

Research Based Lessons for Effective Mentor/Mentee Relationships in STEM

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Pronouns: They/them

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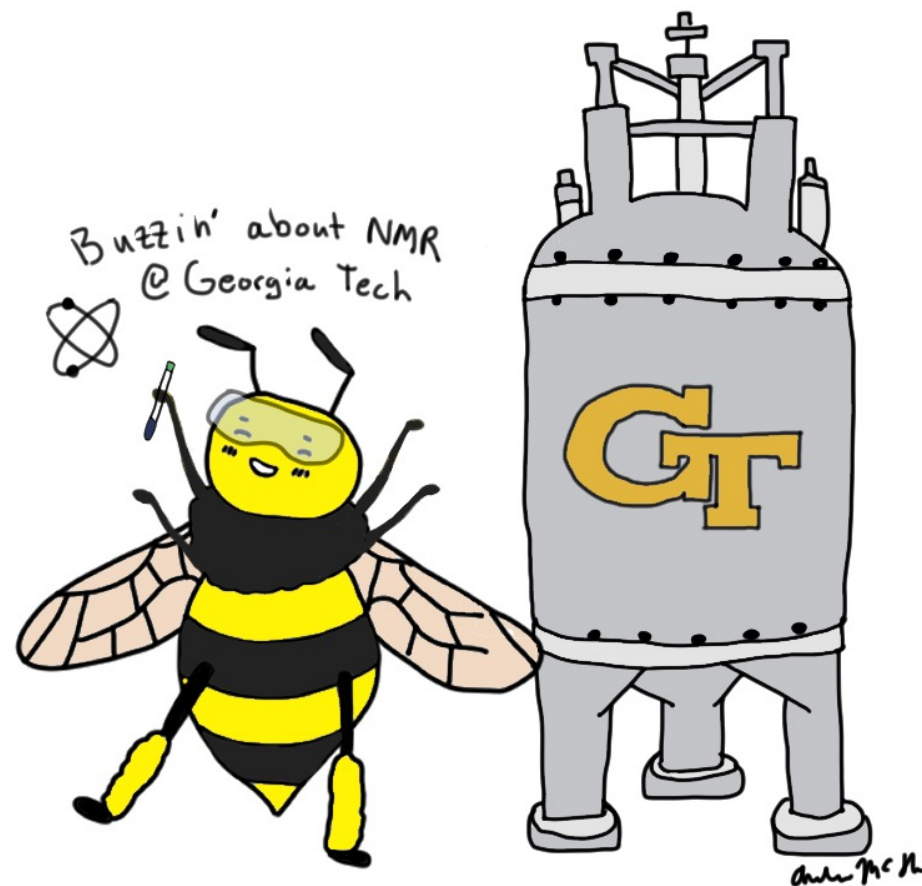
Women+ in Chemistry

Spring 2023 retreat

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What is a mentor?

Take a second to write down or think of a fictional character you view as a mentor.
It could be someone from a TV show / movie / book, etc.

Consider what qualities they have or actions they take
that makes you see them as a mentor.

What is a mentor?



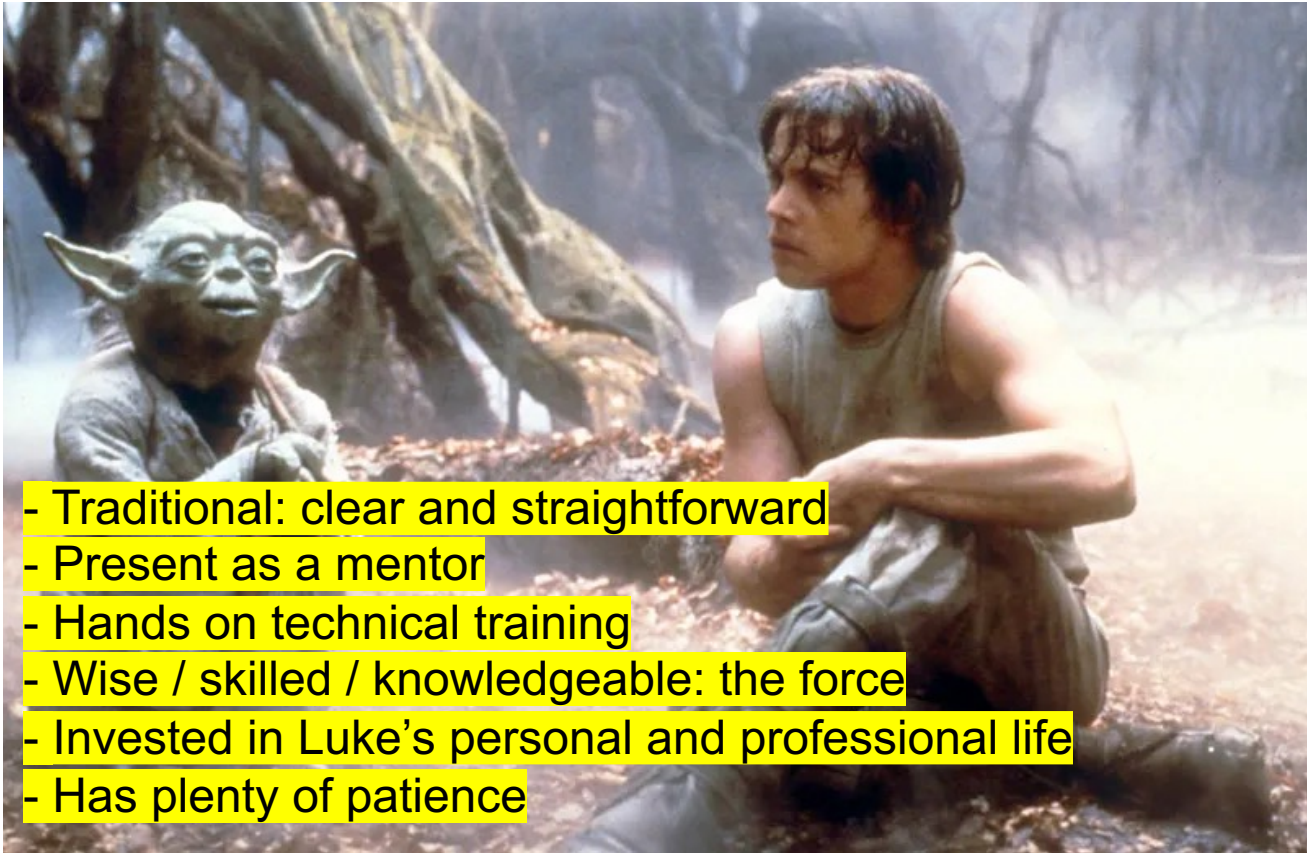
Yoda and Luke
Star Wars, The Empire Strikes Back / Return of the Jedi



Rafiki and Simba
The Lion King

What is a mentor?

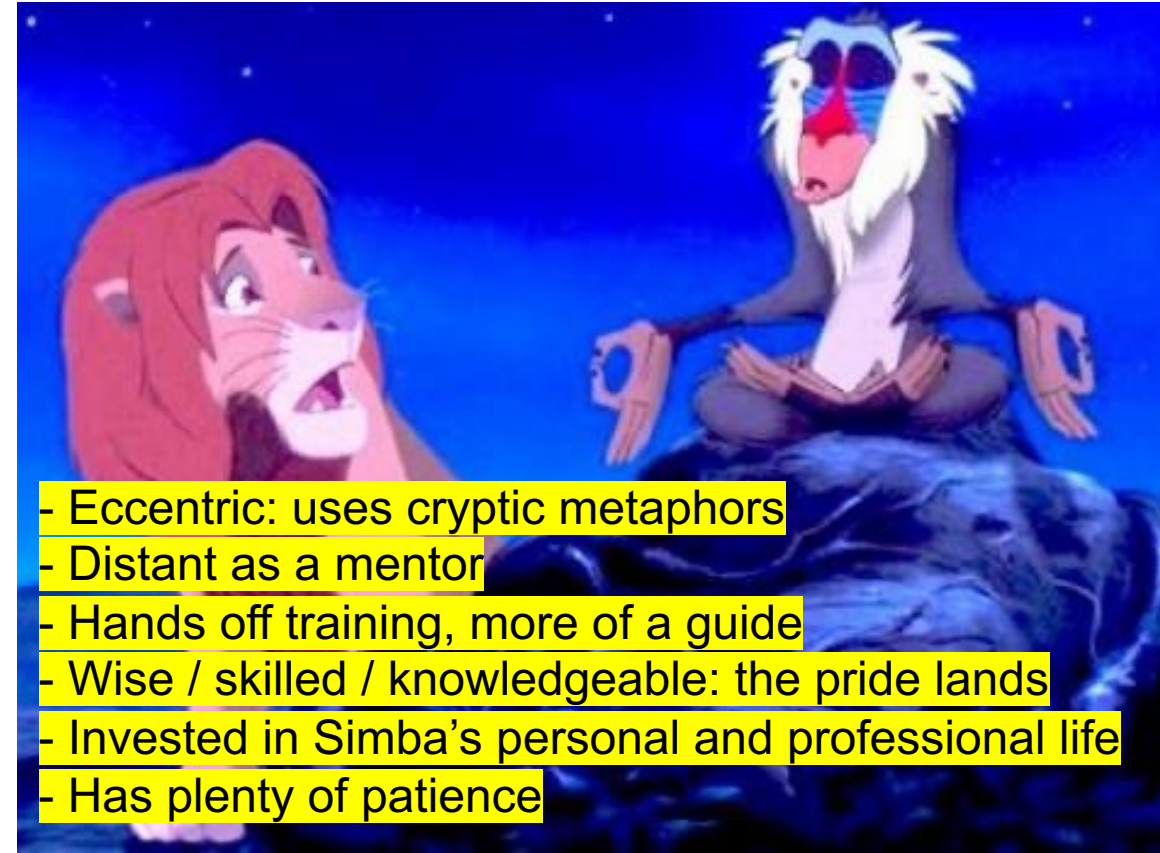
“Yes, [I am] afraid. Hmm, surprised are you?
A challenge lifelong it is, not to bend fear into anger.”



- Traditional: clear and straightforward
- Present as a mentor
- Hands on technical training
- Wise / skilled / knowledgeable: the force
- Invested in Luke's personal and professional life
- Has plenty of patience

Yoda and Luke
Star Wars, The Empire Strikes Back / Return of the Jedi

“The past can hurt. But the way I see it,
you can either run from it or learn from it.”



- Eccentric: uses cryptic metaphors
- Distant as a mentor
- Hands off training, more of a guide
- Wise / skilled / knowledgeable: the pride lands
- Invested in Simba's personal and professional life
- Has plenty of patience

Rafiki and Simba
The Lion King

Effective mentoring includes advising, supervision, sponsorship, and more

Mentorship: Lifelong reciprocal, mutually beneficial, mutually empowering, mutually respectful interpersonal and professional relationship.

- Advisors
actively share knowledge & aid career process; promote professional development
- Supporters
provide emotional support, affirmations, safe spaces
- Tutors / Masters
provide technical training & feedback on research design & paper / grant writing
- Sponsors
provide funding & space; advocate and “cheerlead” student accomplishments; opportunities for networking
- Models of identity
research & life role model

Advising	Supervision	Sponsorship	Mentoring
<p>“Assists students in the clarification of their life/career goals and in the development of educational plans for the realization of these goals”</p> <p>Can be formal and support specific questions (e.g., coursework)</p> <p>Frame of mind may be transactional</p> <p>Winston et al. (1982)</p>	<p>Oversight for work or tasks such as Research or Teaching assistantship, Dissertation completion</p> <p>Often defined as part of mentoring, but this framing may also mask power dynamics</p> <p>Manathunga (2007)</p>	<p>“publicly acknowledges the achievements of the mentee and advocates for the mentee”</p> <p>Supports career opportunities, advancement, recognition in concrete ways</p> <p>NASEM, 2019</p>	<p>“a professional, working alliance in which individuals work together over time to support the personal and professional growth, development, and success of the relational partners through the provision of career and psychosocial support”</p> <p>NASEM, 2019</p>

Equity in Graduate Education Resource Center
Thiry et al. *J Sci Educ Technol* 20, 6, 771-784 (2011)

Qualities that STEM graduate students seek in mentor/mentee relationships

“What are three words that describe a good mentor?”



“How important are the following qualities in mentor/mentee relationships?”

	Extremely important	Very important	Moderately important	Slightly important	Not at all important
Honesty	71.1	6.0	1.7	20.9	0.4
Directness	47.1	39.8	11.8	0.9	0.5
Regular meetings	21.7	39.8	29.0	6.8	2.7
Flexibility	28.1	49.3	20.8	1.4	0.5
Trust	72.3	6.0	1.3	20.0	0.4
Respect	86.4	10.9	1.8	0.5	0.5
Hierarchical	2.3	9.5	31.4	29.5	27.3
Critical	6.3	32.6	34.4	20.8	5.9
Reflective	26.4	45.0	25.0	2.7	0.9
Empathetic	32.6	39.8	23.5	3.2	0.9
Personal rapport or chemistry	19.5	39.1	31.4	9.1	0.9

Summary: flexibility, communication, and trust

Why do mentor / mentee relationships matter?

Positive mentor / mentee relationships cultivate:

- a sense of belonging and development of identity
- better retention and persistence in STEM fields
- reduced stress and role conflict; better mental health
- increased confidence in scientific research skills and better mentorship skills for the mentee
- academic performance and productivity (publish more / better manuscript, higher paid jobs)
- even more important for women and URMs in STEM!

Clark et al. *CBE Life Sci Educ* 15, 3, ar45 (2016)

Atkins et al. *Int J STEM Educ* 7, 42 (2020)

Ma et al. *PNAS* 117, 25, 14077-14083 (2020)

Mentorship will change the world

- Kam Phillips



YouTube, TEDxCoMo

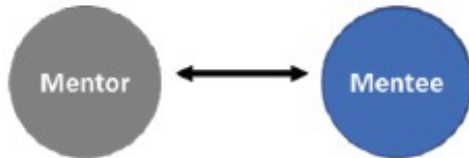
Example mentor / mentee frameworks

PhD advisor: you should be writing!
PhD student: you should be reading my manuscript!



Spider-Man (1967 TV series)

Dyadic pairing between one mentor and one mentee with bidirectional engagement



The Shining



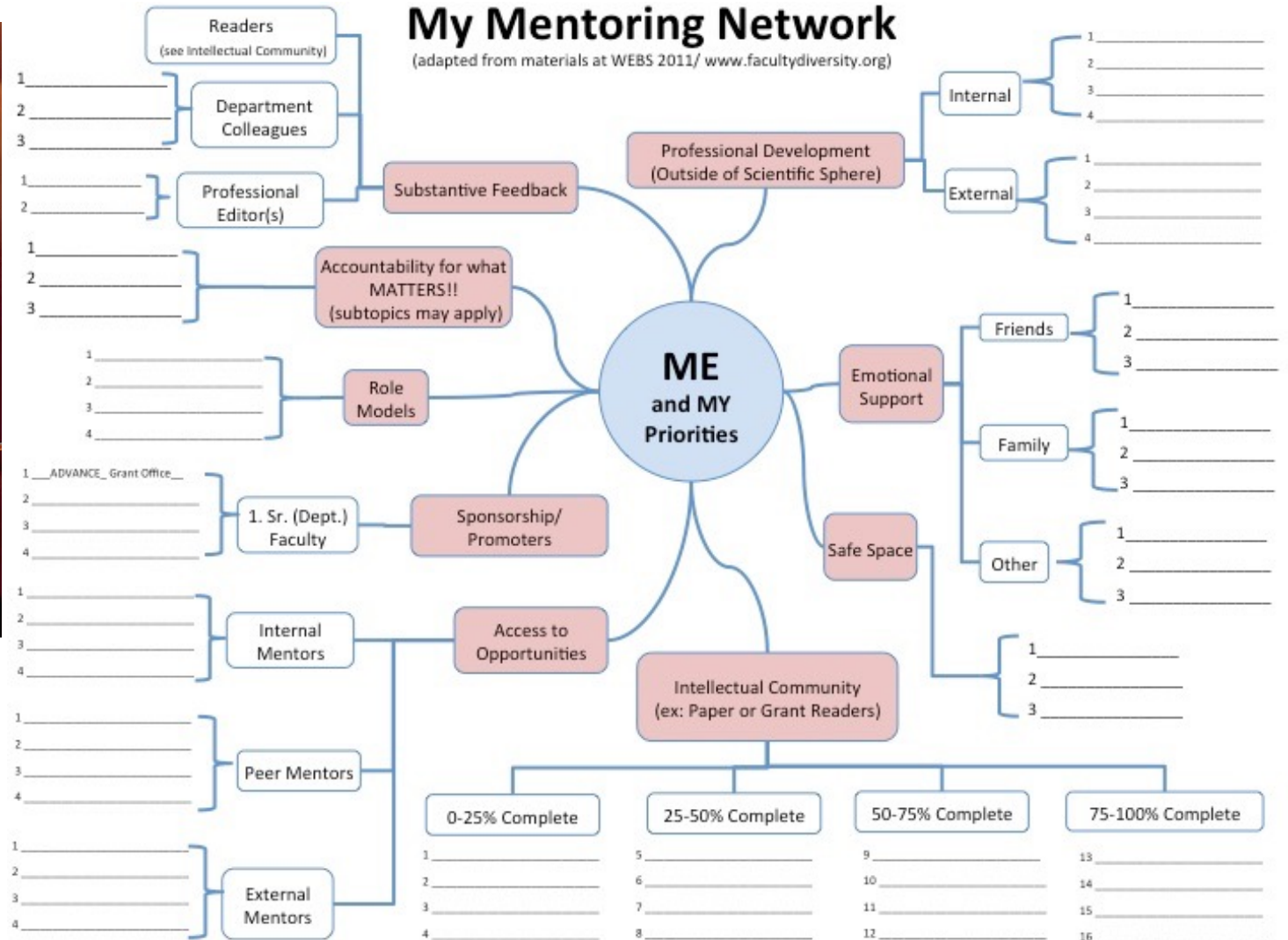
Dahlberg et al. The Science of Effective Mentorship in STEMM. National Academies Press 2019; Lehigh University ADVANCE

Example mentor / mentee frameworks

Rafiki and Simba
 +Nala+Timon+Pumbaa+Zazi+...Scar?

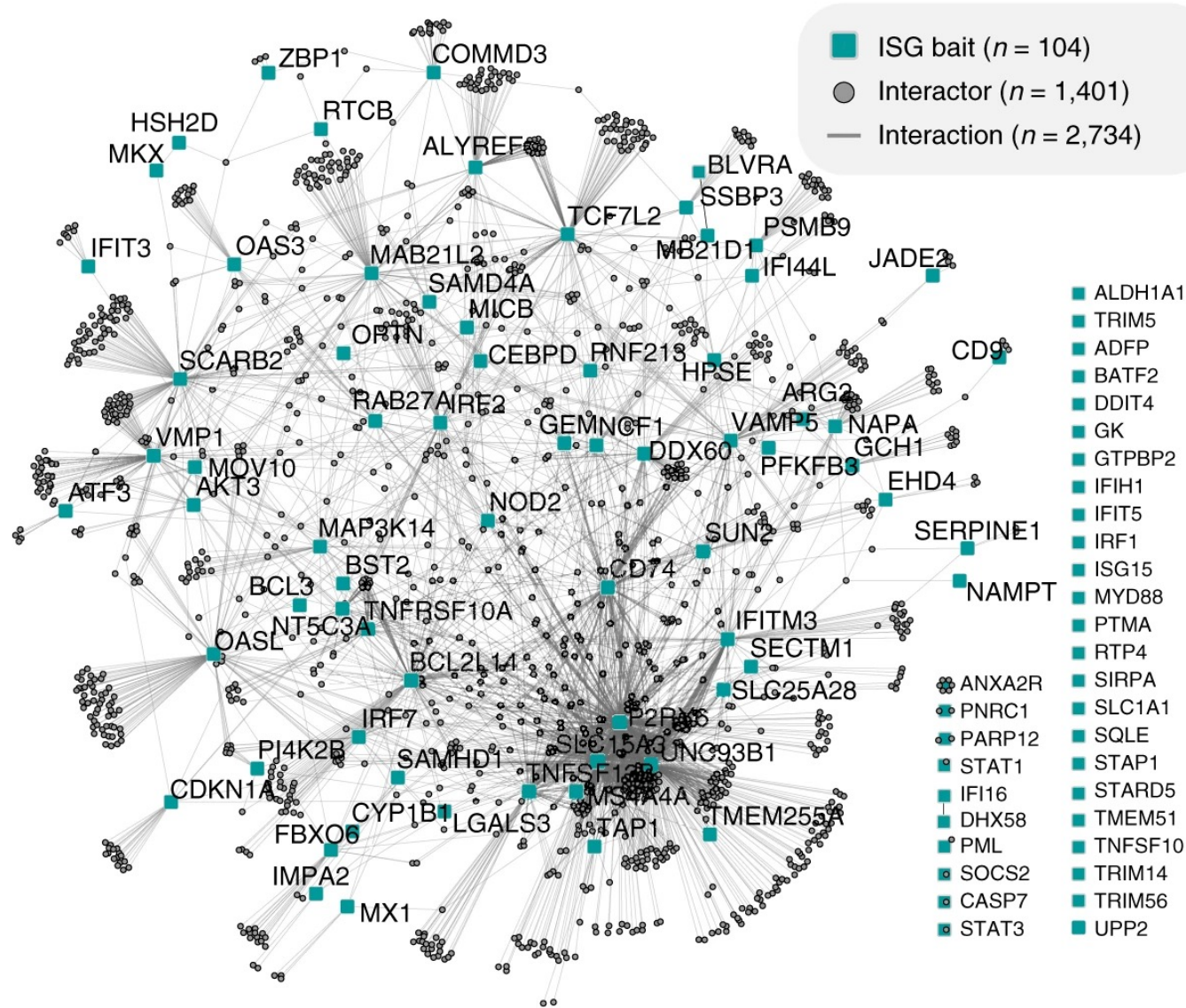


Diverse, dynamic networks composed of multiple mentors fulfilling unique professional and personal roles



Dahlberg et al. The Science of Effective Mentorship in STEMM. National Academies Press 2019; Lehigh University ADVANCE

Mentoring networks are complex, dynamic, and evolve like interaction networks



So what does the research say?

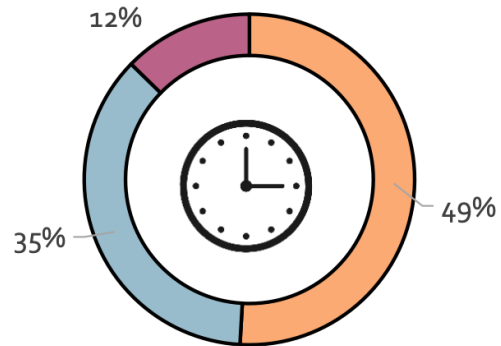
What is the research on:

- **how STEM graduate students feel about their mentor?**
- **how STEM graduate students feel about their MS/PhD program?**
- **what mentoring qualities are most effective or not effective?**

Grad students report feeling ignored, bullied, and lack of sense of belonging

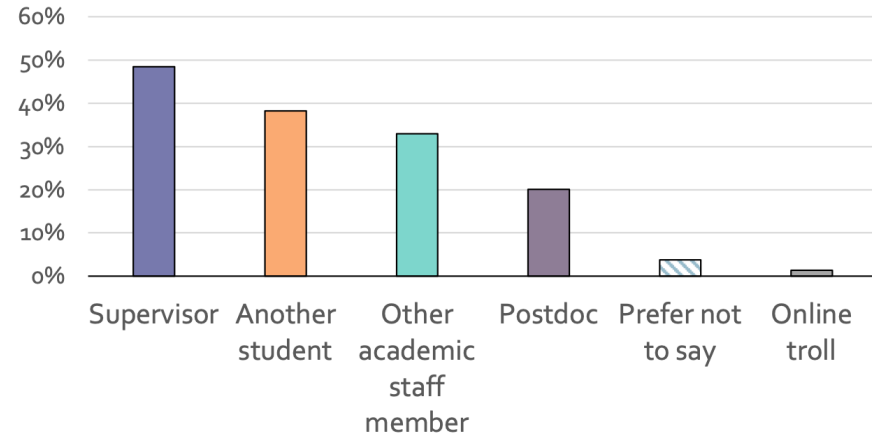
- Many graduate students have discovered that not all mentors can devote much time to the job
- Supervisors are among the most common perpetrators of bullying
- A good supervisor can either make you happy during your PhD journey or destroy your life/career.

Q: On average, how much one-on-one contact time do you spend with your supervisor each week?

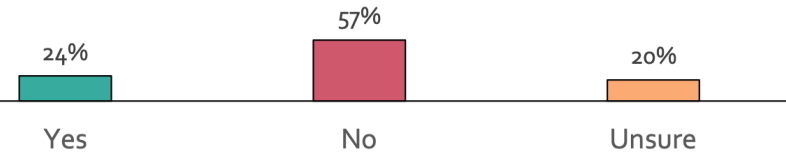


- Less than an hour
- Between one and three hours
- More than three hours

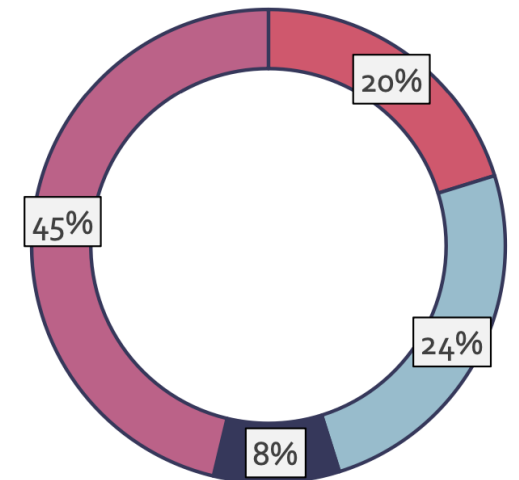
Q: Who was the perpetrator(s)?



Q: Do you feel able to speak out about your experiences of bullying without personal repercussions?



Q: What would you do differently right now if you were starting your programme?



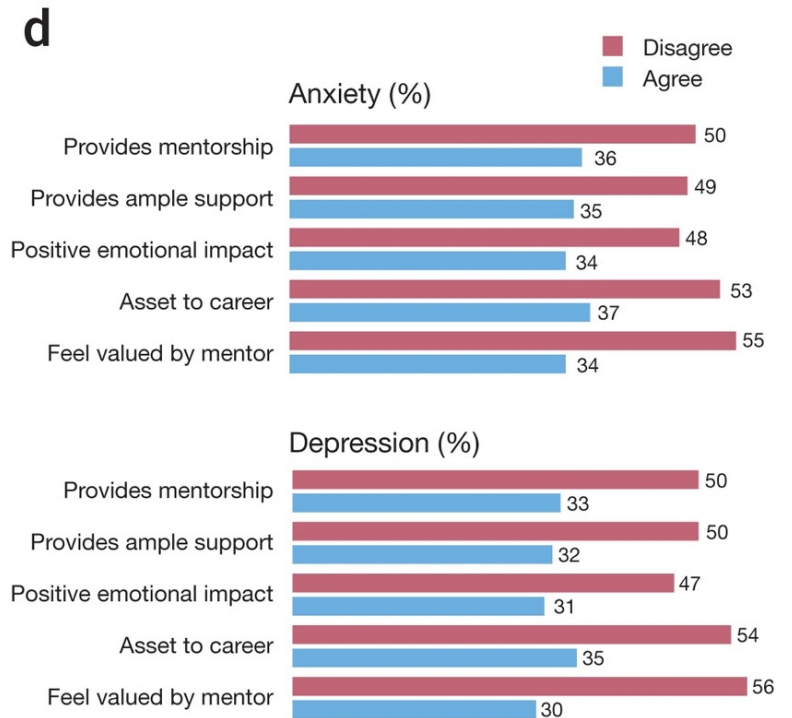
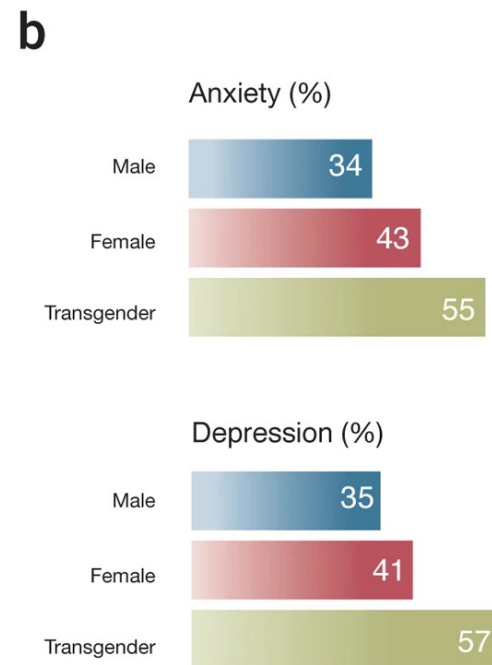
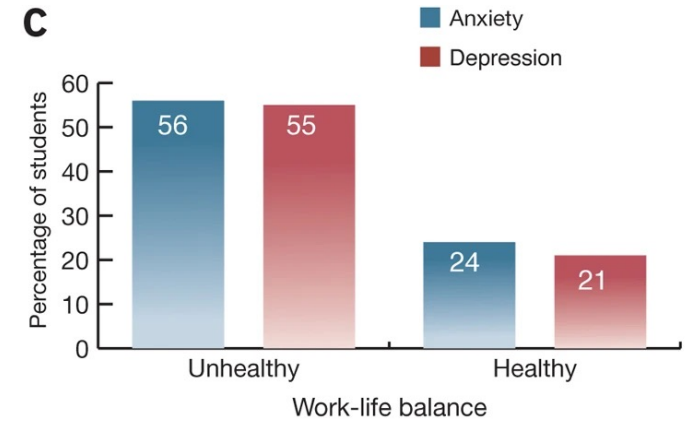
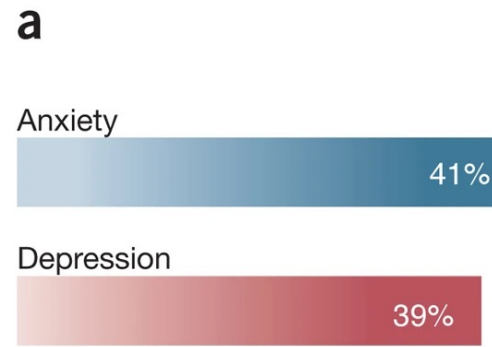
- Change area of study
- Change supervisor/PI
- Not pursue a PhD at all
- Nothing

Worldwide survey of 6,300 grad students in STEM
Woolston. *Nature* 575, 551-552 (2019)

Grad students report high levels of stress, anxiety, depression, and burnout

“Our results show that graduate students are more than six times as likely to experience depression and anxiety as compared to the general population.”

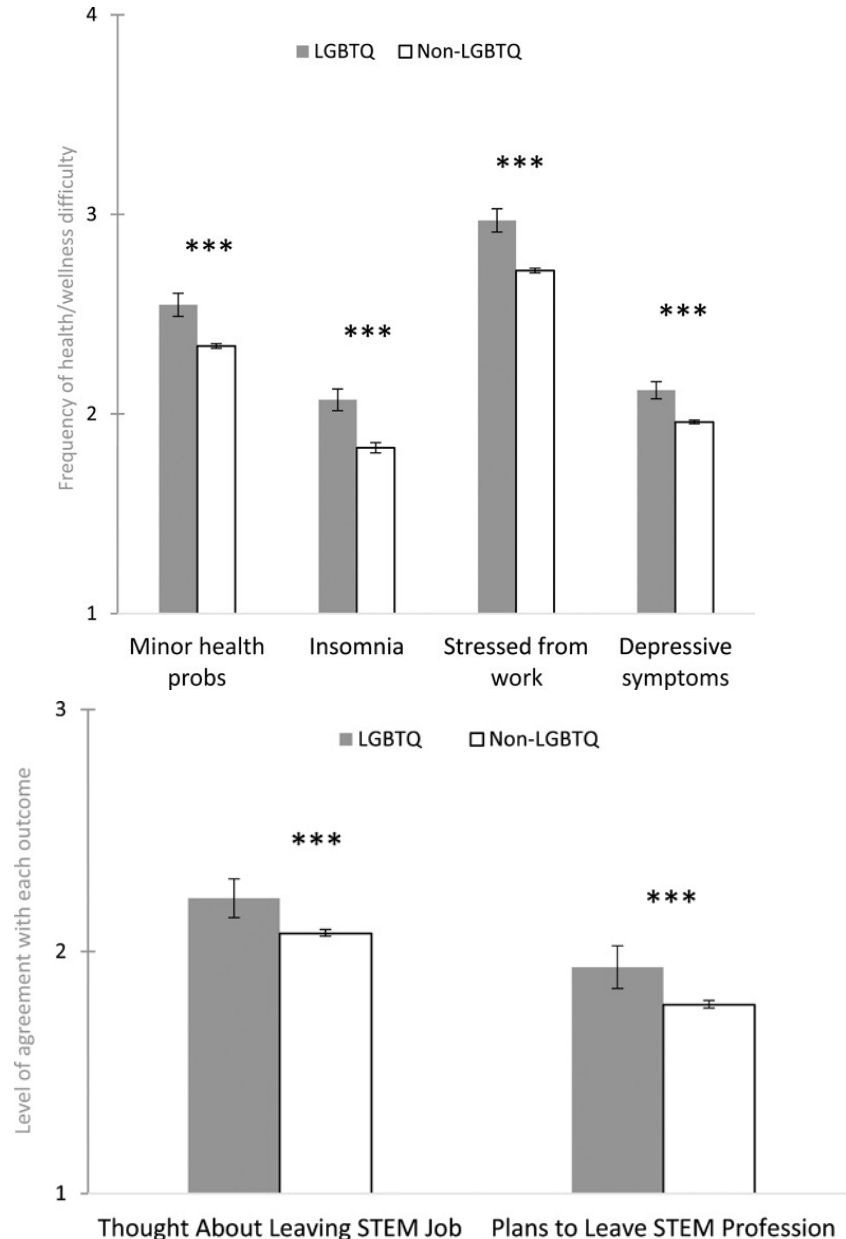
- 56% of grad students did not feel they had a good work-life balance due to high pressure from their PI or advisor
- 50% of graduate students did not agree with the statement that their PI or advisor provides “real” mentorship



Worldwide survey of 2,279 grad students in STEM

Evans et al. *Nature Biotechnology* 36, 282–284 (2018)

Mentor / mentee relationships for LGBTQIA+ STEM graduate students

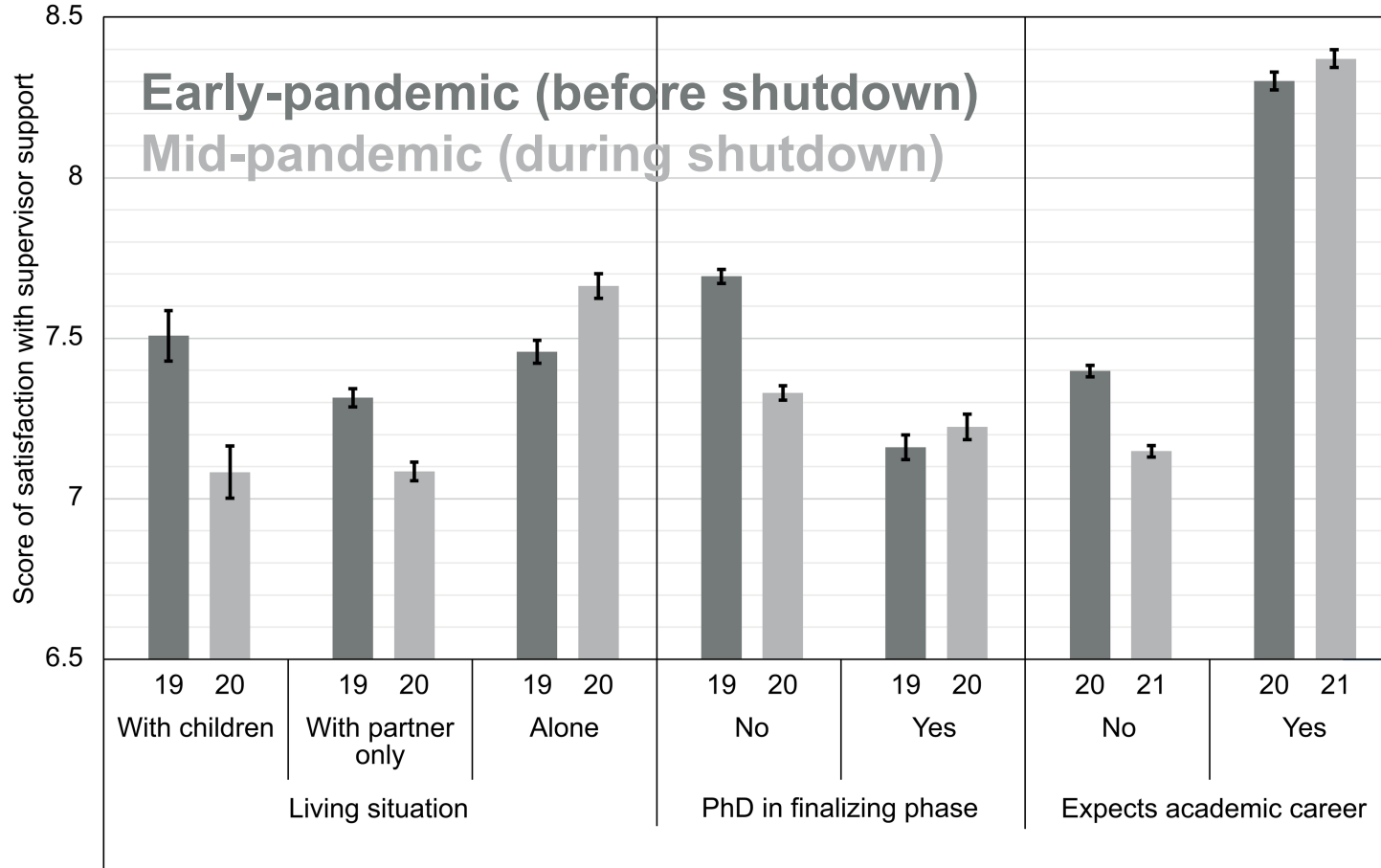


- Be thoughtful about the language used regarding the LGBTQ+ community.
- Create opportunities / space for people to describe who they are (if desired) and avoid assuming people's identities, names, and pronouns.
- Meaningfully advocate for the LGBTQ+ community.
- Create an inclusive STEM classroom (course content)
- Conduct STEM education research in a way that is inclusive of the LGBTQ+ community.

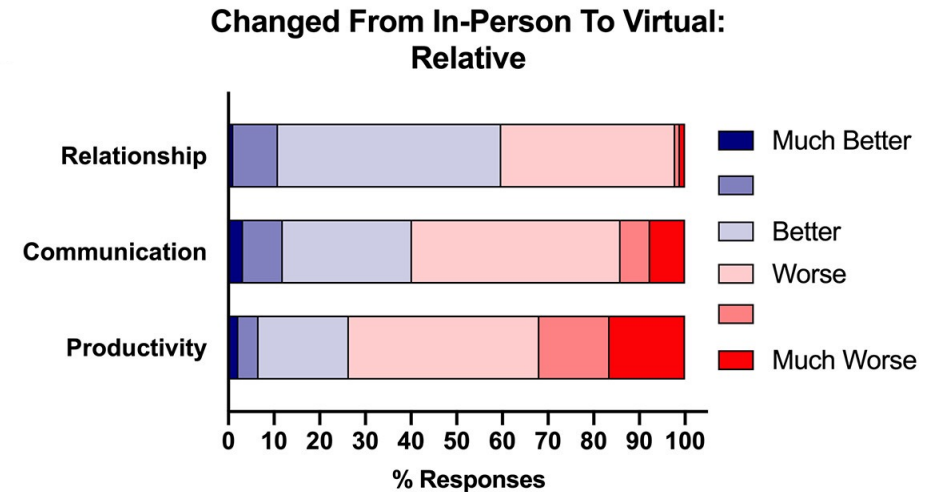
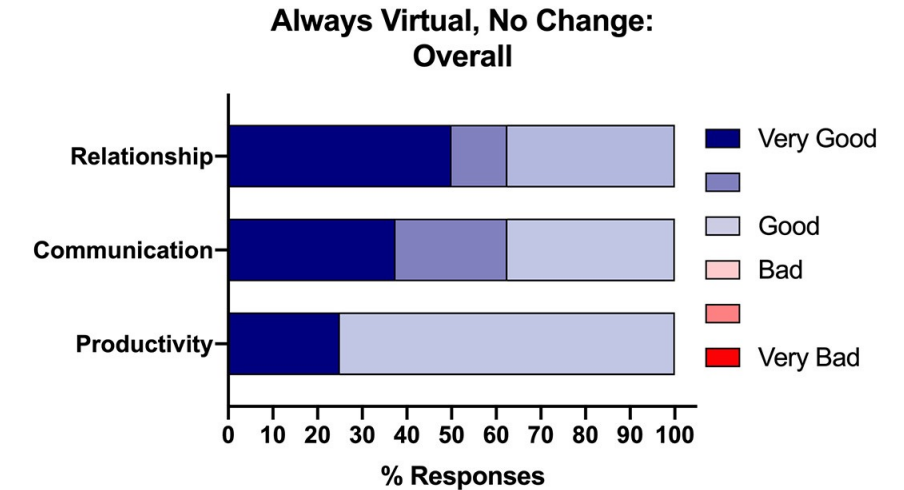
Cech et al. *Science Advances* 7, 3 (2021)
Cooper et al. *CBE—Life Sciences Education* 19, 3 (2020)
Hughes et al. *Science Advances* 4, 3 (2018)

Effect of the COVID-19 pandemic on mentor / mentee relationships

COVID-19 disproportionately effected STEM graduate students



Error bars represent 95% confidence intervals of means



Myers et al. *Nature Human Behavior* 4, 880–883 (2020)

Speer et al. *CBE Life Sci Educ* 20, 2 (2021)

Tienoven et al. *PLoS ONE* 17(5): e0268923 (2022)

Mentoring behaviors associated with negative experiences for grad students

Gatekeeping

Social
undermining

Interpersonal mismatch

Unequal
Power
structures

Limited interpersonal abilities

Limited psychosocial
support

Role tension

Supervisory styles

Unequal treatment

Poor relationship quality

Collegial protections

Limited career support

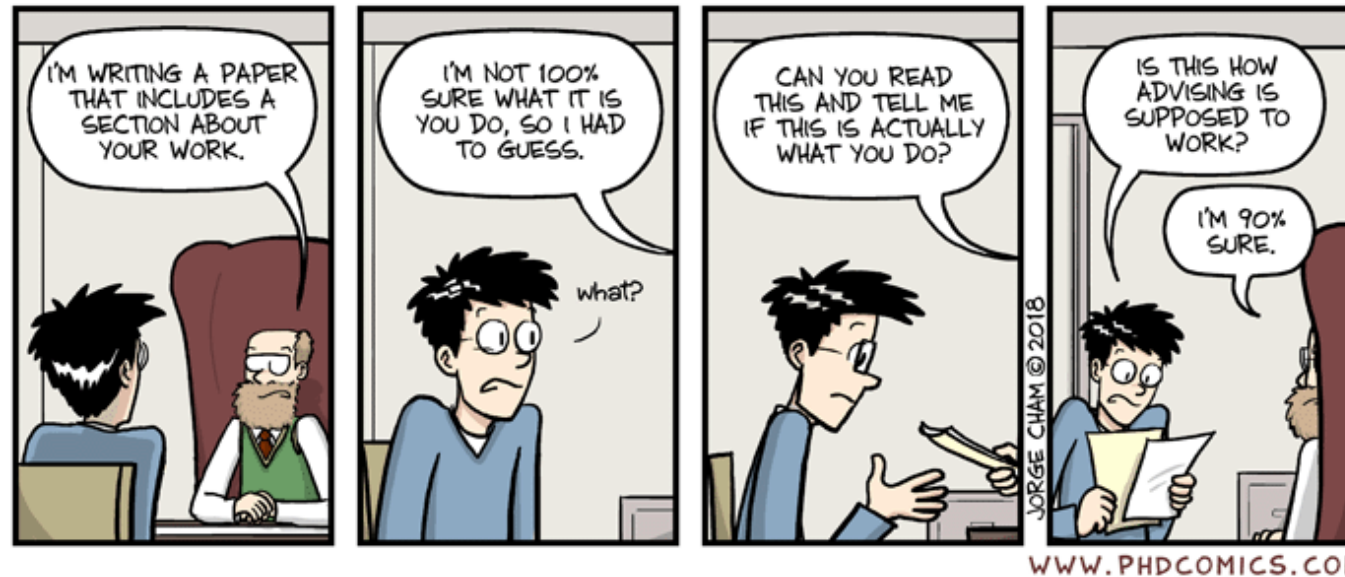
Inaccessibility

Insufficient structure

Deceit

Limited expertise

Mentoring behaviors associated with negative experiences for grad students



Why are many mentors in academia so bad?

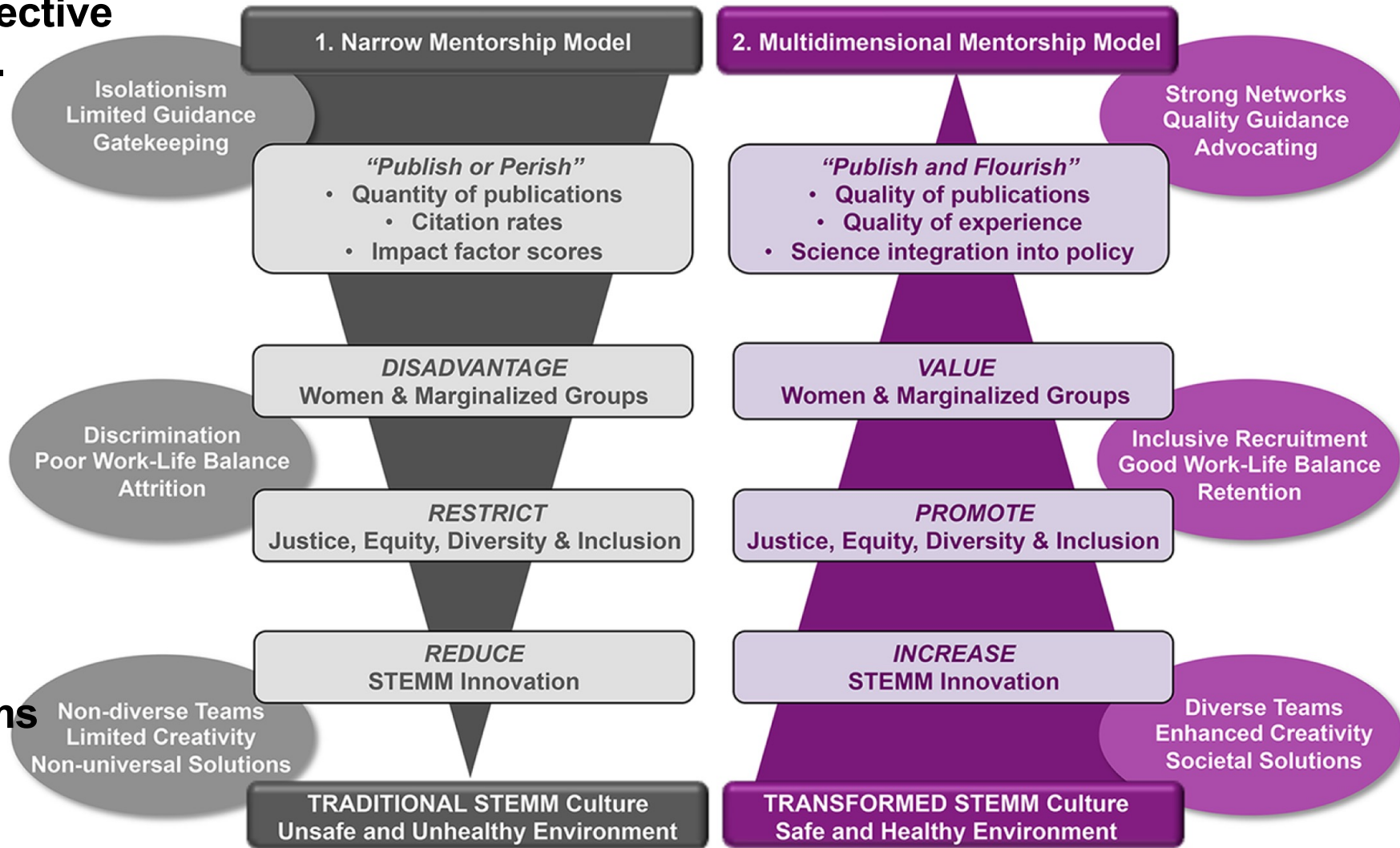
“70% of self-described mentors that took our survey felt that they rarely mentor poorly”

- Many academics do not receive formal mentorship training; training may be available but not required
- Training received is not sufficient (short workshops addressing a single issue); no hands on learning
- Too many students to effectively mentor, instead rely on peer-peer mentoring
- Disconnected from the lab environment, forget how research actually works, forget how it feels to be a mentee
- Little time or energy to focus on mentoring as the result of high teaching loads; service requirements; administrative work; grant/paper deadlines; work-life balance
- Culture: mentoring not valued in their previous research environments; “publish or perish”
- Mentoring skills are not typically weighted as an important factor influencing faculty hiring and tenure decisions
- Students feel uneasy about providing feedback; Don’t know who else to turn to; No punishment for bad behavior

Limeri et al. *CBE Life Sci Educ* 18, 4, ar61. (2019); Diggs-Andrews et al. *BMC Proceedings* 15, 7 (2021)
Hund et al. *Ecol Evol* 8,20, 9962–9974 (2018); Tuma et al. *CBE Life Sci Educ* 20,2, ar16. (2021)

Plans of action: culture shifting, education, formal training

- Educate ourselves about effective mentorship skills and methods.
- Provide resources to learn how to effectively mentor.
- Value the impact of multidimensional mentorship.
- Provide opportunities, safe spaces, and equitable resources for women and URMs in STEM.
- Shift outdated values systems and eliminate toxic behavior in STEM cultures towards inclusivity and empowerment.



Take home messages on mentor / mentee relationships

What can / should good mentors do?

- **Learn and grow to be better and do better as a mentor.**
Know the common complaints graduate students have about mentors and actively address them
Know the science behind effective mentoring. Participate in plenty of workshops / training activities.
- **Know students at personal level: invest in their life and mental health. Provide psychosocial support.**
- **Know students at a professional level: projects, experimental techniques, data. Provide career support.**
- **Be present / accessible. Let students know you're there for them. Follow through with words and actions.**
- **“Ride or die”. Provide affirmations, empowerment, empathy, reciprocity, and respect. Cultivate safe space.**
- **Communicate and discuss expectations / short-term and long-term goals on a regular basis.**
- **Provide constructive and timely feedback. Be open to criticism / ideas. Ask mentees for feedback!!!!**
- **Help students to form their dynamic mentorship network and professional networking opportunities.**
- **Give students credit for their ideas and research. Be open, honest, and transparent. Respect boundaries.**

Resources for gaining mentoring skills at Georgia Tech

- Inclusive STEM Teaching Fellows program
<https://www.inclusivestemteaching.org/>
- Center for Teaching and Learning
<https://ctl.gatech.edu/faculty/events/workshops>
- Various Workshops: Addressing Microaggressions, Equity-Minded Mentoring
<https://diversity.gatech.edu/student-support/workshops-students>
<https://diversityprograms.gatech.edu/>
<https://equitygraded.org/>
- Undergraduate Research Ambassadors
<https://urop.gatech.edu/content/undergraduate-research-ambassadors>
- Implicit Bias Workshop
<https://diversity.gatech.edu/faculty-staff-development/advance/implicit-bias-workshops>
- MentorTech
<https://pe.gatech.edu/wlpd/programs/mentortech>