of products, such as Tupperware, cooking supplies, cosmetics, purses, and jewelry. A 1990 study of purchasing decisions made at these home demonstration parties found that the guests’ affection for their hostess was twice as influential in decisions to purchase than regard for the product itself

(Cialdini, 2001, 74). To embrace liking as a tool of persuasion, win friends through *similarity* and *praise* (Cialdini, 2001, 74). Research suggests that individuals gravitate toward those who share common interests, so creating early bonds of commonality (sports, family, hobbies, favorite TV shows) can increase ability to influence down the road (Cialdini, 2001, 74). Offering genuine praise builds rapport and can be used to repair damaged relationships (Cialdini, 2001, 74).

Reciprocity: “People repay in kind” (Cialdini, 2001, 75). Reciprocity arises from an inner drive to return a favor and has strong implications for compliance. This give/take can transpire in a variety of ways. One might extend a favor today and feel confident that the favor will be returned at some point in the future (Cialdini, 200, 49). Or, one might give something right before they ask a favor to increase the likelihood of compliance (Cialdini, 200, 49). Charities have leveraged this strategy. When the Disabled American Veterans organization mailed their typical letter to solicit donations, they had an 18 percent response rate (Cialdini, 2001, 75). However, when they included a “free gift” (address labels), the response rate nearly doubled to 35 percent (Cialdini, 2001, 75). A slight variation is to lead with a concession, in the hopes of securing a concession (Cialdini, 200, 49). Students can encourage reciprocity by strategically offering help in a variety of ways, such as serving on committees, assisting with high profile departmental events (symposia, retreats, seminar series, etc.), volunteering for additional service duties (inventory management, maintaining instrumentation, lab safety officer, etc.) and training/mentoring peers and undergraduates.

Commitment and Consistency: “People align with their clear commitments” (Cialdini, 2001, 76). This principle is tied to “a desire in most people to be and look consistent within their words, beliefs, attitudes, and deeds” (Cialdini, 2009, 95). The principle is reinforced by three

factors: (1) society places high value on good personal consistency, (2) consistent conduct generally simplifies daily life, and (3) consistent orientation provides valuable shortcuts for life's complexities (Cialdini, 2009, 95). Evidence suggests that securing an *initial commitment* is key, as individuals are generally more willing to agree to requests that maintain alignment with a previous commitment (Cialdini, 2009, 95). Students can effectively leverage this persuasive strategy by securing commitments for key milestones (permission for an industry internship, conference attendance, defense dates, etc.) far in advance, when advisors may be more likely to agree. Commitments made actively, through public or written agreement, are more likely to be honored (Cialdini, 2001, 76). Students can strengthen advisor commitments by securing them during group meetings (public) or by circulating meeting minutes for approval (written). The public nature of commitments feeds into the human desire to be consistent with the kind of person we *aspire* to be (Cialdini, 2001, 76). Since faculty advisors typically wish to exhibit behaviors *consistent* with being a good mentor, strategies that connect behaviors to the desired identity can be influential (Cialdini, 2001, 77).

Social Proof: “People follow the lead of similar others” (Cialdini, 2001, 75). Social proof arises from a human tendency to “rely heavily on the people around them for cues on how to think, feel, and act” (Cialdini, 2001, 75). Social science experiments mimicking emergency situations have clearly illustrated this phenomenon. In a 1968 study by Darley and Latane, a person appearing to have an epileptic seizure received help 85 percent of the time when a single bystander was present; however, this dropped to 31 percent when five bystanders were present (Cialdini, 2009, 113). In another experiment, the same researchers observed the behavior of people witnessing smoke seeping under a door. Single observers reported the smoke 75 percent of the time, while three-person groups reported only 38 percent of the time (Cialdini, 2009, 114).

However, when two of the three were coached to ignore the smoke, the smoke was only reported 10 percent of the time (Cialdini, 2009, 114). A key finding of this research is that “groups of bystanders fail to help because the bystanders are unsure rather than unkind” (Cialdini, 2009, 115). Specifically, the bystanders are *unsure* about whether an emergency exists and whether it is *their* responsibility to take action; they look to *similar others* (other bystanders) for cues about how to respond (Cialdini, 2009, 115). This information can be immensely useful to students regarding their relationships with faculty. It can offer insights into why advisors may not act when students think they should and why they look to other faculty for cues about how to behave, perpetuating the status quo, misaligned incentive system that currently challenges graduate education. Students can improve their situations by reducing uncertainty and directing attention to (desired) “similar others” as references for how to behave (Cialdini, 2009, 115). If students want help from faculty, they must reduce uncertainty by making direct, specific requests. Students seeking to *persuade* faculty, should evoke “similar others” as references. For example, students may reinforce their recommendations by referencing other faculty in the department, researchers in the subfield, or fellow dissertation committee members, as these sources can offer influential social cues for behavior.

Authority: “People defer to experts” (Cialdini, 2001, 77). From a young age, humans are socialized to believe that obedience to the proper authority is right and disobedience is wrong (Cialdini, 2009, 180). People commonly defer to experts as a necessary decision-making short cut or in situations where they lack personal expertise (Cialdini, 2001, 77). There are many useful ways that students can use authority figures to influence their advisors, such as experts in the field, other dissertation committee members, future employers (to move up defense dates), collaborators, funders, and published or widely accepted standards. While this training primarily

focuses on the application (and not defense) of influence, the challenging power structure warrants a caution regarding automatic compliance to authority. “Once a legitimate authority has given an order, subordinates stop *thinking* in the situation and start reacting” (Cialdini, 2009, 181). Cialdini cites a Temple University study where a researcher made a phone call to 22 separate nurses’ stations in various hospital wards, identifying himself as a physician and directing the nurse to give a specific patient 20mg of Astrogen. Simply because the order *appeared* to come from a doctor, 95 percent of nurses prepared the drug for administration, even when the bottle clearly indicated a 10mg/day maximum dosage (Cialdini, 2009, 187). This clearly indicates how the presence of authority can lead people to catastrophic and unethical decisions. Students must remain diligent in their decision-making processes.

Scarcity: “People want more of what they can have less of” (Cialdini, 2001, 78). Here, items become *more valuable* as they become *less available* (Cialdini, 2001, 78). It connects to loss aversion, described in *Organizational Behavior and Human Decision Processes* (1994) as the tendency for “potential losses to figure far more heavily in managers' decision making than potential gains” (Cialdini, 2001, 78). Essentially, it translates into a fear of loss or exclusion. We constantly check our emails, because we are compulsive about “missing something.” For students, scarcity of resources (reagents, student labor, grant funding, etc.) can be persuasive strategies for moving projects forward. Deadlines (defense dates, grant submissions, collaborations, etc.) can also impose a persuasive sense of urgency. A potentially powerful application of scarcity is the notion of a diminishing publication window, as competitors may “scoop” the research.

After providing baseline information for each section (cognitive biases and principles of persuasion), the *Persuasion and the Art of Decision Making* module uses interactive exercises to

apply learning to real-life scenarios experienced by graduate students. In teams, participants identify biases and propose persuasive strategies to achieve desired outcomes.

Getting to Yes: Negotiating Agreement Without Giving In; Getting Ready To Negotiate:

The Getting to Yes Workbook

In STEM graduate education, students navigate challenging power dynamics amidst a faculty incentive system that conflicts with mentoring best practices. Science has evolved into a multidisciplinary, team-based machine and success is highly dependent on collaborative skills. To succeed in this environment, graduate students must learn to advocate for their needs (particularly in power mismatches) by promoting strategies that support mutual gain.

Many STEM graduate students are unfamiliar with negotiation or how to navigate it within the norms of American culture. “Negotiation refers to any interaction in which there is a difference of opinion, the interests of the participants differ, or the two parties have conflicting agendas” (Cohen, 2012, 35). Negotiation occurs when students work with advisors to design and plan experiments, request funding resources (reagents, conference travel, etc.), discuss roles and responsibilities in research collaborations, decide authorship, and on and on. Students must also negotiate in their personal lives, with partners, roommates, family members and other members of their support systems.

When asked about negotiation styles, many people describe two positional approaches - the *hard* approach and the *soft* approach (Fisher et. al, 2011, xxviii). Hard positional negotiators strive to win and believe that this requires the other party to lose. Because the goal is victory, hard negotiators often distrust the other party, treat them as adversaries, withhold information and demand concessions (Fisher et al., 2011, 9). A hard negotiation strategy can damage relationships, stifle creativity, become derailed by ego and leave value on the table (Fisher et. al,

2011, xxviii). In contrast, a soft negotiation strategy is motivated by a desire to avoid conflict and reach agreement. Soft negotiators treat the other side like friends; they offer concessions, compromise, and openly share information (Fisher et al., 2011, 9). A soft negotiation strategy can quickly become a liability when one party overvalues the relationship or concedes too much, leading to bitterness or a sense of exploitation (Fisher et. al, 2011, xxviii).

In academic environments, students frequently encounter positional negotiations because the power hierarchy enables it. Outside academia, work environments are evolving. Hierarchical structures are being dismantled in favor of flatter organizations and members cannot exert control over their colleagues, bosses or clients to achieve their goals (Fisher et al., 2011, xi). An emerging millennial workforce expects (often demands) to be included in decision-making processes. Organizations need new strategies for dealing with differences, moving away from “destructive, adversarial battling to hard-headed, side-by-side problem-solving” (Fisher et al., xiii).

Working through the Harvard Negotiation Project, Fisher, Ury and Patton developed an alternate model for negotiation, which they named *principled negotiation* and published in their best-selling book, *Getting to Yes: Negotiating Agreement Without Giving In*. Commonly referred to as interest based or *win-win* negotiation, this style offers an efficient and cordial way to decide issues by pursuing mutual gains, deciding issues based on their merits, and seeking external standards for fairness (Fisher et. al, 2011, xxviii). Interest based negotiation is a strategy that can be used by *any person in any situation* and is based on four points (Fisher et al., 2011, 11):

People:	Separate the people from the problem
Interests:	Focus on interests, not positions
Options:	Invent multiple options for mutual gains
Criteria:	Seek objective standards (fairness)

When entering any negotiation, it is important to remember that people are “humans” first. “Most negotiations take place in the context of an ongoing relationship where it is important to carry on each negotiation in a way that will help rather than hinder future relations and future negotiations” (Fisher et. al, 2011, 22). This is especially true for STEM graduate students, who must negotiate with advisors, faculty, peers, and collaborators who can influence current and future professional trajectories. Fisher and his colleagues provide sound advice: “Be soft on the people, hard on the problem” (Fisher et. al, 2011, 13). Since many of these nuances are examined in the *Emotional Intelligence* and *Difficult Conversations* modules, a few key overarching tips will be highlighted in this module. The people problems encountered in negotiation often fall into three buckets: perception, emotion, or communication (Fisher et. al, 2011, 24). Understanding that parties usually have different perceptions of the situation, effective negotiators work to demonstrate empathy, avoid assumptions, resist blame, involve people in the process to secure buy-in, and offer face-saving options (Fisher et. al, 2011, 25-30). Emotions can run high for both parties in a negotiation. Effective negotiators learn to recognize and understand the emotions – both theirs and others’ (Fisher et. al, 2011, 31). For scientists and engineers, simply learning to recognize, name, and manage emotions can be very challenging. Fisher and Shapiro advise negotiators to “address the concern, not the emotion” and provide a succinct framework to help negotiators identify and preserve five core concerns: appreciation, affiliation, autonomy, status, and role” (Fisher and Shapiro, 2005, 15). Remaining cognizant of these core concerns can help negotiators understand (and even anticipate) emotional reactions to certain

aspects of a deal. Reframing and restructuring options to satisfy core concerns can be an effective strategy for achieving agreement. It is also important to consider how aspects of a deal might intersect with one's sense of *identity* (Fisher et. al, 2011, 32). Faculty may wish to see themselves as *good advisor* or *highly productive researchers with publications in top journals*. Negotiations that threaten identity can trigger emotional responses; humans will resist challenges to their desired views of identity. The final people problem is communication. In negotiations, communication challenges often arise when participants are not talking, not listening, or misunderstanding one another (Fisher et. al, 2011, 36). To avoid communication problems, participants should exercise active listening skills. This requires negotiators to give their full attention when the other party is speaking, rather than robotically nodding while secretly brainstorming their own next response (Fisher et. al, 2011, 36). Interrupting occasionally to repeat information back offers a dual benefit of reducing chances of misunderstanding and allowing the other party to feel *heard* and *understood* (Fisher et. al, 2011, 37).

A pillar strategy of interest based negotiation is to focus on interests, not positions. Interests are the needs, wants, concerns and fears behind a negotiation (Fisher et. al, 2011, 42). A position is a decided upon solution proposed to satisfy interests and is typically expressed as an offer or demand (Fisher et. al, 2011, 43). Negotiating based on positions is problematic because it frequently fails to satisfy the interests of both parties, stifles creativity and hurts relationships (Fisher and Ertel, 1995, 21-2). Because STEM graduate students (and faculty) are trained to identify problems and propose solutions, distinguishing *interests* from *positions* can be a challenging transition, much like distinguishing between *feeling* and *thinking* in the *Emotional Intelligence* module. This module will encourage them to unpack interests by probing with

“why?” or “for what purpose?” (Fisher and Ertel, 1995, 22). They will also be encouraged to ask questions (resist assumptions) and practice active listening skills.

Once underlying interests are extracted from positions, problem-solving skills are summoned for the task of inventing options for mutual gain. In negotiation, options are possible solutions to a problem and keys to success are brainstorming a long list of options and learning to trade on differences (Fisher and Ertel, 1995, 33). “Out of diversity – of perspectives, resources or interests – comes the opportunity to create value. It is about recognizing how those differences can make each of us better off than we would have been without a deal” (Fisher and Ertel, 1995, 33). Coming up with as many solutions as possible supports creativity and increases chances for agreement. Fisher, Ury and Patton offer the following tips: (1) separate inventing and judging of options, (2) broaden your options, (3) focus on mutual gains, and (4) make decisions easy for the other side (Fisher et. al, 2011, 62). Because STEM graduate students are often analytical by nature, it is important to exercise personal discipline during brainstorming sessions to maximize the number of invented options; premature judgment or criticism can hinder the outcome. It is also important to broaden perspectives, analogous to the evolution of interdisciplinary science. It takes creativity and practice to imagine options that would not be possible for the parties independently. For example, a STEM graduate student may have budget for reagents and supplies but lack access to equipment or expertise to carry out their experiments. In this case, they might exchange financial resources (reagents, supplies) and authorship credit in exchange for access to equipment and technical assistance that a collaborator can provide.

After the careful exploration of interests and options, an additional step is important for securing commitment. Independent, objective criteria are necessary to legitimize the *fairness* of a negotiated outcome (Fisher et. al, 2011, 83). Objective criteria provide reasons and precedent

that allow the other party to feel good about the deal (Fisher et. al, 2011, 84). Examples include things like building codes, Kelly Blue Book or glassdoor.com, which provide a basis for comparison. In academia, STEM graduate students can access institutional data to research precedent for things like time-to-degree. They can reference graduate handbooks to identify procedural precedent for negotiations about milestone progress and timelines. They can refer to prestigious published manuscripts to support negotiations with advisors over experimental methods, design or research direction.

It is important to realize that not every negotiation ends in agreement. Preparing for a negotiation includes planning for alternatives, in the event that interests cannot be satisfied through the negotiation (Fisher and Ertel, 1995, 45). Negotiators must have a solid understanding of their *best alternative to a negotiated agreement*, also known as their BATNA (Fisher and Ertel, 1995, 45). Having a BATNA prevents an individual from making a bad deal and helps to inform an appropriate walkaway. Similarly, *not* having a BATNA can pose a significant liability. It becomes hard to assess whether the agreement is *good enough* and can increase insecurity and uncertainty, particularly in those who lack confidence or experience in the negotiation process (Fisher and Ertel, 1995, 45). It is important to remember that the other side has a BATNA, too, and that BATNAs can be strengthened and weakened throughout the negotiation (Fisher and Ertel, 1995, 47).

Difficult Conversations: How to Discuss What Matters Most

As the scientific enterprise becomes increasingly team-based, success and innovation hinge on members' abilities to relate to one another in an effective and constructive manner. While technical managers may be offered procedural training on topics such as setting goals, communicating objectives, giving feedback, managing projects and evaluating employees, this

does not guarantee effective managerial practices (Cohen, 2012, 62). According to Cohen, an experienced pharmaceutical scientist who leads Management and Leadership training workshops for scientists, success “is determined by how well you understand yourself and how well you relate to and respond to the people” (Cohen, 2012, 62). Often, scientists are either unable to *notice* that a conflict exists or they are unwilling to *admit* that a conflict exists (Cohen, 2012, 62). Research by Gemmill and Wilemon (1994) revealed that a lack of awareness of conflict among team members was more common among scientists than nonscientists (Cohen, 2012, 62). Furthermore, when scientists *do* recognize conflict, they frequently opt to avoid it, either because conflict makes them uncomfortable or because they are unsure of how to handle it (Cohen, 2012, 62). While avoiding conflict may feel good in the moment, there can be significant consequences, such as lost time and productivity, damaged relationships, decreased morale, and adverse effects on physical and mental health (Kabacoff, 1998, *Washington Business Journal*). It is equally important for students to realize that conflict is not always bad. Differing perspectives inspire creativity and drive progress. Dissenting views defend against cognitive biases. The goal is not to eliminate conflict, but rather to learn to navigate it effectively.

Uncertainty plays a significant role in conflict avoidance. By nature, scientists and engineers are analytical and data-driven, preferring answers over unknowns. To reduce the ambiguity and discomfort associated with conflict and increase willingness to engage, graduate students would benefit from a structure for understanding conflict and strategies to better manage them. In the bestselling book *Difficult Conversations: How to Discuss What Matters Most*, the authors provide a useful framework for unpacking and analyzing the *three conversations* that permeate every difficult conversation: the “*What Happened?*” conversation, the *Feelings* conversation, and the *Identity* conversation (Stone et al., 2010, 7). Understanding this baseline

structure and the errors that frequently derail conversations can help students avoid predictable errors and develop more effective habits (Stone et al., 2010, 7).

The “What happened?” conversation describes the space where different perspectives inform different perceptions of reality. Each side has access to information the other side does not, culminating in different stories about who said what, who did what, and what should have happened (Stone et al., 2010, 7). In the process, both parties make predictable and damaging assumptions about truth, intentions, and blame (Stone et al., 2010, 9). The truth assumption fuels a compulsion to prove *I am right, you are wrong* (Stone et al., 2010, 9). This is largely ineffective because sides have differing *perceptions, interpretations, and values* about the situation and apply differing *standards* for deciding outcomes (Stone et al., 2010, 9). Each side thinks the other is the problem and each person *makes sense* within their own story (Stone et al., 2010, 27). In the end, both parties are left feeling unheard or badly treated (Stone et al., 2010, 27). Arguments also arise due to “Intention Invention” (Stone et al., 2010, 10). People often make assumptions about the intentions of others and when they do, they tend to cast them in a negative light (Stone et al., 2010, 11). In contrast, people commonly view their own intentions in a positive way. Intentions can become liabilities because they influence the way we judge, process and deliver information. A third challenge for the “What happened?” conversation is the instinctual desire to assign blame (Stone et al., 2010, 11). Similar to arguments sparked over truth, notions of fault evoke strong feelings of defense and denial (Stone et al., 2010, 12). Neither side feels they deserve *all* of the blame, and rarely would it be correct to assume so. Rather than focus on blame, attention should turn to “exploring why things went wrong and how we might correct them going forward” (Stone et al., 2010, 12).

The “Feelings” Conversation addresses the emotionally charged aspect of difficult conversations. Accepting and dealing with emotions can be a challenging space for scientists, as was discussed in the *Emotional Intelligence* module. “Getting too deep into feelings is messy, clouds good judgment, and in some context – for example, at work – can seem just plain inappropriate” (Stone et al., 2010, 13). Talking about feelings is often uncomfortable and exposing such vulnerability can feel risky (Stone et al., 2010, 13). Additionally, scientists often consider emotions to be illogical or irrational. Unfortunately, avoiding talking about feelings in a difficult conversation is a big mistake because they don’t just *involve* feelings, they are often *about* feelings (Stone et al., 2010, 13).

The “Identity” Conversation is subtle and often overlooked. It strikes at the core of who we are by asking “What does this say about me?” (Stone et al., 2010, 14). What people believe about themselves, how they *see* themselves, and how they think *others* see them have strong implications for confidence and self-esteem (Stone et al., 2010, 14). When a difficult conversation veers in a direction that challenges identity, one can feel imbalanced and falter (Stone et al., 2010, 14). Common identity triggers in difficult conversations are “Am I competent? Am I a good person? Am I worthy of love?” (Stone et al., 2010, 112). Understanding that identities are involved and learning to recognize when they are threatened can help one stay the course in a difficult conversation.

The *Three Conversations* model provides a structure for better understanding conflict and identifying the common, predictable errors that arise during them. The next step is to learn new habits and establish effective strategies for engaging in difficult conversations. Often, difficult conversations arise from a belief that one already possess all necessary information and simply needs to make a point, express discontent, and strongly urge others to do what we want (Stone et

al., 2010, 16). Through the three conversations framework, one becomes aware that differing perspectives exist, intentions cannot be assumed and both sides have contributed to problem (Stone et al., 2010, 16). A new approach emerges as the emphasis shifts to understanding the other side's point of view, offering information about yours, sharing blame and inviting a joint problem-solving approach (Stone et al., 2010, 16). The process explores feelings (yours and theirs) and considers the potential impacts on identity (Stone et al., 2010, 19). As Stone and his colleagues describe, one exchanges a "battle of messages" for a "learning conversation" (Stone et al., 2010, 17). Adopting the learning conversation stance requires a shift to new habits that explore interests, move beyond "who's right," resist assuming intentions, and avoid blame.

As introduced in the *Developing an Effective Negotiation Strategy* module, discussing what matters most should be framed using *interests* not *positions*. Too often, parties speak in *demands*. Each become entrenched in their positions and the conversation quickly reaches an impasse. As one considers what they *really* want, they should also be mindful of what they *don't* want. Another quick blockade is the argumentative and unproductive "right versus wrong" loop. Instead, students should adopt a curiosity stance, where they step to the other person's side to see how their story makes sense to them (Stone et al., 2010, 37). This means asking clarifying questions and working to understand which rules or standards are informing their positions. A common hurdle is thinking, "we must either accept or reject the other person's story, and that if we accept theirs, we must abandon our own" (Stone et al., 2010, 39). The goal is to understand both stories and acknowledge that the feelings of both parties matter (Stone et al., 2010, 40). For STEM students, a key is realizing that understanding *the other story* does not require them to negate *their own story*; one need not *agree* in order to *understand*. One strategy for embracing both stories is adopting the AND Stance, which "gives you a place from which to assert the full

strength of your views and feelings without having to diminish the views and feelings of someone else” (Stone et al., 2010, 40).

Making assumptions about the intentions of others can have significant ramifications on downstream decision-making. If a person believes that someone *intentionally* harmed them, they judge them more harshly than they would if they had *accidentally* harmed them (Stone et al., 2010, 40). When actions negatively impact them, people are more patient when there is good *reason*, as opposed to a careless disregard of others (Stone et al., 2010, 40). A challenging but essential shift in the approach to difficult conversations involves attitudes about intentions and actions. Two disastrous mistakes about intentions are to *assume* the intentions of others and to believe that once one *clarifies* their own intentions, the other party should no longer be upset with them (Stone et al., 2010, 45). Unfortunately, people make assumptions about intentions that are frequently wrong for predictable reasons. First, people tend to associate intent with impact, which causes bad outcomes to translate into bad intent (Stone et al., 2010, 46). Mischaracterizing intentions can have dire consequences. Accusations about intention can fuel defensiveness, inappropriately inform broader character assumptions, and even lead to self-fulfilling prophecies (Stone et al., 2010, 48). For example, if managers translate inconsistent work hours or missed deadlines into negative character assumptions, it could affect future work assignments and result in employee demotivation. Another challenge regarding intentions is well summarized as “good intentions don’t sanitize bad impact” (Stone et al., 2010, 50). When one’s intentions are misrepresented, the natural defensive response is to clarify one’s intentions and expect this to immediately resolve the conflict (Stone et al., 2010, 51). Unfortunately, this emphasis on clearing up intentionality leads to a key oversight - acknowledging the full the impact of one’s actions (Stone et al., 2010, 51). To counteract the automatic leap from bad result to malicious

intent, Stone and his colleagues suggest to “disentangle impact and intent” (Stone et al., 2010, 51). Students should be encouraged to form a *hypothesis* about intention and then test the hypothesis by asking clarifying questions focused on the *actions* and their associated impact (Stone et al., 2010, 54). When one is on the receiving end of misunderstood intentions, it is important to “listen past the accusation for the feelings” (Stone et al., 2010, 56).

Many difficult conversations trigger a visceral desire to blame the other side. However, there are several undesirable consequences of this approach. In addition to evoking a defensive response, assigning blame can actually block productive solutions. “Focusing on blame is a bad idea because it inhibits our ability to learn what’s really causing the problem and to do anything meaningful to correct it” (Stone et al., 2010, 59). Stone and his colleagues offer an alternate strategy – *mapping the contribution system* – in which they exchange blame for contribution (Stone et al., 2010, 59). Because blame is associated with *judgment*, it is backward looking; in contrast, contribution is associated with *understanding*, which focuses efforts toward forward progress (Stone et al., 2010, 60). The beauty of this system is its simplicity. It simply requires one to consider “*How did we each contribute to this situation?*” and “*What can we each do to improve things going forward?*” (Stone et al., 2010, 60). This approach diffuses emotion and sets the stage for productive future interactions. Additionally, being the first to offer contributions can encourage reciprocity and change the entire dynamic of the conversation. This strategy has the potential to profoundly impact the success of STEM graduate students. Doctoral students are on campus for about six years. Success depends on their ability to establish and maintain professional relationships with advisors, faculty, collaborators, peers and staff to achieve their milestones. Abandoning blame and learning to map the contribution system will help them maintain collegial relationships.

Methods and Context

To analyze the current landscape of STEM graduate education and identify recommendations for curricular reform across a broad base of concerned stakeholders, a review of literature, studies and commissioned reports was compiled from top scientific journals (*Nature*; *PLoS ONE*), business magazines (*Harvard Business Review*; *Forbes*), nonprofit higher education and research organizations (Council of Graduate Schools; National Academies of Sciences, Engineering, and Medicine; National Bureau of Economic Research), scientific organizations (New York Academy of Sciences), professional associations (National Association of Colleges and Employers), and international organizations (World Economic Forum). Research efforts focused on identifying gaps in soft skills training for STEM graduate students that contribute adverse effects on workforce development and preparedness. Training insights and best practices were extracted from successful model programs offered through Cold Spring Harbor (*Workshop on Leadership in Bioscience*), the University of California at Davis (*Leaders of the Future*), and Cornell University (*Colman Leadership Program*). This cumulative research informed topic selection for four pilot training modules at UMass Amherst.

A deeper review of seminal works in the field revealed frameworks for the training modules. The *Emotional Intelligence* module was largely informed by Goleman's groundbreaking *Emotional Intelligence* (2005) book and his follow-up work with Boyatzis and McKee, *Primal Leadership: Unleashing the Power of Emotional Intelligence* (2013). Cohen and Cohen contributed valuable perspective by contextualizing emotional intelligence for scientists in their book, *Lab Dynamics: Management and Leadership Skills for Scientists* (2012). The *Persuasion and the Art of Decision-making* module explores heuristics and cognitive biases described by Ariely's *Predictably Irrational: The Hidden Forces That Shape Our Decisions*

(2009) and Kahneman, Lovaglio, and Sibony's article "Before You Make That Big Decision..." (2015). Participants were introduced to the principles of persuasion framework detailed in Cialdini's book *Influence: Science and Practice* (2009). The *Developing an Effective Negotiation Strategy* module provided an overview of interest based negotiation, drawing upon Fisher and Ury's framework, *Getting To Yes: Negotiating Agreement Without Giving In* (2011) and Fisher and Ertel's supplementary *Getting Ready To Negotiate: The Getting to Yes Workbook* (1995). The *Navigating Difficult Conversations* adapted concepts from *Difficult Conversations: How to Discuss What Matters Most* (2010) by Stone, Patton, and Heen. While these best-selling books and articles are staples in business school curricula, such works are rarely referenced in STEM graduate education. To effectively translate lessons for a STEM audience, interactive exercises were designed for each module. The inclusion of sample scenarios explored through interactive group work allowed participants to immediately apply new concepts to real-life, STEM-specific circumstances that reflect familiar day-to-day challenges.

Four two-hour modules were piloted for graduate students and postdoctoral researchers from the UMass Amherst College of Natural Sciences, School of Public Health and Health Sciences and College of Engineering between August 9, 2018 and October 2, 2018. Participation was voluntary, not incentivized (other than refreshments), and required pre-registration. Though content from previous sessions could provide advantageous background knowledge, participation in previous sessions was not required. Modules were strategically designed to allow participants to take them in any order, maximizing flexibility and sustainability. The sessions were advertised through targeted emails to graduate program coordinators, requesting dissemination of session descriptions (approximately 100 words) to their graduate students and postdoctoral researchers. To evaluate the effectiveness of pilot training modules, pre- and post-module surveys were

issued at the open and close of each session to assess learning and identify strengths and areas for improvement.

Results, Discussion & Analysis

Top leaders from highly regarded scientific organizations, professional associations, higher education research organizations, government agencies, international economic organizations and major employers of STEM professionals align behind a demand for improved soft skills training in STEM graduate education. This capstone project addressed this gap for STEM graduate students at UMass Amherst by piloting a four-part *Leader's Toolkit* series through the Graduate School Office of Professional Development on the following topics: *Emotional Intelligence, Persuasion and the Art of Decision-Making, Developing an Effective Negotiation Strategy* and *Navigating Difficult Conversations*.

Though a thorough research process informed session themes and content, additional factors were considered in the design and implementation of the series. A significant participation hurdle is always time. As “employees” in the STEM education system, graduate students have very little time and little *control* over how they allocate it. Because participation in this training is voluntary, it can be hard to secure commitments amidst more pressing demands. The challenge was to divide training into small enough parcels that graduate students could fit them into packed schedules, teach baseline concepts, *and* integrate interactive, real-life scenarios to apply concepts in real time. Similarly, competing for their time is a challenge when participation is voluntary. Significant effort goes into crafting event descriptions. In just 100 words, the description must capture a student’s interest, address a pain point, and convince them that the session will be a good use of their time amidst other demands. The session descriptions used for this series are provided in Appendix A. Finally, there was a goal to establish cohesion

across the series without introducing barriers to participation. The series was piloted as four standalone two-hour workshops, designed to allow sessions to build upon one another, yet maintaining enough flexibility that they can be taken in any order. This structure allows students to complete the series over time, accommodating schedules and increasing the likelihood that they can complete all four sessions. The series was evaluated by analyzing registration and attendance data, as well as pre- and post-module surveys administered to participants.

Participant Registration and Attendance

Registration and attendance numbers are valuable data points for assessing the practicality of a two-hour training window and the effectiveness of the event description used to advertise the module. The Graduate School Office of Professional Development (OPD) offers more than 250 workshops annually to help graduate students and postdoctoral researchers improve their skills in areas of career preparation, communication, submission of grants and fellowships, personal development and teaching. Historical registration and attendance trends for OPD sessions provide valuable references for assessing the practicality of the pilot training modules. Most OPD sessions are 1-1.5 hours in duration and include 10-20 participants, depending on the topic and range of disciplines targeted. Attrition between registration and actual attendance is a continual challenge for OPD, with approximately 40-60 percent of registrants actually attending the event. Considering the longer two hour time requirement for pilot modules and targeting to STEM disciplines, an attendance goal was set at least 10 participants per module. Based on historical OPD attendance trends, it was predicted that at least 25 registrants would be required to secure this goal. The final registration and attendance data are presented in Table 1.

Module Description	Number of Registrants	Number of Attendees
Emotional Intelligence	31	18 (58%)
Persuasion and the Art of Decision-Making	27	14 (52%)
Developing an Effective Negotiation Strategy	49	14 (29%)
Navigating Difficult Conversations	28	16 (57%)

Table 1. Registration and attendance numbers for pilot training modules.

Modules achieved the attendance goal, recruiting 14-18 participants to each live session. Most modules exhibited attrition rates in alignment with OPD workshop trends, suggesting that the workshop duration (two hours) and module descriptions are effectively recruiting participants.

One factor for the high attrition rate observed for the *Developing an Effective Negotiation Strategy* module might have been semester timing. The session was offered on September 20, 2018. Registration was opened on September 10, which was the Monday of the second week of the semester. For STEM students, this was the week when Teaching Assistant (TA) responsibilities for laboratory sections were assigned and meeting times for journal clubs established. On September 10 alone, 33 participants registered, which represents 67 percent of the total module registration. It is highly likely that scheduling conflicts arose post-registration, contributing to the high attrition rate. However, the high registration rate remains a positive indicator of session interest.

The pilot training program successfully recruited participants from all three UMass Amherst colleges targeted: the College of Natural Sciences, School of Public Health and Health Sciences and College of Engineering. Collectively, the modules served 62 total participants, which included 49 unique participants spanning 15 different departments (71 percent doctoral students, 18 percent master's students, 11 percent postdoctoral researchers). Seven participants completed two modules and two participants completed all four modules.

Overarching Series Results

To measure the effectiveness of the training and identify opportunities for improvement, pre- and post-module surveys were administered to participants during the session. Some questions were consistently asked across all modules to provide an overarching perspective about the series. This data is summarized in Table 2 below.

Survey Question	Emotional Intelligence	Persuasion and the Art of Decision-Making	Developing an Effective Negotiation Strategy	Navigating Difficult Conversations
How would you rate the overall quality of this event? (Likert scale, 5=Excellent, 1=Poor)	4.7	4.7	4.7	4.9
How would you rate the overall quality of the presenter? (Likert scale, 5=Excellent, 1=Poor)	4.8	4.8	4.9	4.9
How would you rate the overall significance of the topic? (Likert scale, 5=Extremely significant, 1=Not significant)	4.7	4.8	4.9	4.9
Would you recommend this workshop to a friend or colleague?	Yes (100%)	Yes (100%)	Yes (100%)	Yes (100%)

Table 2. Summarized post-session survey feedback about the module quality, presenter, topic significance and willingness to recommend the session to colleagues.

This overarching data suggests that the topics were highly valued by participants, the quality of the event and presenter were highly rated and that participants were unanimously willing to recommend the modules to their colleagues. Additional, module-specific feedback is analyzed for each session below.

Emotional Intelligence

The *Emotional Intelligence* module included 18 participants. The pre-session survey included open-ended questions to assess participants' current understanding of emotional intelligence and what drew them to the session. When asked to share their own understanding of emotional intelligence, common themes included the ability to control my emotions (33 percent), the ability to identify and understand emotions in others (11 percent), and the ability to understand my emotions *and* the emotions of others (56 percent). When asked to share what brought them to the session, common reasons included an overarching desire to learn more (61 percent), a desire to learn how to control my emotions (17 percent), a desire to learn how to identify my emotions and the emotions of others (11 percent) and a desire to learn about the role of emotions in the American workplace (11 percent). When asked to rate the importance of *technical skills* for professional success, the mean response score was 4.4 (Likert scale, 5=Very Important, 1=Not Important). When participants were asked to rate the importance of *non-technical skills (interpersonal skills)* for professional success, the mean response score was 4.7. Survey results suggest that module registration self-selected for participants who already embrace emotional intelligence and agree in its importance for professional success. For these participants, the module value was developing skills and building confidence, which the following data measured.

Participants were asked a series of identical questions to look for pre- and post-session differences. One question measures the importance of data and logic relative to emotions when making decisions. Results are illustrated in Tables 3 below.

When making decisions, it is important to consider: (Likert scale, 5=Very important, 1=Not important)	Pre-survey response average	Post-survey response average
Data and logic	4.7	4.4
Your emotions	3.5	4.2
The emotions of others	3.7	4.4

Table 3. The importance of data, logic and emotions in decision making, measured pre- and post-session.

During the emotional intelligence module, research was presented that suggests scientists give preferential weight to logical, rational approaches in decision-making, while delegitimizing emotional inputs. Pre-survey data reinforces these findings. Throughout the training, great emphasis was placed on the value of emotional inputs and their influence on decision-making (ours and others'). The post-session survey suggests an increased acceptance of the importance of emotions in decision-making.

A key emphasis of the module was helping scientists *identify* emotions (in themselves and others). This required them to distinguish between *thoughts* and *emotions*, a challenging task for many during the interactive exercises. A pre- and post-session question sought to assess participants' *confidence* about identifying skills and emotions. Data is presented in Table 4 below.

I am confident I can identify: (Likert scale, 5=Strongly agree, 1=Strongly disagree)	Pre-survey response average	Post-survey response average
My technical skills	4.0	4.4
My non-technical skills (interpersonal skills)	3.5	3.8
My emotions	3.9	3.8
Emotions in others	3.0	3.3

Table 4. Confidence in one's ability to identify technical skills, non-technical skills, and emotions, measured pre- and post-session.

The differences between pre- and post-session responses are interesting. For technical skills, there was an increase in participants who reported "strongly agree," which caused the mean to

increase from 4.0 to 4.4. While it was not intended that the strategies learned in this session would translate to “technical skills,” it is possible that participants perceived them that way. The strategies were intended as “non-technical skills”, which would account for increased confidence in that area. The evaluation of confidence regarding emotions was insightful. In the session, participants appeared more confident in identifying *others’* feelings and less comfortable recognizing *their own* feelings. Many struggled to identify and accept their *own* feelings during sample scenarios, which may be reflected in the slight confidence decrease.

To assess learning, participants were questioned about their understanding of emotional intelligence and the four associated domains, as indicated in Table 5 below.

After participating in this session, I have a better understanding of: (Likert scale, 5=Strongly agree, 1=Strongly disagree)	Post-survey response average
Emotional intelligence	4.7
Self-assessment	4.6
Self-management: recognizing and managing my emotions	4.6
Social awareness: empathy; recognizing emotions in others	4.1
Relationship management	3.7

Table 5. Post-session understanding of emotional intelligence and the four associated domains.

Overall, participants reported a strong understanding of emotional intelligence and two of the four associated domains (self-awareness and self-management). In contrast, understanding was not as strong for social awareness and relationship management. These results were not surprising, because the vast majority of module time was absorbed by self-assessment (self-awareness) activities and a four-step construct for self-management, as skills in these domains are crucial for success in subsequent domains. Additionally, the session was highly interactive, with many thoughtful questions and lively discussion that unexpectedly slowed the pace. As a result, the final two domains only received a cursory overview.

An open-ended question asking participants what they found most helpful about the workshop elicited a variety of responses, such as the interactive exercises using sample scenarios (27 percent), the time allocated for self-awareness and reflection (20 percent), learning the differences between *thinking* and *feeling*; naming emotions (20 percent), and learning a four-step framework for self-management (20 percent). The post-session survey also suggested strong intent to apply the concepts learned, as 89 percent reported intent to continue self-assessment, 72 percent reported intent to notice and name their feelings, 89 percent reported intent to anticipate the relationship between emotions (feelings) and actions, 89 percent reported intent to consider the consequences before reacting, 72 percent reported intent to make informed decisions that acknowledge emotional inputs, and 78 percent reported intent to be empathetic.

In another open-ended question, participants were asked to offer suggestions for improvement. Of the six who responded, two recommended more time be spent on social awareness and relationship management, one suggested more tips for developing emotional intelligence skills, one suggested more interactive exercises, one suggested a minor edit to the sample scenario, and one suggested shortening the session to 1.5 hours.

Persuasion and the Art of Decision-Making

The *Persuasion and the Art of Decision-Making* module included 14 participants and covered material related to cognitive biases and persuasion. The pre-session survey asked an open-ended question about the factors participants consider when making decisions. Most respondents considered one or more of the following: potential benefits (for self and others), consequences, parameters (time, cost, effort, priorities, etc.), and advice from trusted sources (colleagues, friends, family). To broaden participants' views, the module compared and contrasted decision-making across different organizational cultures. In traditional hierarchical

structures (academia, legacy corporations), decision-making power is concentrated at upper levels. However, many corporations are moving to flat organizational structures and delegating decision-making to lower levels. In this structure, where individuals do not exercise *control* over those they must influence, persuasion becomes more influential than power. The module described several cognitive biases and highlighted the importance of watchdogs to offer dissenting views that expose biases to improve decision-making. To assess participant learning of these concepts, a series of identical questions were asked to look for pre- and post-session differences, as illustrated in Table 6 below.

In the context of professional success, how important will it be for you to: (Likert scale, 5=Very important, 1=Not important)	Pre-survey response average	Post-survey response average
Make decisions	4.9	5.0
Evaluate others' decisions	4.1	4.6
Use your authority/status to influence others' actions	3.5	4.1
Use persuasion to influence others' actions	4.4	4.8

Table 6. The importance of making decisions, evaluating decisions, using authority to influence and persuading others in a professional setting, measured pre- and post-session.

Participants entered the session with a strong understanding that professional success requires one to make decisions, so there was little change observed. Data suggests that lessons about cognitive biases, combined with the revelation that individuals cannot reasonably recognize or control their own biases, contributed to an increase in the importance of evaluating *others'* decisions. Similarly, the session increased the importance of persuasion to participants, as values increased from 4.4 to 4.8. Responses related to the use of authority and status to influence others' actions were surprising, as values were expected to decrease as participants learned the benefits of a *persuasive* strategy over a *control* strategy. A conflicting use of terminology may have made this question confusing to participants. For example, participants were encouraged to take a more proactive role in *others'* decision-making, given the prevalence of biases and tendency for

STEM-based work to occur in teams. They were encouraged to assert with dissenting views, which may be construed as exhibiting authority. Additionally, one of Cialdini's principles of persuasion is actually called *authority*, so it may have been interpreted as a mechanism of persuasion.

The pre-session survey asked participants to explain what *persuasion* means to them and 92 percent described it as *convincing, influencing, or changing someone else's mind*. When asked what works when *others* try to persuade *them*, common themes included acting with a kind demeanor and understanding my viewpoint (36 percent), communicating benefit (36 percent), and using logic/evidence (28 percent). The module introduced participants to strategies for persuasion that could be delivered in genuine, authentic and emotionally intelligent ways. A survey question was used to assess their post-session understanding of these principles, as illustrated in Table 7 below.

After participating in this session, I have a better understanding about how to apply tools of persuasion, such as: (Likert scale, 5=Strongly Agree, 1=Strongly Disagree)	Post-survey response average
Liking	4.6
Reciprocity	4.8
Commitment and Consistency	4.6
Social Proof	4.3
Authority	4.4
Scarcity	4.4
Power of Because	4.8

Table 7. Reported post-session understanding of the tools of persuasion.

The post-session data in Table 7 suggests that the module effectively introduced participants to strategies for persuasion. Participants were similarly asked if they had a better understanding of cognitive biases that can affect the decision-making process and 100 percent of responded that they agree or strongly agree. When asked what they found most helpful about the workshop,

common responses included learning about cognitive biases (46 percent), learning strategies for persuasion (18 percent), handouts/exercises (18 percent), and learning the behavioral psychology behind decision-making (18 percent). Only five participants provided suggestions for improvement and the most useful was to allocate more time on the principles of persuasion, as they were not as clear as the cognitive biases. This was not surprising, as the cognitive biases section invited many questions and lively discussion, which caused the persuasion portion to fall short on time.

Developing an Effective Negotiation Strategy

The *Developing an Effective Negotiation Strategy* module included 14 participants and introduced students to interest based negotiation. The pre-session survey asked open-ended questions to get a sense of what negotiation *means* to participants and how they judge whether a negotiation has been *successful*. Common themes about what negotiation *means* included an agreement both sides can live with (38 percent), seeking maximum benefit for oneself (23 percent), compromising with other side (15 percent), and exchanging ideas (15 percent). The most commonly reported attributes of a *successful* negotiation were benefits to both parties (58 percent) and an amicable and/or fair process (25 percent). To further assess participants' awareness of negotiation, an identical series of pre- and post-session questions asked participants who they might expect to negotiate with in a professional setting. Results are presented in Table 8 below.

In my current or future professional environment, I expect to negotiate with: (Likert scale, 5=Strongly Agree, 1=Strongly Disagree)	Pre-survey response average	Post-survey response average
Supervisors	4.4	4.8
Co-workers	4.5	4.7
Employees/students (those I supervise)	3.8	4.7
Collaborators	4.5	4.6
Vendors	4.2	4.3

Table 8. Participants' assumptions about who they may negotiate with, measured pre- and post-session.

Participants did not need to be convinced that negotiation skills are important and they demonstrated a strong sense of what a successful negotiation accomplishes. Post-session data suggests that these expectations increased after participating in the module. A variety of factors can influence one's expectations about negotiation, including one's skill, willingness to engage/participate, and confidence level. To study these factors, pre- and post-session questions were asked to measure changes in attitude before and after the module, as illustrated in Tables 9 and 10 below.

Question	Pre-survey response average
How would you rate your current <i>skill</i> level regarding negotiation? (Likert scale, 5=Excellent, 1=Very poor)	2.4
If an opportunity to negotiate arises, how likely are you to <i>participate</i> ? (Likert scale, 5=Very likely 1=Not at all likely)	3.1
How would you rate your current <i>confidence</i> level regarding negotiation? (Likert scale, 5=Very confident, 1=Not at all confident)	2.6

Table 9. Participant self-rating of skill, likelihood to participate and confidence related to negotiation, reported pre-session.

Question	Post-survey response average
Participation in this session has increased my understanding of negotiation <i>strategies</i> (Likert scale, 5=Strongly Agree, 1=Strongly Disagree)	4.5
If an opportunity to negotiate arises, how likely are you to <i>participate</i> ? (Likert scale, 5=Very likely 1=Not at all likely)	4.3
Participation in this session has increased my <i>confidence</i> to negotiate (Likert scale, 5=Strongly Agree, 1=Strongly Disagree)	4.2

Table 10. Influence of session participation on strategy development, likelihood to participate and confidence related to negotiation, reported post-session.

Survey results suggest that participants joined the module with strong perceptions about the importance and goals of negotiation. However, limited negotiation skills and low confidence likely influenced their willingness to participate in negotiations. After completing the module, participants reported an increased understanding of negotiation strategies, which likely contributed to increased confidence and greater willingness to participate in negotiations.

The module introduced participants to structure and strategy of interest based negotiation and post-session questions were used to evaluate changes in confidence in these areas, as illustrated in Table 11 below.

After participating in this negotiation session, I am confident that I can (Likert scale, 5=Strongly Agree, 1=Strongly Disagree)	Post-survey response average
Identify my interests	4.3
Identify their interests	3.9
Generate options	4.4
Apply criteria for fairness	4.3
Know my walkaway	3.9

Table 11. Post-session measure of confidence related to the negotiation competencies reviewed in the module.

While the learning and understanding of new skills may be inferred as a likely contributor to increased confidence levels, this question would have been more useful if it had asked, “*I have a better understanding of...*” The mere learning of new skills does not immediately translate into greater confidence. That growth requires subsequent practice and experience. So, while these results remain favorable, they may underestimate the level of learning truly conferred during the module. When asked if they plan to apply the negotiation strategies learned in the session, 75 percent reported that they *strongly agree* and 25 percent reported that they *agree*.

An open-ended question asked participants what they found most helpful about the session and common themes included learning a framework and strategy for negotiation (40 percent), applying concepts in real-life examples (30 percent) and learning the difference between interests and positions (20 percent). Four respondents offered suggestions for improvement. Three requested more exercises and examples and one requested tips for dealing with hard positional negotiators or emotionally charged situations.

Navigating Difficult Conversations

The *Navigating Difficult Conversations* module included 16 participants and introduced students to the *Three Conversations* framework developed by Stone, Patton, and Heen. The pre-session survey asked open-ended questions to get a sense of what makes difficult conversations *difficult*, what participants *struggle with*, and what they *hope to learn* from the session.

Commonly referenced factors included mismatched power dynamics (33 percent), aggression in the other party (20 percent), concerns over one's own reaction, both passively and aggressively (20 percent) and concern about hurting the other party (13 percent). During difficult conversations, primary struggles included initiating or starting the conversation (27 percent), maintaining poise/controlling emotions (27 percent), successfully communicating points (20

percent), and protecting the relationship (13 percent). For this session, participants predominantly wished to learn general strategies for difficult conversations (53 percent), tips for standing one's ground in emotionally charged situations (20 percent) and how to start a difficult conversation (20 percent).

Clearly, there was much anxiety associated with difficult conversations. As experienced in the negotiation module, anxiety about difficult conversations is often connected to one's skill level, willingness to initiate, and level of confidence. Questions were asked to measure changes in attitude before and after the module, as illustrated in Tables 12 and 13 below.

Question	Pre-survey response average
When you find yourself in a difficult conversation, how would you describe your <i>skill</i> level? (Likert scale, 5=Excellent, 1=Very poor)	2.5
When a conflict arises, how likely are you to <i>initiate</i> a conversation to discuss the conflict? (Likert scale, 5=Very likely 1=Not at all likely)	2.9
When you find yourself in a difficult conversation, how would you describe <i>confidence</i> level? (Likert scale, 5=Very confident, 1=Not at all confident)	2.7

Table 12. Participant self-rating of skill, likelihood to initiate and confidence level related to difficult conversations, reported pre-session.

As a result of participating in this session, I (Likert scale, 5=Strongly Agree, 1=Strongly Disagree)	Post-survey response average
Have learned <i>skills</i> that will help me be more effective in difficult conversations	4.5
Feel more willing to <i>initiate</i> difficult conversations	4.1
Feel more <i>confident</i> in my ability to participate in difficult conversations	4.3

Table 13. Influence of session participation on skill level, willingness to initiate, and confidence related to difficult conversations, reported post-session.

Survey results suggest that participants began the module with limited skills and low confidence related to difficult conversations, which likely reduced their willingness to initiate them. In the

post-session survey, participants reported that the session helped them learn new skills, which increased their confidence to participate in difficult conversations, as well as their willingness to initiate them.

The module introduced participants to the *Three Conversations* structure, common mistakes that derail our conversations, and strategies to avoid them. The module encouraged self-reflection, asking participants to consider how frequently these common mistakes have permeated their past difficult conversations. Results are summarized in Table 14 below.

This session described the predictable mistakes that are common in difficult conversations. Looking back, how often have you done these things in your past difficult conversations? (Likert scale, 5=Always, 1=Never)	Post-survey response average
Ignore feelings	3.6
Disregard identity	3.6
Fail to consider “What do I want?”	3.4
Fail to consider “What don’t I want?”	2.9
Focus on proving that “I am right.”	3.5
Assume they meant to harm me	3.2
Assume the problem is their fault	3.2

Table 14. Participant reflection about the frequency of “predictable mistakes” in their past difficult conversations, reported post-session.

While Table 14 conveys a general sense that participants have made several of these mistakes in past conversations, it was informative to analyze the data another way: 64 percent always or often ignored feelings, 57 percent always or often failed to consider what they want, 50 percent always or often disregarded identity and 50 percent always or often focused on proving they were right. These results suggest high impact potential for the new strategies learned.

In addition to describing the common mistakes that derail difficult conversations, the module offered productive alternative strategies. To evaluate the effectiveness of this training, post-session questions were asked, as detailed in Table 15 below.

After participating in this session, I am confident that I will be able to (Likert scale, 5=Strongly Agree, 1=Strongly Disagree)	Post-survey response average
Apply the Three Conversations Model	4.0
Identify my interests	4.4
Step to their side; work to understand both stories	4.5
Explore intentions (not assume them)	4.4
Resist blaming: map the Contribution System	4.4
Respect the role of feelings	4.5
Respect the role of identity	4.3

Table 15. Post-session measure of one's confidence in their ability to apply the difficult conversation strategies presented in the module.

Although the feedback suggests a positive learning outcome, it may have been preferable to measure *understanding* of strategies rather than *confidence* to apply them, as was noted in the negotiation module analysis. When participants were asked if they plan to apply the strategies learned in the session, 86 percent *strongly agreed* and the remaining 14 percent *agreed*.

Collectively, data suggests a positive outcome for module participants.

An open-ended question asked participants what they found most helpful about the session and participants overwhelmingly praised the structure for dissecting conflict, concrete strategies for navigating it and the use of interactive scenarios and role-plays to apply the concepts in a group setting. For one participant, the most valuable lesson was, "Learning not to try to change the other person, but succeeding in my own space regardless." This was a valuable contribution, as much time was spent on the notion of "stop trying to change the other person." Suggestions for improvement included allocating more time to *starting* the conversation and specifically addressing situations complicated by *power dynamics*. Participants enjoyed discussing the sample scenario and requested more opportunities to do so.

Successes and Opportunities for Improvement

The *Leader's Toolkit* series piloted to UMass Amherst graduate students and postdoctoral researchers was highly successful. Though participation was voluntary and demanded a steep time commitment, registration and attendance were strong. Participant feedback suggested that all modules were of high quality, with 100 percent of participants reporting that they would recommend them to their friends and colleagues.

Module participants offered recurring suggestions for improvement. One observation was that time ran short, causing later topics to become rushed and inadequately covered. Another common request was the inclusion of more exercises and sample scenarios. Participants greatly enjoyed these interactive role-plays, which allowed them to work in teams to tackle common challenges *and* experience the therapeutic effect of learning that others are facing similar struggles. Group work is an ideal way to develop interpersonal skills!

These requests are not a simple matter of better time management. While modules were strategically designed to balance instruction with interactive exercises, sessions became more engaging than expected, with frequent questions from the audience. The result was wonderfully enriching, but caused the schedule to become unrealistic. Because extending module time beyond two hours is a likely barrier to entry, other options can be explored, such as dividing modules into multiple sessions and/or creating follow-up *discussion groups*, “by invitation only.” For example, the *Emotional Intelligence* could be logically split into two modules, a Part I focused on “self” and a Part II focused on “others.” Similarly, the *Persuasion and the Art of Decision Making* could be split into two parts, one focusing on cognitive biases and the other on persuasion. Follow-up *discussion groups* could be offered for all sessions to allow participants to engage in more sample scenarios to apply the lessons learned in the core module (access

would be granted only to participants who completed the module). This practice in a supportive setting would allow participants to develop their skills, build their confidence, and seek the support of peers as they navigate challenging situations in their graduate experience.

Conclusion

Global prosperity is highly dependent on the innovation that arises from a well-trained science, technology, engineering, and mathematics (STEM) workforce. For decades, the world of work has been evolving. Major scientific discoveries once dominated by individuals are now driven by interdisciplinary teams. Advances in automation have delegated mundane, routine tasks to machines, freeing humans to focus on more complex tasks like problem-solving. An increasing dependence on the outputs of diverse, high performing teams has led to startling revelations about the STEM workforce and the graduate education enterprise that is preparing it.

The United States, widely considered the gold standard in STEM graduate education, recruits top talent from all over the world to earn STEM advanced degrees from American universities. Despite a doubling in the number of STEM degrees earned in the U.S. between 1975 and 2015, employers complain that they cannot fill their STEM positions from the current applicant pool. Surprisingly, the problem is not the *quantity* of applicants but the *quality* of applicants. Quite simply, advanced degree holders in STEM do not possess the skills employers are looking for. Employers do not stand alone in this criticism. Concerned stakeholders across higher education nonprofits, leading science research organizations, professional associations and international organizations have commissioned numerous studies and reports to substantiate this growing concern. The prioritization of *technical skill* training and virtual absence of *interpersonal skill* training in STEM graduate education is perpetuating a paralyzing mismatch between what universities are producing and what employers want.

If STEM graduate programs are to produce the workforce that society demands, educational reform is required. The goal of this capstone project was to ignite that effort for STEM graduate education at UMass Amherst. A thorough literature review identified the key soft skills desired by employers, extracted best practices from existing training programs, and modeled structural frameworks from seminal works in the field to inform a four-module *Leader's Toolkit* pilot series spanning *Emotional Intelligence*, *Persuasion and the Art of Decision-making*, *Developing and Effective Negotiation Strategy* and *Navigating Difficult Conversations*. Administered through the Graduate School Office of Professional Development at UMass Amherst, each two-hour module was offered to 14-18 voluntary participants. Workshop content was strategically designed to blend lecture-based instruction, structural frameworks and strategies with interactive group exercises that allowed participants to apply concepts to real-life, STEM-based scenarios. Participant feedback was highly positive, with 100 percent of participants reporting that they would recommend the workshops to their friends and colleagues.

While the capstone project successfully identified soft skills that are in high demand with STEM employers and developed highly rated pilot training programs to introduce graduate students to these skills, there is still much to accomplish. Participation in these pilot modules was *voluntary*. Such a system *self-selects* for graduate students who have bought into the importance of these skills, received permission from their advisors ("employers") to participate, and/or found a way to fit them into their schedules. Such a system often excludes those who need the training the most. Sustainable, systemic reform requires buy-in from STEM graduate programs willing to *embed soft skills training in core curricula*. Such a measure would ensure that *all* students experience equal access to the training. To strengthen momentum in this direction, additional

voluntary modules can be offered, incorporating early suggestions for feedback and increasing participation data. Armed with sizeable statistical data and participant testimonials, alliances could be pursued with supportive STEM Graduate Program Directors. Such collaborations could be publicly praised (perhaps even rewarded) and hailed as a best practice for other departments to follow. Graduate programs could embed soft skills training into credit-bearing curricula by creating a one-credit leadership course. This would send a signal to *students* that soft skills are essential for professional success and to *employers* that the University acknowledges the need for reform and is proactive in implementing a solution.

While a systemic approach will be required to ignite institutional culture change, this capstone project alleviates one small hurdle – the design and implementation of effective training modules that can be expanded and broadly disseminated across disciplines and institutions. Resistance to reform cannot be scapegoated to a lack of available training curriculum. We have to start somewhere, and this capstone contributes a first swing to the pendulum for change.

References

- Abi-Ghanem, Daad. "Leadership in Science: Cultivating soft skills for career advancement." *blog.quartzy.com*, 10 May 2017, <https://blog.quartzy.com/2017/05/10/science-leadership-career-growth-requires-people-skills-beyond-research>
- Ariely, Dan. *Predictably Irrational: The Hidden Forces That Shape Our Decisions*. HarperCollins Publishers, 2009.
- Chamorro-Premuzic, Tomas. "Can You Really Train Soft Skills? Some Answers from the Science of Talent." *Forbes*, 24 June 2018, <https://www.forbes.com/sites/tomaspremuzic/2018/06/14/can-you-really-train-soft-skills-some-answers-from-the-science-of-talent/#5cfe7b4dc460>
- Cialdini, Robert. "Harnessing the Science of Persuasion." *Harvard Business Review*, October 2001, pp 72-79.
- Cialdini, Robert. *Influence: Science and Practice*. Pearson Education, 2009.
- Cold Spring Harbor Laboratory. Workshop on Leadership in Bioscience, 2018, <https://meetings.cshl.edu/courses.aspx?course=C-LEADER&year=19>. Accessed 20 July 2018.
- Cohen, Carl and Suzanne Cohen. *Lab Dynamics: Management and Leadership Skills for Scientists*. Cold Spring Harbor Laboratory Press, 2012.
- Cornell Engineering. Colman Leadership Program, 2018, <https://www.engineering.cornell.edu/engdiversity/current-students/graduate-students/colman-leadership-program>. Accessed 20 July 2018.
- Deming, David. "The Growing Importance of Social Skills in the Labor Market," *The Quarterly Journal of Economics*, vol 132(4), 2017, pp. 1593-1640.
Working paper version: <http://www.nber.org/papers/w21473.pdf> (p. 1-49)
- Denecke, Daniel, et al. "Professional development: Shaping effective programs for STEM graduate students." Washington, DC: Council of Graduate Schools, 2017.
- Fisher, Roger and Danny Ertel. *Getting Ready To Negotiate: The Getting to Yes Workbook*. Penguin Books, 1995.

Fisher, Roger and Daniel Shapiro, D. *Beyond Reason: Using Emotions as You Negotiate*. Penguin Books, 2005.

Fisher, Roger, William Ury, and Bruce Patton. *Getting To Yes: Negotiating Agreement Without Giving In*. Second Edition. Penguin Books, 2011.

Goleman, Daniel. *Emotional Intelligence*. Bantam Books, 2005.

Goleman, Daniel et al. *Primal Leadership: Unleashing the Power of Emotional Intelligence*. Harvard Business Review Press, 2013.

Gray, Kevin and Andrea Koncz. "The Key Attributes Employers Seek on Students' Resumes." 2017, *naceweb.org*, <https://www.naceweb.org/about-us/press/2017/the-key-attributes-employers-look-for-on-students-resumes/>

Hammond, John et al. "The Hidden Traps in Decision Making." *The Art of Decision Making*, Harvard Business Review OnPoint, Winter 2015, pp. 50-59.

Jerald, Craig D. "Defining a 21st century education." *Center for Public Education*, 2009.

Kabacoff, Wayne, Ellen. "It pays to find the hidden, but high, costs of conflict." *Bizjournals.com*. *Washington Business Journal*, 9 May 2005. <https://www.bizjournals.com/washington/stories/2005/05/09/smallb6.html>. Accessed 10 Sept. 2018.

Kahneman, Daniel et al. "Before You Make That Big Decision..." *The Art of Decision Making*, Harvard Business Review OnPoint, Winter 2015, pp. 31-41.

Kidder, F. Key. "For Managers, Emotional Intelligence Trumps IQ, *Labmanager.com*, 6 September 2016, <http://www.labmanager.com/leadership-and-staffing/2016/09/for-managers-emotional-intelligence-trumps-iq?fw1pk=2#.W1I0vdVKjIX>

Kramer, Mark, et al. "The Global STEM Paradox." *The New York Academy of Sciences*, 2014.

Mervis, Jeffrey. "Making grad school work for STEM students." *Science*. <https://doi.org/10.1126/science.aau3473>

National Academies of Sciences, Engineering, and Medicine (NASEM). 2018. *Graduate STEM Education for the 21st Century*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25038>.

Nurse, Paul, et al. "STEM Education: To build a scientist." *Nature*, vol 523, 2015, p. 371-373.

Palmer, Wendy and Janet Crawford, J. *Leadership Embodiment: How the Way We Sit and Stand Can Change the Way We Think and Speak*. Embodiment Foundation, 2013.

Seeliger, Jessica. "Scientists must be taught to manage." *Nature*, vol. 483, no. 7391, 2012, pp. 511.

Stone, Douglas, et al. *Difficult Conversations: How to Discuss What Matters Most*. Penguin Books, 2010.

The Future of Jobs Report. World Economic Forum, 2016.

The UC Davis Graduate School of Management. Leaders for the Future, 2018, <https://gsm.ucdavis.edu/program-detail/leaders-future>. Accessed 20 July 2018.

Ury, William. *Getting past No: Negotiating in Difficult Situations*. Bantam Dell, 1993.

Wood, Susan, et al. "Influence of pharmaceutical marketing on Medicare prescriptions in the District of Columbia" *PLoS ONE*, 12(10): e0186060. <https://doi.org/10.1371/journal.pone.0186060>

Appendices

Supplemental materials are attached as appendices in a separate document and include:

Appendix A: Session descriptions used to advertise the four *Leader's Toolkit* modules.

Appendix B: Presentation and handout materials for the *Emotional Intelligence* module.

Appendix C: Presentation and handout materials for the *Persuasion and the Art of Decision-Making* module.

Appendix D: Presentation and handout materials for the *Developing an Effective Negotiation* module.

Appendix E: Presentation and handout materials for the *Navigating Difficult Conversations* module.