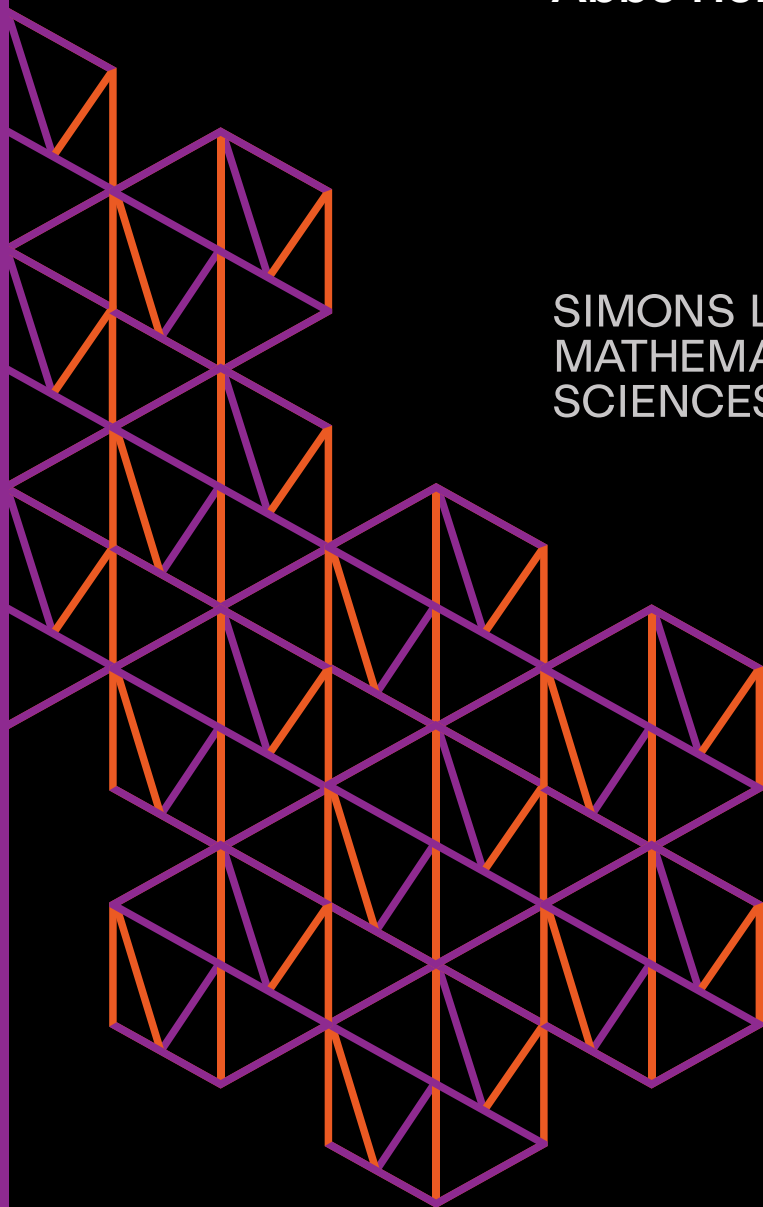


Mentoring *for* Equity

Abbe Herzig and Aris Winger

SIMONS LAUFER
MATHEMATICAL
SCIENCES INSTITUTE



Mentoring *for* Equity

Critical Issues in Mathematics Education 2023

Simons Laufer Mathematical Sciences Institute | March 22–24, 2023

Abbe Herzig (Sarah Lawrence College)

Aris Winger (Georgia Gwinnett College)

WORKSHOP ORGANIZERS

Pamela E. Harris (University of Wisconsin-Milwaukee)

Abbe Herzig (Sarah Lawrence College)

Aris Winger (Georgia Gwinnett College)

Michael Young (Carnegie Mellon University)

With thanks to the members of SLMath's [Educational Advisory Committee](#) (EAC).

MSRI, now the Simons Laufer Mathematical Sciences Institute (SLMath), has been supported from its origins by the U.S. National Science Foundation, joined by other government agencies, over 110 Academic Sponsor departments in the U.S. and worldwide, private foundations and corporations, and generous and farsighted individuals. Learn more at slmath.org.

The 2023 CIME workshop received additional support from [Math for America](#).

This booklet is published by the Simons Laufer Mathematical Sciences Institute (SLMath), 17 Gauss Way, Berkeley, CA 94720-5070. The collected material in this publication and any video or supplemental media referenced within does not constitute endorsement by the Simons Laufer Mathematical Sciences Institute and its employees, trustees, or advisory committees.

CIME 2023 workshop photo by Aaron Fagerstrom. Illustrations featured in this booklet are by Cassandra Johnson ©Abbe Herzig and Aris Winger, used with permission of the authors.

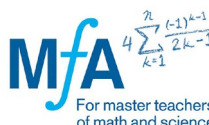
Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the U.S. National Science Foundation, Math for America, or any entities the authors and workshop participants represent.



SIMONS LAUFER
MATHEMATICAL
SCIENCES INSTITUTE



National
Science
Foundation



For master teachers
of math and science

Creating Change

Goals

The 2023 SLMath (MSRI) workshop [Critical Issues in Mathematics Education: Mentoring for Equity](https://www.slmath.org/workshops/1059)¹ was designed to create change in how members of the mathematical sciences community support one another. Rather than passively listening to a series of talks, we wanted to ensure that participants were actively involved in creating visions and plans for growth. We believed that this was the only way to have a meaningful impact on the mentoring of members of the mathematics community.

Workshop participants included a broad audience of faculty and students in postsecondary mathematical sciences. The workshop included presentation and discussion of research evidence, review and adaptation of practical tools, and explicit training in effective mentoring, including how to bring these tools back to participants' home institutions. A focus on culturally responsive mentoring that supports all students and faculty along their mathematical paths permeated the work we did together. The workshop aimed to increase participants' knowledge of the scholarship on effective mentoring while engaging them in interactive activities to develop tangible skills as mentors and as mentor-trainers. Participants were challenged to reflect on their experiences as mentors and mentees and to actively contribute to activities that built skills for implementing effective, evidence-based mentoring practices. Another aim was to cultivate local and national mentoring communities that bring effective tools and strategies to mentoring, so that mentees can persist and thrive in research, teaching, education, and all other aspects of life in the mathematical sciences.

“Community is a deep human desire.... Those who desire community in mathematics must develop the virtue of hospitality, which includes ... excellence in mentoring and a disposition to affirm others ... those who value community in mathematics must develop the virtue of attention to people.” –Francis Su, *Mathematics for Human Flourishing* (2020)

1. Link: <https://www.slmath.org/workshops/1059>

Making substantive change in this work requires as many voices and perspectives as possible. Collectively, the participants have decades of experience in mentoring and equity work. The workshop was designed to leverage the vast knowledge of participants, who hold keys to the problems that we are trying to solve, not just in terms of providing answers, but more importantly, in asking the right questions. To support these goals, we asked participants to commit to these goals:

“Although I am a typical loner in daily life, my consciousness of belonging to the invisible community of those who strive for truth, beauty, and justice has preserved me.” – Albert Einstein

- Actively take in the talks from the speakers and reflect on anything you hear that might be relevant for you as a mentor (or just as a human!).
- Dig deep into the activities as a mechanism for examining your practices, including the reading and other activities for each evening.
- Enjoy your colleagues and engage with them about best practices.
- Develop a clear non-empty set of practical changes that you can begin the moment you return to work.
- Develop a plan to keep yourself accountable for change.

Shared Expectations for Successful Collaboration



The workshop addressed some experiences and issues that were sensitive or even personal to some participants. To ensure we had a productive discussion in a space that was safe for everyone, we asked all attendees to work according to these norms.

1. *Be present and engaged*
2. *Introspect about your experiences and practices*
3. *Ensure that all voices are heard*
4. *Listen to understand, not to respond*
5. *Adopt a posture of curiosity and generosity of spirit*
6. *Recognize impact and intent*
7. *Maintain a safe space*
8. *Honor confidentiality*
9. *Use “I” statements*
10. *Challenge ideas, not people*
11. *Lean into discomfort*

The workshop setup

To center the variety of voices and perspectives among us, we relied heavily on Padlets, online virtual boards that allow all participants to post their ideas openly and anonymously. A contribution that is personal, controversial, or unpopular can be beneficial for the entire room. The anonymity and interaction of the Padlets freed people to say what they needed to say without concern of judgment or loss of privacy. The Padlet also served as a community board and record of our beliefs and thoughts, bringing us together and providing the basis for our collective ongoing work.²

Participants received discussion prompts and posted their reflections on Padlets through QR codes and links we provided. Following each discussion prompt, the corresponding Padlet board was projected for all to see and served as a springboard for active discussion. Key ideas from the Padlets are summarized in this booklet, and you can read the details of participants' contributions by following the links to the Padlets throughout this document.

In addition to the shared spaces on Padlets, participants needed a way to explore and record their private reflections. Changing the way that we mentor requires serious reflection, and people's inner voices are a key factor to providing change in mentoring for equity. In order to get participants thinking deeply about themselves and their experiences during the workshop, we provided each participant with a journal that provided a place to explore their thoughts privately and to chronicle their journey over the course of the program and beyond. The journal provided space to jot down notes from the activities, thoughts, ideas that resonated, questions, and reflections on their experiences as a mentor and mentee. This book roughly follows the format of the journal. The journal was provided both in physical and digital form.



“I love the way the Padlet offers a model for how to get feedback when there is a perceived power differential. People offered a sense of discomfort, and the organizer modeled how to respond with grace. That feels like something we can all take home—what mechanisms are we using to get that feedback that is safe for mentees?” – *Workshop participant*

2. Select Padlet quotes are presented throughout this booklet as written by the workshop participants.

There were a number of different types of workshop activities, all of which are described in detail later in this report. In each of these activities, participants were asked to reflect, recording their responses privately in their journals or publicly on a Padlet.

- **Interactive presentations** on [The Science of Mentoring](#), [Mentoring Experiences Through the Lens of a Mentee](#), [Studying Successful Doctoral Students from Underrepresented Groups](#), [Building Institutional Support for Mentoring](#), and [Knowledge-GAP: The Impact of Mentoring on the Graduate School Application Process](#)
- **Authentic scenarios** of math students and faculty struggling with issues of equity in mathematical spaces, along with the discussion prompt *What Would You Do?* Some of the scenarios were controversial, and the opportunity to respond anonymously through the Padlet facilitated sharing and discussion of authentic responses that often related individuals' experiences, fears, concerns, and challenges. Scenario prompts are fictionalized and presented verbatim as discussed in the 2023 workshop.
- **General Activities** involving topics such as dimensions of mentoring and mentoring agreements were unpacked with participants either reporting their reflections in a Padlet, individually, or in groups together with discussion questions and interaction with facilitators. These activities included opportunities for participants to identify specific plans to continue this work after the workshop.

What does it feel like to start something new?

On the first day, we grounded the idea of *mentoring for equity* by reflecting on our experiences when we were novices at something. Participants were asked to respond to this prompt, recording their private reflections in their journals and sharing them publicly and anonymously on the Padlet:

PROMPT

Think of a time when you were navigating something unfamiliar and important. It might have been applying for grad school, your first weeks as a grad student or new faculty member, or writing your first research paper. What did you *feel*? What challenges did you face?

When asked what they felt when they started something new, many respondents—who included graduate students, senior professionals, and people at various career stages in between—reported having been excited and hopeful, and almost all of them also told us about fear, being overwhelmed, and feeling lost and isolated. They told us about fear of failure, feelings of not belonging, and even panic.



“Overwhelmed; didn’t know what I was doing or where to look for help. Frustrated; felt like I was spinning wheels & going nowhere.”

– Workshop participant

Some other common themes discussed by participants included:

- Happenstance mentoring can be a reflection of privilege, and mentoring will not always appear by happenstance when needed. It is ok to ask for help and to advocate for ourselves.
- Everyone struggles, yet failure can be productive.
- Not all advice is worth listening to. Some advice is directed at what the advice-giver's needs, rather than what the asker needs.
- Others sometimes underestimate us. Sometimes we underestimate ourselves.
- We don't have to know everything, others are typically supportive and want us to succeed.



“Really thinking about how happenstance mentoring is a reflection of privilege. Also pondering the question of whether mentoring in mathematical practices is inherently enacting whiteness.” – *Workshop participant*

“It is a great opportunity for me to think about my role as a mentor by reflecting my own experience of being a mentee.” – *Workshop participant*



Check out the full [Padlet discussion](#)³ of this prompt.

EVENING ASSIGNMENT:



Read *The Science of Effective Mentorship in STEMM*⁴

On the first evening, participants were asked to review the 2019 consensus report from the National Academies of Science, Engineering, and Medicine (NASEM) [The Science of Effective Mentorship in STEMM](#).⁵ This report presents a comprehensive review of scientific evidence, resources, tools, and other information about effective mentoring. (We encourage you to read the report as a companion to this document.) In this report, the NASEM defines mentorship as “a professional, working alliance in which individuals work together over time to support the

3. Link: <https://padlet.com/ariswinger/cime-reflective-journal-what-did-you-feel-fkcfjm5hy3ex2956>

4. STEMM: Science, Technology, Engineering, Mathematics, and Medicine

5. Link: <https://nap.nationalacademies.org/resource/25568/interactive/>

personal and professional growth, development, and success of the relational partners through the provision of career and psychosocial support.”

The discussion prompt was intended as a personal reflection and a foundation for the work of the following day.

PROMPT What questions or reactions do you have to this definition? What are three (or more) ideas in this report that you find to be the most compelling? How can you use these ideas in your mentoring relationships? What can you share with your colleagues?

The following morning, we offered an additional prompt and asked for public responses on the Padlet:

PROMPT How was yesterday? What did you learn? What is lingering in your thoughts?

The responses demonstrated the benefits of the Padlet tool in supporting open shared reflection and discussion. Common themes included:

- There is a distinction between an adviser and a mentor and between informal and formal mentoring. These topics were discussed more deeply later in the workshop.
- Although many participants had served in mentoring roles in the past, many did not have training or resources.
- Similarly, even those who are more advanced in their careers reported the lack of mentoring in their education and career development.
- The importance of personal identities in mentoring relationships was new to some.
- Many people who “should” have been at the workshop were not there. Indeed, a consistent challenge of workshops like these is the self-selection of participants.

As facilitators of this work, we are honored to impact those who have chosen to join us, with hopes that the work we do together will galvanize them to be change agents at their institutions in some meaningful way, impacting those who have chosen not to attend.



Check out the full [Padlet discussion](https://padlet.com/ariswinger/cime-check-in-and-reflect-5kknpuat0tegnnqnl).⁶

6. Link: <https://padlet.com/ariswinger/cime-check-in-and-reflect-5kknpuat0tegnnqnl>

The Science of Mentoring

Abbe Herzig, Sarah Lawrence College

As a foundation for thinking about mentoring and equity, we defined apprenticeship based on a model adapted from anthropological research. We then discussed how that model can help mathematicians reconsider the training and retention of young mathematicians, particularly people of marginalized identities.

Mentorship is more than a program or activity, but an **interpersonal relationship**. Programs that include mentoring among their primary goals should not be equated with mentoring—their value is in providing fertile ground and support through which mentoring relationships can be nurtured and sustained.



Apprenticeship is often used as a metaphor for training graduate students, postdoctoral fellows, new faculty, or any person who is developing more expertise in their roles in the mathematical community. Apprenticeship is an authentic educational form with a long history. Based on an anthropological study of apprenticeship situations, Lave and Wenger (1991) identified two common features common to these diverse learning contexts:

- Apprentices learn by engaging in *authentic tasks*, beginning at the periphery of practice, and moving to more central participation as their skills grow.
- Apprentices learn through interactions with more skilled members of the community.

They identified three dimensions of an apprentice's learning, which we adapt to mathematical apprenticeship as:

- 1 **Mathematical knowledge:** concepts, theorems, methods of reasoning, major schools of thought.
- 2 **Mathematical practices:** presenting results orally and in writing, conducting research, attending conferences, teaching, applying for and managing grants, applying for jobs, tenure and promotion, and balancing life in and out of academia.
- 3 **Mathematical identity:** “An identity as a scholar, a sense that ‘I belong here,’ is critical in the persistence of graduate students.” (Herzig, 2004)

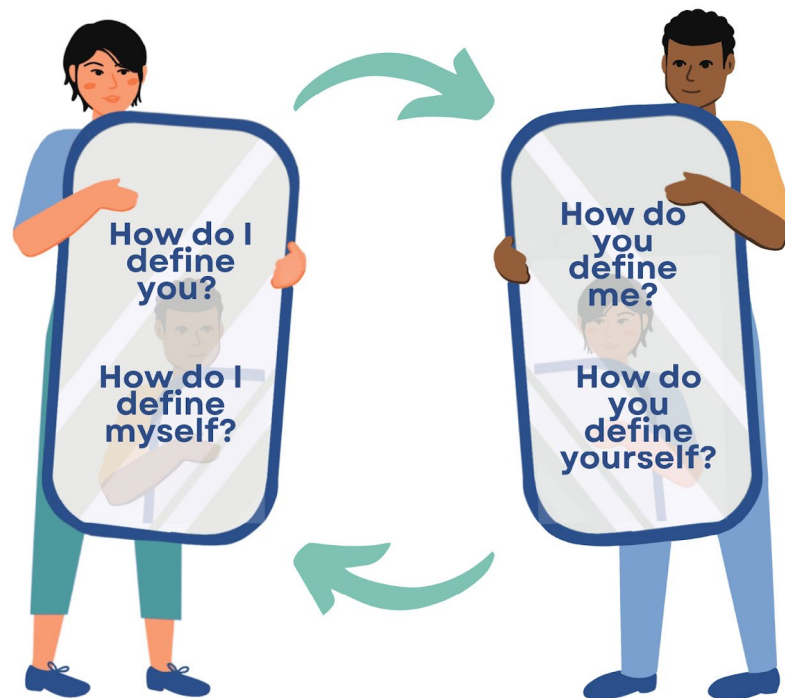


“I learned that I never had a mentor in the sense presented here. It was slow and bumpy learning how ‘the systems/environments worked.’ The overriding pressure was to find a ‘good’ problem to work on.” – *Workshop participant*

These three strands of learning, participation, and identity are intertwined and develop synergistically.



Not only is developing a mathematical identity crucial for mentees, but personal identities are integral to all interpersonal relationships, and mentoring relationships are no exception. Each person has a unique identity based on how they define themselves, which might include their experiences, needs, interests, values, abilities, aspirations, beliefs, gender, family, culture, and maybe more. Furthermore, others often perceive and assign different identities to us than the way we define ourselves.



The identities that we each bring to mentor-mentee interactions influence the decisions we make, our understandings of the world around us, and how we communicate. A mentor does not need to share an identity with a mentee—indeed no two people have the same identities. While our different identities can provide fertile ground for growth, they can also lead to miscommunication and misunderstandings if the individuals are not sensitive to the differences in their identities. Mentors’ recognition that their mentees’ identities differ from their own, often in unknown ways, can help us listen more closely to understand mentees’ experiences and needs.



“I’m really interested in thinking further about building mentee’s ‘identities as mathematicians.’” – *Workshop participant*

Mentoring is often thought of as a one-to-one hierarchical relationship, but it can take many other forms as well. Different mentors provide different resources and support, and networks of one or more mentors with one or more mentees, including people of the same or different career stages, can provide a robust system of support. As we will discuss below ([Dimensions of Mentoring](#)), mentees need support in many aspects of their journeys. Multiple mentors in a variety of configurations provide a mentee with many dimensions of what they need.



“Some mentoring relationships might include multiple mentors, and others might have several mentors who do not know one another. Either approach is valid, depending on the needs of the mentee and who the mentors are.”

– Workshop participant



You can see more detail about this presentation by viewing [a recording and the slides](#).⁷

7. Link: <https://www.slmath.org/workshops/1059/schedules/33030>

Mentoring Experiences through the Lens of a Mentee

Lucy Martinez, Rutgers University

As a complement to research about mentoring, we needed to hear from mentees themselves about their experiences with mentoring and what they need. Lucy Martinez, a mathematics graduate student at Rutgers University, presented her perspectives on what constitutes effective mentoring. She spoke both about her experiences with mentors and highlighted qualities of a good mentor and their impact on the mentee's life both academically and personally.



An effective mentor has a sincere interest in promoting the well-being of their mentee and is committed to their success. While the mentor might focus on the professional development of the mentee, they are also aware that the mentee is a complete human, with a broad range of needs, interests, and characteristics. The mentor seeks to help the mentee find what they need.



“There are ways to give constructive feedback that entail naming assets at the same time as pointing out things that can be done better.”

– Workshop participant

Some characteristics of an effective mentor include:

- Takes initiative to develop a constructive relationship with the mentee and anticipates what the mentee might need to know and do.
- Builds open and honest communication, listens closely, and recognizes that each mentee has unique interests and needs.
- Gets to know the mentee, in order to provide what the mentee needs.
- Is approachable, reflective, and inspiring, and demonstrates compassion.
- Identifies clear boundaries and realistic expectations.
- Is a supportive and encouraging teacher, balanced with providing constructive feedback and criticism.
- Helps mentees develop their professional networks.
- Seeks out opportunities for their mentees and encourages the mentees to pursue them.



“Listening to understand is important when trying to address students’ well-being. Only being solution-oriented when addressing issues is not enough.” – Workshop participant

Mentoring shows up in different forms and with different people. It can be formal or informal, structured and systematic or naturally occurring, and can be short-term or long-term. Even the most effective mentor cannot meet all their mentee’s needs; the mentor needs to acknowledge their individual strengths and support mentees in developing multiple mentoring relationships to support their research, education, collaboration, advising, careers, and all other aspects of their professional well-being.

Power is inherent in any mentor-mentee relationship (including amicable ones!). Mentors can have a considerable impact on a mentee’s development, including

the mentee's access to opportunities. Mentees are aware of these power differentials, which might challenge their sense of safety and block open and honest communication. An effective mentor is also attuned to the power in the relationship and strives to create a safe space for the mentee to flourish.



“Dysfunctional mentoring relationships need adjustment ... ending them is one way ... and the person of more power ought to be extremely mindful to reduce harm in that case.” – *Workshop participant*

“Surround yourself with people who build you up, and avoid as much as possible people who will tear you down.” – *Workshop participant*



You can see more detail about this presentation by viewing [a recording and the slides](#).⁸

8. Link: <https://www.slmath.org/workshops/1059/schedules/33026>

What would you do?

How do we mentor in difficult moments? How could these difficult moments be resolved to help all involved to succeed and thrive? As a community, we analyzed real-world scenarios in which mentoring might be called for and asked participants “What would you do?” in response to each scenario.

Scenarios provide a context in which we can think about effective mentoring on two levels: concrete ideas and concerns for addressing a specific situation, and more general principles and challenges that we can incorporate in our mentoring practice overall. These scenarios stimulated vibrant, challenging, wide-ranging, and sometimes controversial discussions about what it means to be a mentor, and generated a plethora of ideas for all of us to consider in our work as mentors, particularly for those who have too often been left behind.

What would you do?

SCENARIO: Jamyll feels ignored by his professor⁹

Jamyll, an African-American¹⁰ student, is a math major with a 3.6 GPA in his math courses. You are Jamyll’s advisor. He is at risk of failing analysis and tells you, “I’m having a really hard time with this professor. In class, he never calls on me. I’ve been getting bad grades on homework and exams, but when I go to office hours for help, he answers everyone else’s questions except mine, as if I’m not even there.” This professor is a well-respected member of your department.

The history of the United States has many examples of marginalization of communities and groups of people from various sectors of society. As educators and mentors, we can combat this history and its consequences by fighting back against the unfair and destructive narratives about these groups. How might we assist Jamyll in authentic ways that honor his experience and uplift him while recognizing potential unconscious biases?

9. Scenario prompts are fictionalized and presented verbatim as discussed in the 2023 workshop.

10. The terms “African-American” and “Black” are used interchangeably throughout this text



“Listen to understand. Then show genuine empathy, then brainstorm with the student what can be done, assuming the student is open to it.”

– Workshop participant

Many participants vocalized concern for Jamyll. How can we assist him? What can we do with our colleague who is teaching him? How might we get Jamyll assistance outside of class? There was definitely a hesitation in dealing with faculty members directly, while participants described some of their concerns with power and status.



“As a grad student, I would want an advisor to validate the experience and then step in and be willing to say something if it turns out that the professor is intentionally targeting or ignoring me ... if I’m comfortable. I probably actually wouldn’t want them to do it, but knowing they’d be willing to would make me feel better.” – Workshop participant

“Once the specific student is out of harm’s way (and consents): try using this as a case study for working with the entire department on becoming aware of unconscious bias, its impacts, and how to check our biases.”

– Workshop participant

Some of the most common themes that were addressed in participant responses were:

- Validate Jamyll that this is not OK.
- Ask Jamyll what kind of help he wants. Listen to understand, then brainstorm solutions together.
- Check for more details to unpack what’s going on, while being aware of power dynamics with the professor.
- Ensure Jamyll knows where he can get mathematical help.
- Directly approaching the professor can be productive or could backfire. For example, being asked to reflect on the potential impact of racial bias might lead this professor to grading Jamyll even more harshly. In some cases, the department chair or another faculty member may need to be involved.

What would you do?

SCENARIO: Martine is interrupted¹¹

Martine is a junior faculty member and was the course coordinator for calculus last semester. In a faculty meeting, the faculty are discussing what to do about the high failure rates in calculus. Each time Martine begins to speak, other faculty cut her off or speak over her.



“I was once Martine.” – Workshop participant

This scenario is also about power, and how we as bystanders can find ways to interrupt it. Most of the responses in the Padlet were clear in trying to find ways in which we could make sure that Martine’s voice was recognized and that her expertise and authority as a course coordinator was respected. Some people chose more colorful ways to respond than others, as demonstrated in the Padlet. In the Padlet, you will see a theme of “overstepping bounds” arises. How do we speak up for Martine without being patronizing?



“Oh, this happens to me all the time. I have to be really obnoxious to stop it. It is irritating that I end up seeming like the obnoxious one.”

– Workshop participant

“To support Martine in the moment I would be sure to use my seniority and privilege (power) to ask that my colleagues pause and focus on Martine’s expertise and experience. In the longer term, I would work for department meeting norms that balance participation.” – Workshop participant

Common themes that were addressed in participant responses were:

- Call it out by interrupting the interrupter with a statement like “Martine was trying to say something and I’d like to hear her finish.”
- Those with power and privilege need to notice when this kind of thing happens and call it out. On the other hand, we need to know if

¹¹. Scenario prompts are fictionalized and presented verbatim as discussed in the 2023 workshop.

Martine wants someone to stand up for her, as this can take power away from her.

- Invoke community norms and remind the group of the community standards for constructive conversation. It might be helpful to begin the year with developing a community agreement and have it posted as a reminder for each session.
- Check in with Martine afterwards. She might need validation.



“What not to do: email Martine after the meetings and apologize when you could have said something in public.” – *Workshop participant*

What would you do?

SCENARIO: Ahmad is lost¹²

Ahmad is a third-year graduate student and just finished his prelim exams last semester and is ready to begin his research. His research advisor tells you he hasn't begun investigating any of the problems she suggested to him. Ahmad rarely comes to talk with her about his progress. When you see Ahmad, he tells you that his research is going well and he is making a lot of progress.



“As a third-year PhD student, this is exactly what I am afraid of ... I'm afraid of thinking I'm doing well but my advisor thinking I'm doing terribly.”

– *Workshop participant*

This scenario was offered to spark us to think about how to give feedback and have conversations that might border on conflict. How might we want to call Ahmad into question while still making him feel welcomed and have a sense of belonging? How might our identity and Ahmad's identity impact this conversation?

We all discussed Ahmad with the assumption that he was a person with a marginalized identity, which highlights our own collective biases since his identity

12. Scenario prompts are fictionalized and presented verbatim as discussed in the 2023 workshop.

was not described in the scenario. The discussion focused on Ahmad's identity and his relationship with his adviser. What is his relationship with his research mentor, and why is there a disconnect between their views on his progress? Is he being untruthful, avoiding conversation, or do he and his mentor have disparate expectations for his work? How can we support Ahmad with compassion, while respecting his privacy and affirming his identity?



"It seems to me that the advisor needs to have a little talk about what they expect with their student. It doesn't seem that communication is working there!?" – Workshop participant

If his identity is such that he lives his life as a person who needs to struggle for validation and who weathers both implicit and explicit marginalization, then we need to ensure that our own voices do not affirm that marginalization but instead communicate respect and support. Some other themes that were addressed in participant responses included:

- The passivity of the advisor's approach is a concern.
- Give Ahmad space to share more about his research. Hopefully find things to validate him and then ask what his advisor's feedback is.
- Bring up the dynamic of the relationship and what expectations/needs are present for both the advisor and the advisee.



"Offer to mentor him, not in words, but by reaching out with compassion as a mentor. There may be some important things going on and he might need some support." – Workshop participant



Check out the full [Padlet discussion](https://padlet.com/ariswinger/cime-mentoring-scenarios-what-would-you-do-q8mdw68vsum6jn7g)¹³ of these scenarios.

13. Link: <https://padlet.com/ariswinger/cime-mentoring-scenarios-what-would-you-do-q8mdw68vsum6jn7g>

Studying Successful Doctoral Students in Math from Underrepresented Groups

Sarah Sword, Education Development Center

This talk discussed early findings from an NSF-sponsored study of 75 doctoral students and recent PhDs in mathematics from underrepresented groups. The project was based on in-depth, semi-structured interviews with four cohorts: newly accepted students, early graduate students (pre-qualifying exams), advanced graduate students (dissertation level), and recent PhDs (0-5 years since graduation). The research questions in the study are: (1) What are lived experiences of successful underrepresented students who are pursuing mathematics PhDs? and (2) What formal and informal structures are perceived by doctoral students as effective supports? Themes drawn from the interviews can inform department policies and practices to create environments that support students from underrepresented groups as they earn PhDs in mathematics.



“I’ve always navigated my math journey alone. I’m learning I don’t have to, but haven’t figured out how to find the people to help me along my journey.”

– Workshop participant

The work described in this presentation is vitally important to what mathematics can be for everyone. The presentation discussed a large-scale ongoing project in which the reflections of people of color in graduate school were collected and analyzed to find common themes. The presentation addressed some of these themes, lessons learned, and takeaways from this work.



“[the presenter] . . . said something along the lines of ‘sometimes students don’t even know what to ask, so mentors should be proactive’ so I want to be more proactive in helping students.” – *Workshop participant*

One major theme was invisibility and isolation. Many students reported being the only minoritized person in the department, being clumped with other minority students rather than being recognized and treated as individuals, feeling invisible or unimportant, not being able to share their experiences about their lives, feeling an extra pressure to succeed, and a lack of access to knowledge about pathways to success.

Some students describe their access, or lack of access, to social capital. Social capital is a construct tied to the ability to gain access to information and other resources, oftentimes through channels that are interpersonal and through relationships which many students of Color do not have. Students’ stories made clear that communication was a major key in their success. Many students reported confusion about official and unofficial paths through their graduate school programs, numerous breakdowns of communication about classes and the feeling of not being understood, resulting in their needs not being met. Vitally important is the observation that in every single reflection of the 75 that were recorded, participants noted that everyone who had success had some level of social capital.



“... the work of getting ‘the missing mentors’ into this kind of space needs to start at even valuing the educational role of faculty ... and the humanity of students in their care.” – *Workshop participant*

Numerous stories reflected how powerful mentors can be. When it came to mentoring, students reported not wanting to be a burden, not wanting to ask questions, and feeling lost at different stages, especially at times of transition. In describing their ideal mentors, students frequently described themselves and their needs first. They described a core of “care and intentionality,” even if that manifests differently in different relationships, and that trust emerges in multiple ways. Here is an aggregate description of an ideal mentor as reported by these students:

- Understands the student’s personal identity and life context.
- Offers a safe space for questions of all kinds.
- Cheers on progress but does not judge setbacks.
- Speaks truthfully and directly, but not unkindly or unduly critically.
- Identifies opportunities and shares them—multiple times, if needed.
- Draws on their network to point students in the direction of different mentors/support.
- Shares their experience but does not expect the student to make the same choices.
- Makes hidden curricula and invisible pathways visible.
- Listens!



“You may not be able to be everything for every student; it’s more about referring them to other resources when it’s something you can’t help with yourself. There are always going to be things I’m not capable of helping with since my perspective is not theirs—but being willing to look for sources of help makes me more able to help with other mentees, too.”

– Workshop participant



You can see more detail about this presentation by viewing [a recording](#)¹⁴ and [the slides](#).¹⁵



This work is supported by the U.S. National Science Foundation under Grant Agreements #1920753 and #2207795. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

14. Link: <https://vimeo.com/811385438/c6115d97bb>

15. Link: <https://www.slmath.org/workshops/1059/schedules/33032>

What would you do differently as a mentor?

This activity was centered around self-reflection and accountability. The first step toward change is being aware that there is a direction for growth in our practice, and that growth needs to build on understanding our challenges and limitations. To encourage participants to reflect on their own mentoring practices and begin to integrate the ideas we have discussed as a community into their practice, we offered this prompt:

PROMPT Spend a few minutes reflecting about your mentoring relationships. Where have you struggled? What did you do well? Are there things you would do differently today?

This reflection time and Padlet facilitated our growth as mentors, allowing us to think about and discuss how we hope to improve as individuals and share with our communities ways to make our environments better for our mentees. Discussion centered around the need to be more proactive in reaching out to mentees, learning about their goals and needs, supporting them by making them aware of opportunities, and being aware of and respecting differences in identity. In particular:

- Talking about identity presents some challenges. How can you support students if your identity and experiences are so different from theirs—can you offer advice? For example, one participant questioned how to guide students' writing processes when they might prefer a different communication style.
- Recognizing that mentees can benefit from multiple mentors includes an acknowledgement that we cannot be everything to everyone and having the self-compassion to recognize that mentors are human and imperfect. We as mentors should do our best to provide our

mentees with what they need, which might be something we cannot provide ourselves. We owe it to our mentees to articulate that clearly and assist them in finding resources and other mentors who can support them. These other mentors are not replacements for us but complements to the network of support that facilitates the mentee's best possible growth.

- It can be a struggle to understand our mentees' goals and respect that they may be different from our own.



“Striking the balance between compassion and holding high standards.”

– Workshop participant

“I tend to really internalize student trauma and I think that goes beyond empathy and isn't necessarily helpful.” *– Workshop participant*



Check out the [Padlet discussion](https://padlet.com/ariswinger/what-would-you-do-differently-utnqjexc9312ec5l)¹⁶ for more participants' reflections.

16. Link: <https://padlet.com/ariswinger/what-would-you-do-differently-utnqjexc9312ec5l>

Dimensions of Mentoring

As multidimensional individuals, the areas in which we each need support are multidimensional as well. In mathematics (and in many other disciplines), we often focus our mentoring on the acquisition of knowledge. As we discussed in [The Science of Mentoring](#) and through the project on [Studying Successful Doctoral Students](#), the need for mentoring and support extends beyond content knowledge.

This exercise was designed to illuminate the various parts of our lives that impact us, to remind the participants that mentoring is a relationship, and that when they sit with a mentee, they're engaging with a complex individual whose well-being is tied to a multitude of factors. While we may not be comfortable or even qualified to speak in some areas, effective mentoring is tied to ensuring that our mentees have access to all available resources that will support them.

We briefly described eight commonly accepted dimensions of wellness (intellectual, financial, environmental, social, occupational, spiritual, emotional, and physical), and asked participants to reflect on how these dimensions are reflected in their careers and in their mentoring.

PROMPT Which dimensions have been most important to your professional and career decision-making? Which dimensions do you think are most important for students or junior colleagues? Why? Are some of these harder than others to discuss with mentees? Are there any dimensions that you have never discussed with a mentee? What parts of who you are (your own identity) make it harder or easier for you to have these conversations?



“Reminding students and mentees that they have put in a lot of work intellectually and they also need to eat and sleep in order to be their best (not just exercise as physical wellness).” – *Workshop participant*



Before you read the summary below or look at responses in the [Padlet](https://padlet.com/ariswinger/scenarios-dimensions-of-mentoring-j1g1x5vrtl4sswz)¹⁷ think about these Dimensions of Wellness and how any of them might be reflected in your own mentoring. As a mentor, which of them would you have the hardest time addressing with your mentees? Why? Which would be the easiest? Which might you think would be inappropriate? For example, is it easy for you to talk to your mentees about finances?

Participants described the areas in which they feel comfortable talking with their mentees and those in which they struggle. Much of the discussion addressed how to begin the conversation.

- Ask how they are feeling—specific questions, more than the general “how are you doing?” Even “How are you doing *today*?” can feel more personal and authentic.
- Mentors can check with mentees about self-care, asking about workload, time management, sleep, eating, recreation, and overall stress.
- Social well-being is important to us all, and we need to remember that mentees are learning to navigate social and professional interactions as an important part of their identity.
- Social well-being relates to belonging and inclusion.

17. Link: <https://padlet.com/ariswinger/scenarios-dimensions-of-mentoring-j1g1x5vrtl4sswz>



“We talked about the importance of doing things outside of academia (organizing, rowing, etc.). Excelling at something outside of work gives you a sense of identity outside of your work and builds resilience. It also builds an alternate network of social capital that can sometimes (coincidentally!) overlap with your professional network.” – *Workshop participant*

Dimensions related to mental health, spirituality, and financial well-being were identified as especially challenging.

- Some participants were clear that they did not want to approach conversations about mental health especially when they have their own struggles.
- Discussing finances is sometimes considered taboo in our society, and it can be hard to begin this conversation, especially if we are financially privileged. However, financial stability is important and often fragile for students. As mentors we can sometimes help reduce financial barriers to success.
- Spiritual well-being is hard to address (such as politics).
- Even if we cannot ease these burdens, validation is crucial to well-being.



“I really struggle to support students when they share with me that they are experiencing mental health issues when I myself am struggling with my mental illnesses. When my depression and/or eating disorder are making it difficult for me to function, I don’t have as much capacity to support my students, and feel like I’m failing them.” – *Workshop participant*

“We talked a lot about social capital in our group. It’s something students need and may not know they need. We talked about ways a mentor can help increase students’ social capital.” – *Workshop participant*



After you’ve had some time to think about these questions deeply, check out the full [Padlet discussion](https://padlet.com/ariswinger/scenarios-dimensions-of-mentoring-j1g1x5vrtl4sswz).¹⁸

18. Link: <https://padlet.com/ariswinger/scenarios-dimensions-of-mentoring-j1g1x5vrtl4sswz>

Building Institutional Support for Mentoring

David Manderscheid

University of Tennessee-Knoxville/U.S. National Science Foundation

Abstract: In this talk Dr. Manderscheid discussed ways to build institutional support, both financial and otherwise, for mentoring for the success of all students, both within an institution and working with outside entities. The presentation included information on various programs at the National Science Foundation within the Division of Mathematical Sciences and the Directorate of STEM Education that could provide funding.

This presentation was a live discussion with audience members.

What would you do?

Our next step was to consider scenarios that addressed institutional support for mentoring.

How do students know about opportunities?

The following scenario was offered because it is tied to the question of social capital discussed earlier. As mentors, we generally have access to much more social capital than our students and mentees. For example, we have access to colleagues and other resources that can help us know about opportunities that our mentees would have no other way of knowing. What can we do if we are not connected to the resources students need? For example, how can we connect our mentees with affinity groups of others who share some of their identities, when we are not connected ourselves? We sometimes have to step out of our comfort zone to make these connections.

What would you do?

SCENARIO: Isabella's concerns²⁰

Your mentee Isabella is a first-generation Latina college student. At your recommendation, she attended a summer REU.²¹ She tells you that she learned about the profession of mathematics in ways she had never understood before, and now she has the goal to become a research mathematician and be an advocate for other Latinas in mathematics. She tells you that most of her peers don't know anything about REUs and asks you how other students from underrepresented groups can learn about these opportunities.

Many participants were quick to want to offer Isabella support. She can be encouraged to speak to other undergraduates in classes or through math clubs or other means. She could provide important insights about ways in which the REU

20. Scenario prompts are fictionalized and presented verbatim as discussed in the 2023 workshop.

21. REU: Research Experience for Undergraduates

was valuable to her and might be of value to others. Some workshop participants noted that this additional labor should not be Isabella's alone and that this work is the responsibility of the faculty.

Several suggestions were made about systemic ways to make this information available to students through programs, posters, in classes, or other means, so that we can advise students to apply to the programs that will provide them with the best opportunities for growth. Other ideas included organizing workshops about what REUs are and how to find the best fit for the individual mentee, and to give visibility to students who have positive experiences in REUs.

Increasing Isabella's social capital was a prevalent theme, with many participants pondering how we could create internal resources to support Isabella and others who do not feel "in the know."



"How do we know which [REUs] will not be traumatizing?"— *Workshop participant*

"My undergraduate mentor is a Latina mathematician and she is how I learned about research, REUs, grad school, conferences ... In my linear algebra class ... she told us 'All you math majors, especially you Latina math majors—come talk to me so I can help you learn how to make the most of your time here.' If it wasn't for her taking 5 minutes at the beginning of the first day of class to say something, I don't know if I would even be in grad school right now."

— *Workshop participant*

What would you do?

This is a change agent question. Once we start to think about best practices and our own ways of growing as professionals, how do we then think about bringing these practices to the communities we are a part of? How do we communicate with our colleagues, and lead them to consider new ideas and to change their practices? This can be difficult and nuanced.

SCENARIO: Colleagues learning to mentor

After this workshop, you realize that your colleagues and students would benefit from mentor training. You're not sure your colleagues will find it necessary, and funding is a concern as well.

It was noted that some faculty resistance might stem from the implication that

they need to be trained to do something they believe they have been doing for a long time and suggested that framing it differently might help engage them.

Other audience suggestions included involving colleagues in leadership positions to assist with funding and building buy-in and petitioning institutional leadership, the National Science Foundation, or other organizations to make improved mentor training standard. However, as one participant noted on the Padlet, “funding is easier to find than allies.” We need to acknowledge that there are some challenges that require more systemic solutions. At the same time, help may be nearby in the form of colleagues, experts, and the community we formed at this workshop.



“Call it something different. ‘Mentoring Reset’ or ‘Mentoring Brainstorm Session’ or ‘Mentoring the Gen Z Generation’ are possibilities. My colleagues will resist being ‘trained’ at something they’ve been doing well enough for a long time.” – *Workshop participant*

“I’m thinking a lot about how to share resources and activities like this with a group of mentors I’ll be wrangling next year. I feel like I’ve come away with a lot of great resources and ideas.” – *Workshop participant*

What would you do?

In our current political climate, it can be dangerous—in terms of physical, career, and social safety—to speak honestly about racism and violence. The previous scenario featured undergraduates. How would you handle the following scenario, this time featuring a faculty member?

SCENARIO: Safety in speaking up²²

The shooting of an unarmed Black man by a White police officer in a town neighboring your campus has made national news. The college president sends an email to faculty saying that they are not to make any statements relating to the incident publicly, including in classes. A junior faculty member in your department, who is Black, tells you that they have no intention of being quiet on this issue.

This scenario generated more discussion than the others. Many participants questioned whether the president had the right to make this demand. One of

22. Scenario prompts are fictionalized and presented verbatim as discussed in the 2023 workshop.

the themes from the audience stands out here: how do we balance the seeming tension between supporting the faculty member's need to express themselves and help their community with the possible repercussions they may face, for example in how their career trajectory might be affected? This may be a career defining moment for this faculty member. What role do you play here?



“This is the moment when you find out what you are made of. Will you stand with your colleague or not?” – Workshop participant

“This makes me think about a broader question recently on my mind a lot: how much personal risk do you take for a greater good?” – Workshop participant

The audience members were quick to answer with what they would do in solving the problem. This makes complete sense as solving problems is what mathematicians do. This can also be problematic. One of the facilitators noticed the lack of initial compassion in some people's responses. Where is the compassion and care that one wants to show to anyone who has been traumatized? During the discussion, facilitators reinforced the need to pause and truly think about what the junior faculty member may be feeling first, instead of trying to solve the problem.

One participant described an experience similar to the last scenario while they were teaching at an HBCU. A nearby murder shook the community, and this professor's students, who were all African-American, did not want to process it during class. They wanted to do mathematics, possibly as a balm to distract them and soothe them in the light of the pain they were experiencing. This personal story led to extensive discussion about listening and sensitivity, and the different ways that our students, mentees, colleagues, and we ourselves experience trauma.



“Is the [college] president even allowed to do this? There's nothing political about extending support to students who may need it after someone in their community (physical or identity-wise) has been hurt or murdered.”

– Workshop participant



Check out the full [Padlet discussion](https://padlet.com/ariswinger/cime-mentoring-systemic-scenarios-what-would-you-do-4i39iu4fkd3c7nvu)²³ of these scenarios.

23. Link: <https://padlet.com/ariswinger/cime-mentoring-systemic-scenarios-what-would-you-do-4i39iu4fkd3c7nvu>

Knowledge-GAP: The Impact of Mentoring on the Graduate School Application Process

Tim McEldowney, West Virginia University

The Undergraduate Knowledge of the Mathematics Graduate School Application Process (Knowledge-GAP) project seeks to understand how undergraduate student knowledge about the graduate school application and admissions processes acts as a barrier for students seeking advanced degrees in mathematics. This project was especially interested in experiences of students historically marginalized in STEM disciplines as they attempt to pursue graduate education in mathematics. This presentation discussed how access to mentors in particular has impacted participants' ability to apply to graduate school.

The Knowledge-GAP survey was created to investigate whether undergraduate math majors have access to the necessary knowledge and resources to apply to graduate school. Survey respondents were recruited through various listservs and through direct email to department chairs and program directors, primarily aimed at 3rd and 4th year math majors at colleges and universities with more than 1000 students. The survey asked about participants' knowledge of and interest in applying to graduate school in mathematics. This presentation addressed preliminary analyses of 442 survey responses that responded to the question: "Do you have someone you consider a mathematical mentor?"

The survey respondents' self-identified gender included 184 men (47.2%), 162 women (41.5%), and 44 who were non-binary, transgender, agender, or a gender

not listed (11.3%). Approximately two-thirds of respondents were White.

More than 86% of the respondents reported interest in some form of graduate school overall, including 25% who were interested in doctoral studies immediately after finishing their undergraduate degrees. Men, women, and non-binary respondents differed in their interests about graduate school, with men more interested in a PhD, women more likely to be interested in a master's degree only or not interested at all, and non-binary respondents more interested in a master's degree into a PhD than master's only $\chi^2(8, N = 391) = 20.47, p = .009$. There was not a significant association between participants' race/ethnicity and their interest in graduate school.

Overall, there were no significant associations between respondents' gender or race/ethnicity and whether they felt they knew enough about the application process to apply to graduate school in mathematics.

Men were less likely to report being encouraged to pursue mathematics than respondents of all other gender identities combined $t(390) = -2.14, p = .033$.

White participants were more likely to report being encouraged to pursue mathematics than respondents of all other race/ethnicities combined. $t(389) = 2.57, p = .011$.

Only 55% of participants said they had someone they consider a mathematical mentor. There was not a significant association between participants' reports of having a mentor and gender or race/ethnicity.

Participants who reported having a mentor were significantly more likely to report feeling prepared to apply to graduate school (38% vs. 23%; $\chi^2(2, N = 441) = 11.77, p = .003$) and significantly more likely to plan to apply to a PhD directly (33% vs. 16%; $\chi^2(4, N = 441) = 19.40, p < .001$).

In describing their experiences, some typical reports about why they were not interested in graduate school in mathematics included:

“I have been miserable during my entire undergrad career so far and I’d rather get a boring job.” – Survey respondent

“When I saw my dad getting his Master’s in Applied Mathematics when I was young I did not want to get a master’s degree because of how unpleasant I saw it to be.” – Survey respondent

Having even one mentor changes the experiences of students attempting to navigate the field of mathematics. One participant reported that “[a] mathematician

that came to visit my campus told me more about [graduate school] and invited me to a conference.... Before that, I had no knowledge at all about graduate school.” This participant also reported that by attending that conference they found additional mentors. This comment points to the power of even a single external mentor.

In response to the question “What have you learned about the graduate school application process by taking this survey?” one respondent replied, **“That I should find a mentor.”**



You can see more detail about this presentation by viewing [a recording and the slides](#).²⁴

This material is based upon work supported by the U.S. National Science Foundation under Grant No. 2126018. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

24. Link: <https://www.slmath.org/workshops/1059/schedules/33037>

Mentoring Agreements

Identifying and aligning expectations through mentoring agreements and training programs can be valuable to both mentors and mentees to ensure that mentees' needs are met. The most effective mentoring agreements can address the three dimensions of developing as a scholar: acquiring mathematical knowledge, learning mathematical practices, and developing a mathematical identity.



“I think mentoring agreements and individual development plans are wonderful! Some people worry about formalism and not having a natural relationship, but formality and written boundaries give power back to the mentee/student. Having a formal time/space to talk removes some of the hidden curriculum, and written agreements increase accountability and the power of the student to refer to what a mentor/advisor has previously agreed to.” – *Workshop participant*

Mentoring agreements are a concrete way to keep faculty power in check and to ensure that all parties have a shared understanding of their expectations and responsibilities. Indeed, if the balance of power between mentors and mentees is unchecked, it can be difficult for effective mentoring to take place. After all, if a mentee feels like their mentor wields power over them, why would they risk divulging any of the vital elements of their multidimensional selves? Mentoring agreements allow for a set of shared expectations for all parties, wherein accountability measures are set for everyone. This can give a mentee a sense of relief and provide a concrete reminder that the mentor is committed to their success, while reminding both mentor and mentee of their commitment to each other.

Participants were offered this discussion prompt:

PROMPT Read the sample mentoring agreements available [here](#),²⁵ [here](#),²⁶ and [here](#).²⁷ Choose one of your mentees. What parts of these mentoring agreements are relevant for your relationship? Which of the resources did you use, and why? Draft a mentoring agreement for your relationship. You can use any ideas from the samples, or other ideas, to construct a draft that you can bring home with you and further develop with your mentee.

The following morning, we asked:

PROMPT How was the assignment? What are some challenges and benefits of mentoring agreements? Any lingering questions from yesterday?

Participants were challenged to draft a mentoring agreement for their relationships with one of their mentees, to share the drafts with other workshop participants, and to bring that draft back to further develop with their mentees. Participants noted that mentoring agreements provide both transparency and accountability. They also emphasized the need to review the mentoring agreement regularly between the mentor and mentee to ensure that expectations remain clear. Agreements can be modified if both parties agree.

“The agreements are of use only if you refer to them regularly during the time of mentorship (and not only set them up to not look at them again).”
– Workshop participant

“As a graduate student, I wish my advisor had used a mentoring agreement. I feel as if we have had a mentoring agreement that my advisor would be more aware of my actual wants and needs and how they differ from their experiences.” – Workshop participant

25. Link: https://drive.google.com/drive/folders/16cjv7H4Oaw7oL4ZNMuq5Pm7PEM7Ct_3Q [Folder Owner: Aris Winger]

26. Link: <https://nap.nationalacademies.org/resource/25568/interactive/tools-and-resources.html#section2>

27. Link: <https://ictr.wisc.edu/mentoring/individual-development-plan/>

Expectations delineated in a mentoring contract can include:

Mathematical Knowledge

- Current developments in the research area
- Technical skills
- Research productivity and progress toward research independence
- Learning activities (e.g., coursework, seminars, workshops)

Mathematical Practices

- Skills (critical thinking, creativity, writing, speaking, reviewing, setting priorities, managing time, teaching, mentoring,)
- Allocation of effort to research vs. non-research activities
- Attendance of mentor at mentee's presentations

Mathematical Identity

- Networking by mentor on mentee's behalf
- Time management and work-life balance
- Exploration of career pathways
- Facilitated access to experts, training opportunities, key committees
- Advocacy on behalf of mentee

In addition, agreements can address the logistics of the mentoring relationship, including:

- Frequency of meetings and topics to be addressed
- Information to be prepared in advance of meetings
- Mechanisms and norms for constructive critique and feedback
- Communication norms (e.g., openness, truthfulness, confidentiality)
- Honoring identities of both mentee and mentor
- Strategies for managing conflicts
- Appropriate acknowledgement of one another's contributions to shared projects

Adapted from Huskins et. al (2011).

Goals and Accountability

The goal of this workshop went beyond talking and learning about mentoring, focusing instead on what each of us can do individually and in community to grow our mentoring practices to support all mathematical scientists. The final activity of the workshop was structured to support participants in setting actionable goals and to develop a means for each of us to hold ourselves accountable. Participants were offered this assignment:

First, participants were encouraged to identify someone to support them in holding themselves accountable for growth, to share contact information, and to agree on a communication plan. We encouraged them to begin their work with their Accountability Partners with these questions.

- What are the similarities and differences in your mentoring agreements from the earlier activity? Ask for feedback.
- What are your partner's mentoring challenges?
- How often will you meet to discuss your progress, and through what means (Zoom, email, at meetings, over coffee)?

With Accountability Partners established, we then offered the following activity:

PROMPT Review the National Academies Report [The Science of Effective Mentorship in STEMM](#)²⁸ that you read on Wednesday night. On the first tab, there is a list of 9 recommendations. Use these recommendations and the rest of what you learned to set short-, medium- and long-term goals. Pair up with your Accountability Partner to discuss how you will support each other in making progress.

28. Link: <https://nap.nationalacademies.org/resource/25568/interactive/>



“I need this documentation to be a better mentor.” – *Workshop participant*

SMART goals

SPECIFIC: What change do you want to see?

MEASUREABLE: How will you know when you get there?

ACHIEVABLE: Is it realistically within reach?

RELEVANT: Why is this important?

TIME-BOUND: What are my milestones?

Adapted from Doran (1981).

We defined three categories of goals:

- Short term: What will I start working on right away?
- Medium term: What can I do over the next semester or two?
- Long term: What is my ultimate goal for mentoring?

For each of these goals, we encouraged them to state the goal, the strategy for achieving it, the timeline, people and other resources, and metrics for measurement, using the SMART goals worksheet at the end of this document.



Check out the [full Padlet discussion](#)²⁹ about Goals and Accountability. You can also create your own [Goals worksheet](#) to help you identify goals for your own mentoring practices and experiences.

29. Link: <https://padlet.com/ariswinger/cime-what-did-we-learn-and-take-aways-q3gskxchmdwlmk5d>

Closing Reflections

Effective, personalized mentoring is crucial to increase opportunities for people of marginalized identities to thrive in the mathematical sciences. Building more effective mentoring relationships requires work of individuals, departments, and institutions, as we all strive to do even better at the work we love. We learned a lot from the presentations, activities, and most of all, participants' reflections and contributions.

As mentors, we need to look beyond students' mathematical knowledge and research, to also help them learn the practices of the mathematical professions and build identities as mathematical scholars. This requires centering mentees' identities and needs and being aware of power differentials between most mentors and mentees. *Listening* to mentees was emphasized again and again, as an avenue to understanding individuals' needs, goals, and challenges in order to understand the struggle before trying to solve anything. Only then can mentors help mentees find the resources they need to achieve their highest aims.



We cannot meet every need for our mentees, and should not expect ourselves to. But, if we remain aware of the many aspects of effective mentoring discussed here, we can meet some of those needs and help mentees find support elsewhere

by connecting them with other mentors and other resources. At the same time, we need to care for our own needs by managing expectations and maintaining boundaries.

We heard a lot about the need for humility. Our mentees don't need to do things the same way we do in order to be successful. This might cause tension. Some of us have spent decades mentoring students to success, and over time we may have identified patterns that we think are key indicators of success. However, we also need to resist the traditional model of academic apprenticeship in which "master scientists create successors in their own image as a form of asexual reproduction" (Etzkowitz et.al, 1992, p. 159). When a mentee's journey doesn't fit those patterns, how can we respond with grace and quell our hidden assumptions for where our mentees are "supposed to be," and instead honor the journey that they are on?



"Over the course of my career, my mentoring philosophy has evolved from 'here's what you need to do' to 'I'm ready to go on this journey with you.'"

– Workshop participant

We have all heard a lot about encouraging students to develop a "growth mindset" for themselves in order for them to realize their full potential. Adopting a growth mindset *about our mentees* is also important. We must believe that they are capable of learning and growth and communicate that confidence to them.

It is not only individual mentors who need to do this work. Departments and other institutions should reflect on what they can do to help mathematical scientists succeed. There are some successful models/rubrics that can be used to inform that reflection and subsequent transformation, like the program Creating Opportunities in Mathematics for Equity and Inclusion ([COME-In](https://comeinmath.org)).³⁰

It has been an incredible honor to facilitate this important workshop in collaboration with such a dedicated audience. As a community, we struggled, we debated, we learned, and we set aspirational goals to better serve our community as mentors to our students and colleagues.

We extend our deepest gratitude to the Simons Laufer Mathematics Research Institute for their support, in particular Tatiana Toro, the Educational Advisory

30. Link: <https://comeinmath.org>

Fixed Mindset



There are things my mentee is good at and things they are not.

There are things they can learn and things they can't.

Intelligence and talent are unchangeable characteristics.

Abilities and talents determine success.

Mistakes are a sign of failure.

Growth Mindset



My mentee can learn about anything.

If they don't know something, its because they haven't learned it yet.

Intelligence and talent develop and grow.

Effort and persistence determine success.

Mistakes are opportunities to learn.

Adapted from Boaler, J. (2016).

Board, Chris Marshall, Tracy Huang, and all the staff whose tireless support provided the backbone for this workshop's success. We would also like to thank the National Science Foundation for their support of a number of initiatives that were highlighted and that are instrumental in improving mentoring and the discipline of mathematics. Thanks also to Cassandra Johnson for the beautiful and meaningful illustrations.

It was our goal to create a space where we could have honest conversations about the work we do and support our students and colleagues in STEM disciplines. The conversations were difficult, inspiring, and very fruitful. You can get some of the insights that people gained over the days of the workshop at this



[Padlet](https://padlet.com/ariswinger/cime-what-did-we-learn-and-take-aways-q3gskxchmdwlmk5d).³¹

Where do we go from here? The work continues. Every day, we each strive to grow in the areas where we struggle in supporting students, starting with the

31. Link: <https://padlet.com/ariswinger/cime-what-did-we-learn-and-take-aways-q3gskxchmdwlmk5d>

humility to acknowledge that our mentoring skills are always a work in progress. We are not perfect as mentors and every instance of comfort we feel in doing this work is a threat to improving the lives of our most marginalized students and colleagues. We can keep asking ourselves, “What can I do better?”

We would like to thank you, the reader, for spending your time on this journey by engaging with this document. We hope you took some lessons from this and can join us as we move forward in helping all of our students and colleagues thrive in the greatest disciplines in the history of humankind.



“It’s important to recognize that unless we (as faculty) see mentoring as 2-way, we won’t learn about the experiences of students, we won’t learn how to be a better mentor, [and] we won’t learn how to broaden participation/build capacity.” – *Workshop participant*

“Just amplifying [the] point about receiving criticism with humility. Equally we need to give criticism with humility and grace, and have kindness for those who are processing criticism. All these behaviors have been demonstrated beautifully here, and I think it is an area of potential continued growth for all of us.” – *Workshop participant*

“I’m thinking about how the quotes and stories we heard in the presentations came from individuals, but represent experiences that are happening to many.... I am thinking about how we can teach the practices of the dominant culture while recognizing and honoring students’ identities.” – *Workshop participant*

“What is the benefit to the mentor?’ It’s love. It’s happiness. I’m here to become a better mentor because I love my mentees and want to see them happy and thriving. This is the most important part of mentoring to me. Everything else is second.” – *Workshop participant*

Workshop Participants



CIME 2023 in-person participants at Simons Laufer Mathematical Sciences Institute.



CIME 2023 online participants.

Presenter and Organizer Biographies³²

Pamela E. Harris is a Mexican-American mathematician and serves as Professor and Chair of Mathematics at the University of Wisconsin-Milwaukee. She received her B.S. from Marquette University, and M.S. and Ph.D. in mathematics from the University of Wisconsin-Milwaukee. Dr. Harris' research is in algebraic combinatorics and she is the author of over 70 peer-reviewed research articles in internationally recognized journals. She is a Fellow of the American Mathematical Society and of the Association for Women in Mathematics. Dr. Harris is an award winning mathematical educator, receiving the 2022 MAA Deborah and Franklin Tepper Haimo Award for Excellence in Mathematical Education, the 2020 recipient of the MAA Northeast Section Award for Distinguished College or University Teaching, the 2019 MAA Henry L. Alder Award for Distinguished Teaching by a Beginning College or University Mathematics Faculty Member, and the 2019 Council on Undergraduate Research Mathematics and Computer Sciences Division Early Career Faculty Mentor Award. She is the President and co-founder of [Lathisms: Latinxs and Hispanics in the Mathematical Sciences](https://www.lathisms.org) (<https://www.lathisms.org>) and cohosts the podcast [Mathematically Uncensored](https://www.pamelaeharris.com/post/mathematically-uncensored-podcast) with Dr. Aris Winger (<https://www.pamelaeharris.com/post/mathematically-uncensored-podcast>).

Abbe Herzig teaches mathematics and other courses to incarcerated college students through the [Bard Prison Initiative](https://bpi.bard.edu) (BPI, <https://bpi.bard.edu>). Through BPI and elsewhere, she has taught courses on race, equity, and social justice in STEM education. Previously, she was Director of Education for the American Mathematical Society. She collaborated with the AAAS on the development of self-assessment tools for STEM departments, professional societies, and institutions to identify and address the impacts of their practices and policies on DEI. With Aris Winger, she co-leads [COME-In](#) (Creating Opportunities in Mathematics for Equity and Inclusion), a program that provides departments and programs with resources and a community to create transformational change. Her research documented successful practices and policies for supporting equity and diversity in graduate mathematics education. She is a trained facilitator of the [Entering Mentoring curricula series](https://cimerproject.org) (<https://cimerproject.org>) from the Center for the Improvement of Mentored Experiences in Research (CIMER). Abbe earned her doctorate in math education from the University of Wisconsin-Madison, and has graduate degrees in statistics and mathematics. She is a four-time graduate of U.S. Space Academy.

32. All biographies were current at time of workshop and/or publication.

David Manderscheid is the Division Director for the Division of Mathematical Sciences at the U.S. National Science Foundation. He is also a Professor of Mathematics at the University of Tennessee, Knoxville and former Provost there. Previously he served as Dean and Professor of Mathematics at the University of Nebraska and Ohio State University. He started his career at the University of Iowa where he rose through the ranks to become Director of Graduate Studies and then Chair. His research is in representation theory and number theory and he is a Fellow of the American Mathematical Society and the American Association for the Advancement of Science.

Lucy Martinez is a PhD student in mathematics at Rutgers University, and is an NSF Graduate Research Fellow. Her research interests include experimental mathematics and combinatorics. Along with her coauthors, she received the 2022 AAEE Best Paper Award for their paper “[On Kostant’s weight \$q\$ -multiplicity formula for \$\mathfrak{sl}_4\(\mathbb{C}\)\$](https://link.springer.com/article/10.1007/s00200-020-00454-8) ” (<https://link.springer.com/article/10.1007/s00200-020-00454-8>). She was a graduate mentor for the Summer@ICERM 2022 in Computational Combinatorics, participated in the Enhancing Diversity in Graduate Education (EDGE) program, and conducted research on combinatorial representation theory of Lie algebras at [MSRI-UP](#). She hopes to build a robust mathematical career that includes inspiring other Hispanic students to pursue their dreams and supporting the Hispanic math community. She completed her undergraduate degree in mathematics at Stockton University in New Jersey with a minor in Computer Science.

Tim McEldowney is a Postdoctoral Researcher for the Center for Excellence in STEM Education at West Virginia University and PI for the Knowledge-GAP project. Tim grew up in Southern California and earned his doctorate in Mathematics from the University of California, Riverside. While a graduate student, he created and organized an equity program that helped minoritized students prepare for proof-based mathematics courses. The Advanced Mathematics Program was featured in *Practices and Policies: Advocating for Students of Color in Mathematics* (Winger & Harris, 2022) and served as the inspiration for the Knowledge-GAP project. Tim studies equity and access to graduate education while being interrupted by his two cats, Ruby and Tracy.

Sarah Sword is a principal research scientist at Education Development Center, Inc. has extensive experience in research, instructional design, professional development, assessment design, and strategies to improve the quality and equity of K–20 mathematics learning and teaching. She co-leads an initiative with Carnegie Mellon University, Iowa State University, and University of North Carolina Charlotte to study the experiences of successful doctoral students and

PhD graduates from underrepresented groups in mathematics. Sarah co-authored the book *Mathematical Learning and Understanding in Education* in the Routledge Insights in Education series. She also co-developed the CME Project, a four-year high school curriculum. She holds a PhD in Commutative Algebra from Michigan State University and completed a postdoctoral fellowship in Curriculum and Instruction at the University of Maryland.

Aris Winger is the Executive Director of the National Association of Mathematicians, and an Associate Professor of Mathematics at Georgia Gwinnett College. His current work centers around creating spaces where marginalized groups feel a sense of belonging in mathematics and STEM. This mission has led him to co-authoring a book series, *Advocating for Students of Color in Mathematics*, with Dr. Pamela Harris and conducting numerous professional learning workshops and consulting around the United States, working with educators and administrators at all levels. These experiences compelled him to open a school, Hybridge Academy, a non-traditional accredited school in the greater Atlanta area serving marginalized middle and high school students, of which he is a co-founder and co-director. With Abbe Herzig, he co-leads [COME-In](#) (Creating Opportunities in Mathematics for Equity and Inclusion), a program that provides departments and programs with resources and a community to create transformational change.

Michael Young is an Associate Professor of Mathematical Sciences and Associate Dean for Community Engagement in the Mellon College of Science at Carnegie Mellon University. In his role as associate dean, he works collaboratively with departments and units to create policies, programming, and trainings that provide a better experience for the college's students, staff, and faculty. He earned his Ph.D. in mathematical sciences from CMU and was a faculty member at Smith College and an associate professor at Iowa State University before rejoining CMU. His primary research area is Discrete Mathematics, particularly problems in anti-Ramsey theory and zero forcing. Throughout his career, Young has started a number of nationwide initiatives and held several leadership roles geared towards addressing race and inequity in education. He has recruited and mentored graduate students and postdocs of color through the Building Diversity among Faculty Postdoc Alliance, the Center for Minorities in the Mathematical Sciences, and the Iowa State Postbac Program. He is currently leading a study on departmental policies and practices that create environments that support graduate students from underrepresented groups in the mathematical sciences. Young is also leading the ASCEND Mentor Network, a network to support NSF MPS ASCEND Postdoctoral Fellows.

Additional Resources

[The Science of Effective Mentorship in STEMM](#) is an interactive report from the National Academies Science of Effective Mentoring in STEMM committee.

The Center for the Improvement of Mentored Experiences in Research (CIMER, <https://cimerproject.org>) offers [mentor and mentee training](#) using theoretically-grounded, evidence-based, and culturally-responsive training interventions, as well as a variety of [online resources for mentors](#).

Text References

American Psychological Association. (2012, January 1). *Introduction to mentoring: A guide for mentors and mentees*. <https://www.apa.org/education-career/grad/mentoring>

Byars-Winston, A., Gutierrez, B., Topp, S., and Carnes, M. (2017). Integrating Theory and Practice to Increase Scientific Workforce Diversity: A Framework for Career Development in Graduate Research Training. *CBE—Life Sciences Education*, 10(4) pp. 357–367. <https://www.lifescied.org/doi/full/10.1187/cbe.10-12-0145>

The Center for the Improvement of Mentored Experiences in Research (CIMER, <https://cimerproject.org>) offers mentor and mentee training (<https://cimerproject.org/training/>) using theoretically-grounded, evidence-based, and culturally-responsive training interventions, as well as a variety of online resources for mentors (<https://cimerproject.org/online-resources/>).

Etzkowitz, H., Kemelgor, C., Neuschatz, M., & Uzzi, B. (1992). Athena unbound: Barriers to women in academic science and engineering. *Science and Public Policy*, 19(3), 157-179. <https://doi.org/10.1093/spp/19.3.157>

Herzig, A. H. (2004). Becoming mathematicians: Women and students of color choosing and leaving doctoral mathematics. *Review of Educational Research*, 74(2), 171-214. <https://doi.org/10.3102/00346543074002171>

McGee, R., Lee, S., Pfund, C., Branchaw, J. (2015). Beyond “Finding Good Mentors” to “Building and Cultivating your Mentoring Team.” In : B.L. Huang (Ed). *Advancing Postdoc Women Guidebook*. National Postdoctoral Association. Pp. 23-33. <https://www.awis.org/wp-content/uploads/NPA-Advancing-Postdoc-Women-2015.pdf#page=27>

National Academies of Sciences, Engineering, and Medicine. (2019). *The Science of Effective Mentorship in STEMM: Online Guide 1.0*. <https://nap.nationalacademies.org/resource/25568/interactive/>

- National Academies of Sciences, Engineering, and Medicine (host). (2019-2021). *The Science of Mentorship* [Audio podcast with transcripts]. <https://www.nationalacademies.org/our-work/the-science-of-effective-mentoring-in-stemm>
- Pfund, C., Byars-Winston, A., Branchaw, J., Hurtado, S., & Eagan, K. (2016). Defining Attributes and Metrics of Effective Research Mentoring Relationships. *AIDS and behavior*, 20 Suppl 2(Suppl 2), 238–248. <https://doi.org/10.1007/s10461-016-1384-z> / <https://pubmed.ncbi.nlm.nih.gov/27062425/>
- The Science of Effective Mentorship in STEMM (<https://nap.nationalacademies.org/resource/25568/interactive/>) is an interactive report from the National Academies Science of Effective Mentoring in STEMM committee.
- Wisdom, M. L. (2021, September 21). Why Don't We Teach Ph.D.s to be Mentors? *Chronicle of Higher Education*. <https://www.chronicle.com/article/why-dont-we-teach-ph-d-s-to-be-mentors>

Citations

- Boaler, J. (2016). *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching*. Jossey-Bass/Wiley.
- Doran, G. T. (1981). There's a S.M.A.R.T. Way to Write Management's Goals and Objectives. *Management Review*, 70, 35-36.
- Estrada, M., Burnett, M., Campbell, A. G., Campbell, P. B., Denetclaw, W. F., Gutiérrez, C.G., Hurtado, S., John, G.H., Matsui, J., McGee, R., Moses Okpodu, C., Joan Robinson, T., Summers, M.F., Werner-Washburne, M., and Zavala, M. (2016). [Improving underrepresented minority student persistence in STEM](https://www.lifescied.org/doi/full/10.1187/cbe.16-01-0038). *CBE—Life Sciences Education*, 15(3), es5: 1-10. <https://www.lifescied.org/doi/full/10.1187/cbe.16-01-0038>
- Forrest, B., Kosick, P., McShea, B., & Vogel, J. (2021). [Mentoring webs: Intertwining multiple mentors and mentees to support STEM students](https://www.mentor-cmc.com/cmc/cmc2021/MobilePagedReplica.action?pm=2&folio=428#pg428). *The Chronicle of Mentoring & Coaching*, 5(14). Pp 428-434. <https://www.mentor-cmc.com/cmc/cmc2021/MobilePagedReplica.action?pm=2&folio=428#pg428>
- Huskins, W.C., Silet, K., Weber-Main, A.M., Begg, M.D., Fowler, Jr, V.G., Hamilton, J. and Fleming, M. (2011). Identifying and Aligning Expectations in a Mentoring Relationship. *Clinical and Translational Science*, 4: 439-447. <https://ascpt.onlinelibrary.wiley.com/doi/10.1111/j.1752-8062.2011.00356.x>
- Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press. <http://dx.doi.org/10.1017/CBO9780511815355>
- Su, F. (2020). *Mathematics for Human Flourishing*. Yale University Press. <https://doi.org/10.2307/j.ctvt1sgss>

SMART Goals and Accountability

Differentiate between short-, medium-, and long-term goals

Some changes take longer than others, some are more urgent, and some require less to accomplish. What are your priorities?

Identify goals that are SMART¹

SPECIFIC: What change do you want to see?

MEASURABLE: How will you know when you get there?

ACHIEVABLE: Is it realistically within reach?

RELEVANT: Why is this important?

TIME-BOUND: What are my milestones?

Find an accountability partner:

Find someone with whom you have mutual trust. Develop a plan for how you will communicate regularly and each support the other to be accountable to yourselves.

1. Adapted from Doran, G. T. (1981). There's a S.M.A.R.T. Way to Write Management's Goals and Objectives. *Management Review*, 70, 35-36.

	SHORT TERM I'll start working on this right away.	MEDIUM TERM I'll start soon, but it will take 4-6 months to complete.	LONG TERM This is my ultimate goal. It might take a while, but I will make it achievable.
SPECIFIC What am I going to accomplish?			
MEASURABLE How will I assess progress? How will I know when I've accomplished my goal?			
ACHIEVABLE What is my strategy? How will I start? What people and other resources will I need?			
RELEVANT Why this goal, and why now?			
TIME-BOUND What milestones will I strive for, and on what timeline?			



© Copyright 2024 Abbe Herzig and Aris Winger. All rights reserved.