

Running Title: Equity in the Research Lab

Reflections and Actions for creating an inclusive research environment

Abstract

In order for the scientific enterprise to ensure equitable participation for all identities, the settings of professional research labs must cultivate an environment that is inclusive of all backgrounds. We explore here strategies for research labs interested in cultivating inclusive environments to consider. Investigators enacting inclusive strategies must understand the social context of the lab members and their reasons for engaging in science research. For this to be authentic, principal investigators should spend time exploring their own social positioning as well as the purpose of their professional engagement. We unpack the philosophies behind these constructs and provide specific suggestions to prepare individuals to fully engage in the practice of inclusive mentoring in science research labs.

Keywords: mentoring, inclusion, research lab

Introduction

Research labs in institutions of higher education have an opportunity to play a key role in including more students from historically disenfranchised identities (HDIs) in the scientific enterprise. Evidence from the percentages of HDIs present in many STEM professions speak to the reality that universities and colleges still have a long way to go in this regard (Nelson et al. 2007). Many studies have identified chilly lab climates as a reason why HDI students choose not to remain in basic research labs (Figueroa et al. 2007). Therefore, it is likely that the ability of Principal Investigators (PIs) to cultivate an atmosphere of inclusion would go a long way in helping to retain these students.

The structure of scientific research, particularly at R1 institutions is infused with inherently inequitable structures. Very often, in the absence of intentional and targeted programs, the students who self seek undergraduate research experiences are those with existing social and academic capital (Behar-Horesnstein et al. 2010). This results in being one of a myriad of reasons why underrepresentation is so pervasive at the graduate student, postdoc and ultimately professor level (Metcalf 2014). At the graduate level, STEM doctoral students are

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expected to spend significant time at the bench being supervised for the development of their skills. This often blurs the lines between apprenticeship and employee, the latter being a means for the PI to acquire cheap labor. Pressures on research scientists to access scarce funding sources, publish often, and add to departmental and institutional prestige, sometimes encourage the use of these students to fulfill grant obligations over cultivating independent scientists (Edwards and Roy 2017). Many of these situational factors remain relevant today, but the demographics of the doctoral students, the national uses for the skills from doctorally-trained students, and the contributions required from them has changed. This creates problems for attracting HDIs to the research enterprise in the first place, but once there, many students are supervised by mentors who themselves have not been fully trained in thoughtful and inclusive lab environment practices. There are consequences associated with this lack of knowledge. In its absence, mentors can default to an imprinting model, assuming that the behaviors, attitudes, and approaches that worked for them will be similarly successful with their mentees, regardless of the uniqueness of their social context.

Cultivating inclusive lab environments requires the adoption of a different mindset pertaining to training and mentorship. In an inclusive model, the individual mentee is more important than the techniques, in that the cultivation of their uniqueness is what best positions them to bring their whole selves to the scientific inquiry process. In doing so, the scientific community benefits from their new ideas and paradigms on the discipline. This is important also because 'doing science' through authentic research experiences remains the key mechanism through which students from HDI backgrounds enter scientific research careers. In this manuscript we discuss ways in which PIs can reflect and take action to cultivate inclusive lab environments. Our suggestions focus on the centrality of dialogic relationships as the key to inclusive lab environments. Readers interested in transforming their own labs toward creating more inclusive environments will explore how to

- Define the role that they as mentors play in cultivating inclusive lab environments, particularly for mentees from HDIs
- Describe strategies that can be employed to develop dialogic relationships with mentees
- Identify specific and practical strategies to create inclusive lab climates

Self work

Understanding your positionality

Inclusive mentoring demands psychosocial skills that are not typical components of professional science development. For those new to this type of thinking, it should not be

expected that one would be perfect at engaging their mentees in this level immediately. In fact, social relationships by definition are exercises of constant learning. Therefore, inclusive mentoring should not be viewed as a specific to-do list that once completed achieves inclusion, but more as an iterative process of constant self-reflection and personal growth. It is important therefore for the PI to have a process in place to authentically engage in continuous self-reflection. For the PI this entails coming to terms with their own social positioning. Most US research professors are white (Flowers 2012), a statistic that is not disconnected from the social privileges differentially afforded to this group of Americans over the last several hundred years. It is critical that PIs come to terms with their own relationship with this historical reality, as this is what allows for empathy for others whose social experience is radically different. Self-reflection should happen both on the individual level and as a lab collective. Structured opportunities for the lab to discuss issues, successes, and examine its social operations are key to ensuring that inclusion and equity are not taken for granted. In the process of cultivating an inclusive environment, there may be instances where you as PI may need to be challenged on an issue. Humility and the willingness to listen to dialogue are necessary so that mentees are not afraid to approach you to discuss any item of discomfort. A dialogic relationship (see below) can be crucial in establishing this comfort. Additionally, it behooves you as a PI, to engage in literature about the social contexts of education and the history of power and access in the United States and the world. Many of the identity contingencies experienced by lab employees are not a function of innate shortcomings, rather they are the result of social messages subliminally (or overtly) communicated to them about what constitutes competency in the field. Humility means engaging this history knowing that this sociohistorical scholarship is likely an area where you may need to grow your knowledge. A few suggestions that help support an attitude of self-reflection and humility include:

1. Identify one book or area of study you need to engage in to better understand the social context of education (see Table 1 for suggestions).
2. Maintain a schedule of regular check-ins (beneficial for lab members as well) that keeps you up to date on how employees are navigating your lab environment. Ensure that in those check-ins space is provided for feedback on how you can be a better PI (see below).
3. Pay attention to nonverbal cues and behavioral nuances that suggest an unwillingness to engage. Cues can include employees seeming distracted or withdrawn. It is possible that they may not always be willing to articulate their feelings and therefore you may need to be proactive in asking if something is wrong.

[* add Table 1 here]

Area of study	Suggested reading	Context
Social factors impacting access to education	Savage inequalities by Jonathan Kozol (2010)	In this book the author explores the development and consequences of school

		segregation. This book could be useful in understanding socioeconomic diversity of incoming college students.
Power distribution historically in the United States	When affirmative action was white by Ira Katznelson (2005)	This book details how power systematically benefitted very particular groups in history. It may help one explore one's own social positioning.
Inequity and the college experience	Paying the Price by Sara Goldrick-Rab (2016)	This book explains how the cost structure of higher education exacerbates student disenfranchisement. It is useful for understanding the everyday reality of college students.

Understanding your 'why'

There is often an assumption that attainment of a position of privilege such as directing a research lab group automatically makes an individual a mentor. We argue that it positions them to be a potential mentor, but mentorship requires skills and ways of thinking that are not necessarily packaged in conventional STEM training programs. The paradigm of inclusive mentorship requires the mentor to step outside of the technical functions of the lab and consider the skills needed to respond to the social dynamics presented by the individual mentee. This in turn necessitates a better understanding of how social contexts writ large inform how and why people engage in scientific practice. For mentors, the first step should be an inward reflection exploring their own meaning and purpose as it pertains to their professional choices. Professional researchers spend a significant amount of time communicating *what* they do through publications and professional presentations. Few of those communication avenues provide the same amount of space for them to articulate *why* they do what they do. When pressed, many scientists can hark back to specific situations or individuals who helped them explore deep, abiding passions or ways in which they can do profound good in the world. Fully understanding one's sense of meaning and purpose for engaging in scientific research is important if one is to be positioned to help a mentee do that exploration themselves.

Understanding your 'why' requires deep, ongoing and meaningful self-reflection. Over the course of a career, elements of the 'why' may change. However, fully understanding the deeper, non-content elements that turn your vocation into a calling is necessary to give the mechanistic aspects of the job a sense of purpose. In this context it is important to understand that the concept of 'why' is something that would be unique to you. Therefore, every scientist, including the future scientists in your lab should be supported in their own unique pursuits to explore their 'why'.

Dewsbury et al (2013) designed a seminar series where several scientists were asked to reflect on their own professional journeys and in the process explore their why. It would be helpful to view some of these conversations (<https://case.fiu.edu/biology/quantifying-biology-in-the-classroom/confluence/>) as you begin the process of your own self reflection. Consider creating a written record of these reflections and being transparent with your lab team periodically on why those deep seated passions drive you every day. The following actions may be a helpful place to start.

1. Reflect on your past: When did you first become passionate about pursuing a research career? What makes you excited to answer the scientific questions you are pursuing? In what ways do you envision your work will improve the good of the world?
2. Recall your experiences in science at the stage of career in which your current mentees are. Did you know then what you know now about your own career aspirations? How have you changed? What allowed that change to occur?

Paradigms of student research lab involvement

Every member of the research team is likely to have a different reason for pursuing an opportunity in your program. For those at the undergraduate stage in their careers, there is likely a great deal of exploration still happening, and it is not certain (nor required) that they wind up running a lab like you are. Even graduate students are now wise to the reality that many careers exist other than 'research professor', the default role that most labs are set up to prepare them for. It is worth reflecting on and understanding why different students choose to be part of your program. This needs to be an intentional exercise because conventional lab structures and processes do not encourage that line of questioning. Funding agencies provide support via line items in specifically articulated budgets. The individual who is paid from that line item can thus be viewed as simply fulfilling the obligations of that payment without any real thought for their personal skill development. Similarly, the high stakes pathway that is the tenure track research professoriate places enormous pressure on early, voluminous productivity. Lab members in early-career faculty member programs may be seen in this context simply as potential contributors to the production machine with little attention paid to their personal growth.

Since the higher education machine privileges conveyor-belt type productivity over the cultivation of self, it is up to the PI to be intentional about crafting an experience that reflects the personal goals of the students in their program. Supporting students in their own self-reflection process and the creation of an individual development plan (see below) can go a long way in moving beyond the apprentice model to an approach that is more inclusive. There are specific questions that can be asked of students to assist in their own reflections on their pathway, but prior to that it is worth asking some questions of yourself.

1. Think about the role you play as PI in helping lab members cultivate a sense of meaning and purpose. Do you see this as part of your job description?
2. Seek out resources and connections that will equip you to support and prepare students for careers that are different from your own (e.g. Fruscione and Baker 2018). What resources are available on your campus?
3. Decide for yourself and your lab group, how much time you are willing to allow students to invest in their professional development outside of the project they are doing in your lab. Recognizing the benefits of experiences like teaching, serving on advisory groups, and visiting industry labs for students interested in other careers.

Student awareness

Individual development plan

Individual development plans (IDPs) were recommended by the Advisory Committee to the NIH Director and became a standard part of postdoctoral training in 2013 (<https://grants.nih.gov/grants/guide/notice-files/not-od-13-093.html>). Since then, these plans have been encouraged for graduate students as well in order to provide individualized career planning and explicit conversation around individual goals, mentoring needs, training needs, and reflection on successes and challenges in the research lab throughout the training process. Typically an IDP is completed annually with opportunities to reflect on progress since the previous year's IDP and goals for the next year. While the reflection is done by the mentee themselves, the mentor meeting that occurs after completion is a chance for you as a PI to focus solely on that individual, their needs, and their career goals. In the first year, this meeting may also be a chance for the mentee to share accessibility issues or concerns about working in the lab including but not limited to accommodations for physical disabilities or mental health needs. While most IDPs have been designed for individuals at the graduate or postdoctoral level, they can easily be modified to support undergraduate students in the research lab which is a powerful time for career exploration. Many PIs spend a lot of time with their graduate students and postdocs doing the work of the lab, discussing data, and writing papers, however, this time may not directly address the individual goals and needs of the mentee. The IDP is a simple structure that creates the conditions for a dialogic relationship (discussed below).

1. Familiarize yourself with IDPs. You could consider [this one](#) from Stanford Biosciences Graduate Program or [these examples](#) from the NIH as a starting place to generate your own. What other questions or conversations would you like to have with your mentees?
2. Consider the following questions: How often do you currently have explicit conversations with your mentees about their career goals, mentorship needs, and

professional progress? Who typically initiates those conversations if and when they occur? Are they occurring with all of your mentees? If not, who is not having these conversations with you and why?

Dialogic relationships

Although the IDP is a tool for your mentee to use in order to reflect, this can also be the basis for a dialogic relationship. Dialogic relationships come from the Freirean educational tradition (1970) where authentic pedagogies writ large are based on the cultivation of relationships between instructors and students. Education in this context should not be thought of as limited to formal classroom settings. Any opportunity where learning and growth can occur, including in the research lab, is an opportunity for education to happen. Similar to some conventional classrooms, it is tempting for lab relationships to rely on unidirectional didactic models, where lettered PIs simply tell students what to do and how the world works. A different approach with using the IDP changes that philosophy somewhat. The IDP provides the mentee a meaningful quantifiable mechanism to monitor their progress on specific projects as well as their longer term visions and goals. The IDP also is an opportunity for the mentee to reflect on their evolving thoughts and feelings on how their professional work aligns with their personal vision for impacting the world. In an inclusive lab where the mentee is not simply a line-item technician, constantly engaging them about this aspect of their personal professional development is crucial. Mentees should feel comfortable enough to discuss with their supervisors their evolving thoughts on how the work they are doing is impacting them. These conversations should be periodic, regular and ongoing as this is what provides you as PI the opportunity to mentor the employee in accordance with their own evolving interests on the basis of an authentic dialogic relationship. Some suggestions for the maintenance of meaningful, ongoing dialogic relationships include

1. Maintain a schedule where each lab member has private, individual meetings with you as their PI.
2. Ensure that the meetings are actual dialogues. In other words, provide opportunities for employees to voice any concerns about their experience in your lab without fear of reprisal. You might consider allowing your mentee to develop the agenda for such meetings or collaboratively develop an agenda so both parties are involved.
3. Ask intentionally about ways in which you can be a better support structure for them. Undergraduate students for example may be more reticent to proactively request certain things, so it behooves the PI to anticipate, informed by dialogue, the kinds of things needed for their personal and professional development.

Climate

Ground rules and structures

If an intentional structure is not present in the lab environment, it becomes all too easy for broader social inequities to replicate themselves. Ground rules help address the tendencies that even the well-meaning have to give into their implicit biases, react emotionally over using reason, and respond to circumstances inappropriately due to ignorance. Rules and structures serve to communicate the basic value system of the lab, such that any new member comes to quickly understand how inclusion is achieved and upheld in your program. Rules can include respect for pronoun use where applicable, assigned times for speaking during lab meetings, and statements on zero tolerance policies for racist and sexist behavior. Ground rules message that though the inclusive lab is a place where ideologies and new ideas are aggressively pursued and simultaneously challenged, engaging that pursuit can be done in a safe climate of respect. Safe spaces in this context means that individuals of diverse backgrounds and identities can feel authentically included in that pursuit. Some considerations for establishing ground rules include

1. Create a values statement that is read and signed by every member of the lab. This should be similar to safety rules associated with lab protocols and equipment. This way there is no ambiguity on what behavioral expectations are as they pertain to equity.
2. Develop a system for team contributions during lab meetings. In an average gathering of team members, some individuals are more likely to dominate the conversation and be less mindful of time if given free reign. A time quota for each participant ensures that those less more likely to withdraw are provided an opportunity to contribute.
3. Provide mechanisms for handling conflict. This can range from ensuring mandatory report protocols are followed should that level of resolution become necessary to providing space for dialogues between parties that are having issues. For the latter, the PI may consider seeking training support in conflict resolution so they can appropriately handle different types of conflicts.

Tone of critiques

Set a lab climate where critiques are welcomed by mentees because they are helpful to their growth and focused on professional development rather than a failure in the lab. Critiques that cause mentees to question their competence and value in the laboratory may disproportionately affect HDI students. Research on stereotype threat has shown that in environments where an individual holds a stereotyped identity and the stakes are high, the extra effort required to overcome the stereotype can lead to more errors and worse outcomes (first described by Steele,

Aaronson, 1995). While stereotype threat has primarily been tested in high stakes testing situations, the impact may hold true for the research lab as well. This may cause the most marginalized students in the research lab to be most susceptible to making errors that require critique. On top of the added challenges caused by stereotype threat, because these students do not see themselves represented in the laboratory already, they are less likely to have a strong sense of belonging and science identity, both of which are correlated with increased persistence (Trujillo and Tanner, 2014). So what does this mean for HDI students in the research lab? It means that the tone of critique matters and that care must be made for the tone of critique. If you have developed a strong dialogic relationship with students, their preferred mechanism of feedback can be discussed well in advance of any specific critique. Some students may know that they prefer direct feedback while others might prefer some time and space to process feedback and therefore would like to receive it in written form. By considering your preferred styles of critique and setting up the culture both explicitly and implicitly to focus critiques on the growth and development of the mentee, the process can run more smoothly and the feedback can be received in a way that is safe and effective for the mentee's professional development. The following actions may help you become aware of your mechanisms of critique and when they might be most or least effective.

1. Reflect on the question: What is your preferred way of receiving critical feedback? To what extent is this how you give critical feedback?
2. Think back on your time as a PI: When has critique gone poorly with one of your mentees? How might you have approached that critique differently?
3. Discuss with your mentees: What is your goal in critiquing their work? How can you work together to ensure that they get the feedback they need from you while also feeling supported in their work?

Engaging social issues directly

PIs who cultivate inclusive lab environments recognize that while the lab is a space with obvious physical limitations, the social environment of its members extend into different aspects of their reality. When profoundly negative events occur within one of these aspects it is sometimes difficult to create mental separation between the physical lab and the impact those events may have on the individual. Inclusive lab environments create space for lab members to be comfortable to discuss the ways in which they are impacted by and engage in broader social issues. Part of this engagement may be the highlighting of the ways in which issues of race, class and hierarchical power manifest themselves even within the lab environment. When social fissures erupt in inequitable social spaces PIs should be prepared to address the ways in which this eruption might disrupt the lives of its members, but also explore the ways in which they can take collective and personal responsibility toward a solution.

In the absence of direct engagement, members of lab whose values align with the cause being addressed or whose identity is similar to those being impacted are then left with the task of emotionally navigating this space on their own. Other lab members should not use the presence of these individuals as an uncompensated resource to placate their own ambivalence on these issues, but seek to understand the depth of the work they need to do themselves. For example, in Spring 2020 a nationwide and international protest movement unfolded in response to the death of George Floyd who perished due to a restraining procedure that resulted in asphyxiation. The resulting protests, public statements, and pledges for action have asked those of us with power and privilege to be specific about the steps they will take toward antiracist practices. As a lab, regardless of disciplinary focus, PIs and lab members can collectively consider what structures within their area of study, academic societies, institution and research environment they can inspect to ensure that racist and classist hierarchies are not perpetuated. This is how an inclusive lab can directly engage in social issues of the time, regardless of their intellectual relevance to lab content.

To engage in this process authentically, PIs should consider the following strategies.

1. Identify a reading list on equity and inclusion. Science research labs are typically constantly reading in their discipline, but equity work requires constantly reinforcing your knowledge base about social structures and the ways in which they perpetuate social issues. This should be treated with the same rigor, reverence and vigor as reading science papers in the discipline.
2. Use individual sessions to gauge and discuss (if appropriate) how social issues are impacting your team. In this scenario, you should not assume that all lab members are impacted similarly by the same situations. Being transparent about your own feelings provides an opportunity for mentees to determine what and how much they may be willing to share on the topic.
3. Be brave and consistent in challenging conventional structures that perpetuate racism. Disciplinary societies are as bold as their members as it pertains to how deeply they will speak out on racist policies and structures. An inclusive lab is one that recognizes that its responsibility is not only to its members, but to the disciplinary culture to which it belongs.

Conclusion

Inclusive lab environments are spaces where individuals from any background, including HDI students, can enter and become their best scientific selves. The social reality is such that identity contingencies, implicit and explicit racism, and the lack of training of most lab PIs in this area work in concert to often prevent this from happening. PIs who are interested in cultivating inclusive labs must first consider the role that their own positioning, mentality and relative knowledge play in the process. This reflection can be encapsulated within a sense of 'why', or the purpose behind why one engages in a particular career pursuit. Only a full reckoning with

this will allow for meaningfully engaging the members of the research program. In the subsequent dialogic engagement PIs interested in cultivating an inclusive lab environment must be prepared to invest time into fully understanding the professional, social and personal contexts of their lab members. People will have different reasons that motivate them to be part of the scientific enterprise, and not all of those reasons will align with those of the PI. This does not mean that they cannot be dedicated, valuable contributors to the professional goals of the lab. For some, their identity as an academic may perhaps be evolving, and inclusion proffers that some space and support is provided to allow that evolution to happen. PIs that promote inclusive labs understand that diversity of ideas and backgrounds is ultimately beneficial to the research process, but for those benefits to be realized, its participants should feel comfortable bringing their whole selves to the lab. Lastly, science and scientists do not exist in a vacuum, separate from broader issues of equity and social justice. Therefore, as individuals who generally enjoy enormous privilege, PIs should take a leadership role in rooting inequity from their own research spaces, speaking truth to power within their professional organizations and being willing to engage difficult conversations particularly when they are likely to impact lab members.

The work to create inclusive lab spaces is lifelong and PIs should embrace the likelihood that there will be several imperfect moments during the journey. However, the commitment to the process, and the acceptance of the aspirational goal is crucial if the scientific community is to eventually actualize into a truly inclusive and equitable space.

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