Cultivating a culture of inclusivity in Heliophysics

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Cover Page Abstract

The decadal survey will help guide the Heliophysics community to create opportunities for future success. A uniquely fundamental question will drive science innovations and discoveries in the coming decades: What research environment and community will we build? The most innovative scientific ideas and discoveries develop in safe, inclusive, diverse, accessible, and collaborative environments. These environments strengthen all types of collaborations and advance innovations in concepts and applications. If we ignore this critical aspect of science, current issues regarding diversity, retention, and succession will persist. This paper discusses current critical problems and introduces actionable steps that can cultivate a culture of inclusivity.

High Level Recommendations:

1. Provide funding and opportunities for professional development focused on awareness of how to improve our culture (e.g., bystander training).

2. NASA, NOAA, NSF, universities and other institutions should work closely with research fields in diversity, equity, inclusion, accessibility, and justice (DEIAJ) research to form best practices - then apply those best practices.

3. Provide clear accountability, and resources for offenders to learn and grow.

4. Track metrics safely and securely to target areas of bias and inequality.

5. Encourage inclusion of DEIAJ and service activities as part of performance evaluations, award criteria, promotion evaluations, and hiring practices.

1   Executive Summary

The recommendations in this position paper are a starting point to help our community cultivate a more welcoming and open culture. Achieving this goal will require continual work. Additionally, we must have clear policies and hold ourselves and our institutions accountable. Finally, we must continue to communicate and revise our policies and norms as we learn how different actions, structural elements, and community policies hinder or help individuals to fully and freely engage within our scientific community.

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Science, Technology, Engineering, and Mathematics (STEM) in general are fields whose communities reflect only a small portion of the potential talent available from the broader population. The most recent publicly available demographic survey for Heliophysics was completed by the American Geophysical Union (AGU) [1]. The Space Physics and Aeronomy (SPA) sections of AGU, which encompass a large portion of the Heliophysics community, have fewer non-male participants than most other sections. Anecdotally, non-white participants are also strongly underrepresented, as seen in most STEM fields [2, 3]. This lack of diversity hurts our field and inhibits innovations by not cultivating a culture where all voices are heard, respected, and valued [4, 5, 6].

Like all other humans, scientists can only start engaging in creative and innovative thinking after all of the deficiency needs (physiological, safety, love and social belonging, and esteem) have been met [7]. Within this series of position papers, which stem from the Heliophysics 2050 poster, we have identified some of the more considerable roadblocks to achieving an environment where the best science can be accomplished. We look to experts inside and outside our field who have identified best practices to mitigate and remove roadblocks that create deficiency needs.**We recommend that the institutional leaders adopt these best practices, encourage their use at the individual level through structural incentives and by setting a personal example, and continue to evaluate and improve these tools as we learn more.**

2   Cultivating a Culture of Inclusively and Openness

Tied intimately with our ability to perform at peak potential is our ability to foster a culture where innovation and great science can be accomplished. This ensures that all can participate and freely and safely share ideas and research. While it may hurt some in our community to hear this, our field is not a psychologically or physically safe place for many people, which is reflected in our current demographics. We can improve, learn, and grow.

2.1   Creating a Safe and Welcoming Environment

Improving the culture in our community is the right thing to do, period. However, as we work towards increasing diversity in our field, we must simultaneously ensure that our field is a safe place for people to exist. If we do not, people will continue to leave our field to find fulfilling work in areas where they can thrive. Ultimately Empathy is a necessary trait to foster and cultivate to produce good collaborative team environments and strong collaborations [8, 9]. This includes becoming active bystanders and supportive colleagues as we see macro- and micro-aggressions. Below we address issues that currently make our community exclusionary to some, as well as explicit activities and best practices that we can adopt to make our field more inclusive, improving scientific creativity and innovation.

Action: Institutions with authority (e.g. NASA, AGU, and universities) must actively and intentionally work to look beyond the experiences of the majority to understand the reality of the minority experience.

Continued examination of our behavior, actions, and words: We need a continued examination of our biases, behaviors, and actions along with the structures, actions, and words coming from our institutions. This can be as simple as reflecting and checking our implicit biases when we have significant impacts, such as during panel and paper reviews, inviting speakers, and nominating people to positions and for awards. In addition, we can take some fundamental actions to help mitigate our own and our institution's biases. Here are a few specific suggestions: Adopt anti-racist principles/best practices, Adopt best practices to minimize bias (explicit and implicit), and Establish codes of conduct and safety plans. As an example, the 2019 and 2020 SPA Fellows nomination committee, chaired by Dr. Halford, worked to identify groups we may have biases for or against (list provided in [10]). This list was created so that during discussions of the nominations, the committee could check-in, remind themselves about the biases we all hold, and reflect on whether they had impacted the discussions and rankings.

Types of biases and harassment: There are many types of bias and harassment and we define some common forms here. *Explicit bias* makes another person feel unwelcome because of an individual's deliberate words and actions to exclude them. *Implicit Bias* is when an individual's words and actions are unwelcoming, yet the person is unaware that they are being exclusionary. *Microaggressions* are small actions and words that make others feel unwelcome - the consistent presence of microaggressions causes lasting harm [11]. *Macroaggressions* are large-scale or overt negative actions towards an entire group of people. *Harassment* are actions that make another

person feel unsafe. *Bullying* is harassment where a person coerces another to do something they don't want to do. Biases and harassment often are upheld by *systematic policies and practices* that benefit one group over another. These biases and harassment can occur in concert, amplifying the negative impacts experienced by the targeted person or group.

Addressing these issues: It is vital to make the point here that intention cannot be seen. Thus **intention does not matter, impact matters**. While an individual causing harm may not intend to and can learn and grow from the experience, we can not ignore the injury. We *ALL* have blind spots and have room for improvement. Below are some simple recommendations for how to work towards removing and mitigating the impact of bias:

- Microaggressions: increased bystander intervention training and fostering a culture of calmly yet immediately confronting them [12]

- Macroaggressions: sustained conversations promoting the evidence that diversity and inclusion of all groups leads to better outcomes. Effective reporting and accountability measures in funding and societal agencies is necessary to help mitigate and remove these macroaggressions.

- Harassment: clear and easy reporting procedures followed by serious investigations of alleged abuses and accountability when abuse has been found to occur

- Bullying: this stems from an abuse of power over others; implementing systemic checks and balances to power can minimize the influence of bullies

Respect and collaborate with diverse communities:: There is a real need to nurture environments that respect and collaborate with diverse communities, recognizing and valuing their expertise and understanding. Many people don't want to join a room/a community/a field where people don't look like them (described as a repulsive force). However, we must be aware of this tendency and continue to work towards a more inclusive and diverse community. When reaching outside of our own culture to include other cultures, we must recognize that if people have to choose between their culture and being a scientist, they will choose their culture, and we lose them from our field [13].

Recognize the unique challenges faced by first generation students:: First-generation college and Ph.D. students unfamiliar with academic/research culture face many challenges. Beyond not knowing academic culture norms and how to navigate academia, first-generation students may lack a family support system that is familiar with STEM activities. For instance, many non-academic families may assume that graduate school means more college debt, not understand an academic career path, or the stresses of it. We must ensure support networks are available and take advantage of existing ones, e.g., the McNair Scholars program. Additionally, our field should work to provide mentoring, which may include things that would not be obvious to someone who has not been within the academic culture. For example, helping undergrads prepare for graduate school, and what other career paths may be taken. Additional information such as dress codes at conferences, what to expect when attending meetings, how to travel domestically and internationally, and other non-science-specific information may be necessary to pass on.

2.2   Track and work towards representative demographics

AGU has started to publish and better track demographics, but more institutions need to follow suit [1]. Gathering demographic information must be done safely, requiring expertise in survey design and analysis. However, these statistics will let us know where we start and track our progress.

Action: Agencies (e.g. NASA and NSF) and research societies (e.g. AGU) should employ social science experts to track demographics and report findings in a transparent manner.

2.3   Relationship with one's self / life-work blending

People of diverse backgrounds are more likely to experience adversity. This causes a strain on mental health, and socioeconomic opportunities [14, 15]. Additionally, the workplace has changed dramatically over the past decades. Yet, we continue to perpetuate many workplace stereotypes and expectations which are actively harmful and push people away from the field; the rundown graduate student [16]; the postdoc who works nights and weekends to get enough papers and grants to land that permanent position; the singly focused scientists who work 90 hours a week to get in the following proposal at the expense of sleep, recreation, and family. We have, intentionally or not, elevated and encouraged these images of what a scientist looks like to our detriment.

The glorification of working heroic hours has led to mental and physical health issues, undue stress, fractured families, and suicides. Furthermore, there is little evidence that, over the long term, the best science is achieved within this environment. When one is constantly surviving and stressed, it can be difficult to think creatively and innovate. While work may be completed and advanced, more mistakes will occur, and innovation will be harder to achieve. We all have witnessed talented colleagues depart science for 'greener pastures' where the hours are shorter and the pressures to perform are lower. Unfortunately, we drive talent from the field by accepting these stereotypes as standard and virtuous in the scientific workplace. For all of these reasons – health, happiness, and productivity – we need to recognize that work-life balance is an issue of vital importance for our field. Other cultures have shown that scientific progress can be made without this toxic work culture and constant burnout [17]. Creating a culture where people can feel secure and less stressed leads to more creativity, and more innovative science will be completed [18]. Below we identify and address some of the issues which lead to this imbalance.

Value outside, non-work activities: We must move the conversation forward from life-work balance towards creating fulfilling lives. Normalizing downtime outside of our work activities is also essential to producing innovation. Social activities outside of work should be recognized as healthy and supported. For example, physical exercise is vital for mental and physical health and should be encouraged and supported [19]. Our brains need rest to process what we have learned. When stepping away from a project, having a break in our workshops, our brains are not idle but are provided space to make new connections. As those new connections are made, discoveries are found - the "Ah-ha" moment we have while daydreaming or running come from providing our brains space to process challenging problems.

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Take active steps to avoid Isolation: People tend to interact socially both at work and after work with people they feel more comfortable with. Unfortunately, this can result in underrepresented groups being excluded from meaningful connections, access to networking opportunities, and in severe cases, the climate phenomenon of "invisibility." Veronica Hill, one of the DEIAJ leads at NASA Goddard, has discussed how working with new and diverse people can be uncomfortable. We need to lean into that discomfort. Avoiding it makes the climate worse.

Resources to support families: There is a current lack of support for researchers who are also caregivers or have other life disruptions. The ability to take off for extended periods to address family life events such as family expansions, illnesses, and deaths is critical. But we need more than support for these extraordinary events; the everyday events in our families need to be recognized and supported as well. One of the paramount ones is affordable child care - including support for childcare at work and conferences through grants. While family support impacts everyone, the impacts are not distributed equally. For example, child care has repeatedly impacted the child-bearing individual significantly. As our field has an identified issue with supporting people other than cis-men, this is one area we need to address and acknowledge [20, 21, 20].

Resources for mental health: We need more resources to catch issues earlier and provide better support for scientists. We also need to foster a more open culture to discuss these stresses with others and provide help. A shift is necessary from a culture of labeling talking about stress at or outside of work as 'whining' and instead recognizing it as the reality of problems within the environment and culture. This includes more open discussion about mental health, more accessible access to mental health services, and individuals and institutions checking in with our colleagues and workers.

2.4 Burnout

Burnout is something that many in academia experience and has an enormous impact on our ability to do good work [22]. Long hours, unreasonable deadlines, meeting overload, and other working culture issues contribute to burnout without improving the pace or direction of scientific progress [18]. According to Ellen Hendriksen, burnout has three symptoms: emotional exhaustion, reduced effectiveness, and de-personalization (e.g., being cynical, critical, and resentful) [23]. This perpetuates toxic work environments; as toxic environments are more likely to have stressors that lead to burnout and the symptoms of burnout contribute to toxic environments. Below we discuss some of the issues that lead to burnout.

Unreasonable expectations and overlapping deadlines: Unreasonable and overlapping deadlines inhibit deep creative thinking. Everything becomes last-minute and leads to people feeling pressured to work outside of work hours, feel that they are failing at meeting their potential, and not having time for the development of new ideas, new research, and paper writing. When people feel that they are constantly working in an environment where everything is an emergency or mission-critical, then there is no downtime to stop and think. When there is a constant feeling of failure, people will not feel that they have time, energy, or confidence in their ability to suggest new and innovative

ideas. Marginalized groups are less likely to possess tools to combat these feelings, which may trigger past traumatic experiences that inhibited their self-worth.

We need to have a culture where there is a transparent and honest assessment of realistic deadlines. **This frank assessment needs to include discussions over the number of work hours required to complete the task, asking people to work beyond a 40-hour week for extended periods, and what would happen if the deadlines were to slip.** In addition, we need to start prioritizing our communities' mental and physical health and including this in assessing deadlines.

Meeting Overload: Meetings can be an essential tool in any group. They are a way to check in, transfer knowledge, and identify any issues which may be coming up. They can also be fantastic methods for brainstorming and collaboration. However, too many meetings can lead to burnout, "zoom fatigue" [24]. Even if a group has few meetings to provide time for deep thinking and independent work, unproductive meetings can waste time and lead to feeling drained.

As scientists, we often work in geographically dispersed teams. This leads to more online meetings. The pandemic and increased telework for many individuals also increased the need for more virtual meetings. One dimension to the availability to hold meetings at any time is a false sense of urgency created around all discussions. With that comes pressure to be a part of every one of them to remain 'relevant' and visible in the field (e.g., the 'fear of missing out' effect). These two factors conspire to make meetings a source of unhappiness and burnout.

Expectation of required, unpaid overtime: The stereotype of a scientist often consists of a laser-focused person dedicated to their research. Their love for their research is above all else, and they will sacrifice everything – including their health, family, and financial security – to find the next big breakthrough. Unfortunately, while we can all point to individuals for whom this seems to work, we can point to many more who burn out, leave the field, or are continually miserable. One issue is that budget limits for major projects frequently drive the expectation that employees will regularly work more than 40 hours. Missions are often under-funded in the development phases for the scope of the work required. PIs cannot involve the number of Co-Is or hire the number of employees that would be necessary to reasonably split workloads. Budgets are too tight to allow PIs to hire and retain experienced professionals while supporting, training, and advocating for students and junior research scientists. Mission PIs must often contract work out to industry consultants who are typically paid more than civil servants, faculty, or academic soft-money researchers because their institutions do not have permanent employees with the needed expertise.

While there will always be times when one must put in extra hours, this should not be normal. We must have honest discussions over the number of work hours needed to complete a task, whether it includes asking people to work beyond a 40-hour week for extended periods, and what will happen if the deadlines or projects slip. We must start prioritizing our communities' mental and physical health and include this in the assessment of projects, funding, and deadlines.

Action: **NASA and NSF help establish realistic expectations through self-reflection and open discussion with the affected community.**

2.5   Developing an Inclusive Culture and Dismantling culture and practices that push people out

We are relatively good at encouraging people to enter space physics. However, there are many ways people are pushed out as discussed above. When people are left out, discouraged, and unable to participate, they will find other fields which allow them to thrive. However, there are more ways in which we actively push people out. What can seem like a small thing (such as not having a place to identify your gender in a survey) can feel like you are not allowed to exist in this space.

Those with both visible and invisible disabilities face additional significant challenges in navigating the current norms in the field. Students and postdoctoral researchers often are not eligible for comprehensive healthcare insurance at their institutions, making access to the necessary care challenging. Cultural practices such as last-minute networking over dinner or drinks can be prohibitive for those with accessibility needs. Finally, workplaces, laboratories, and conferences should be designed, adapted, and planned with consideration of those with special needs. These changes positively impact those without a constant need for extra consideration. For example, a non-disabled person may suffer a broken limb and not be able to reach their workspace if access issues are not addressed before it becomes a critical problem.

3   Concluding Remarks

There are five elements to achieving DEIAJ in a community: individuals, groups, organization, compliance, and communication. It helps if you had everyone on board, e.g., institutional practices must be transformed, and institutions must deal with infractions promptly and consistently.

1. Individual-level: It is very difficult for a collaboration group to be inclusive and equitable if the individuals are not committed to it. Leaders can help, but the climate is determined by interaction with one's peers. Therefore, **education and training is key for individuals to understand the factors involved, identify the manifestation of impediments to DEIAJ, and have clear and effective strategies to counteract them**.

2. Group level: DEIAJ at the group level ensures people have access to opportunities and play a significant, valued role. The **adoption of 'Science of Team Science' and other best practices provide strategies to understand, identify, and mitigate impediments to a diverse, equitable, and inclusive environment at the group level [25]**.

3. Organizational level: **Proposal reviews, performance evaluations, hiring, promotion, etc. are all practices that must adopt explicit strategies to counter bias.**

4. Compliance: **Enact a clear policy of behavioral expectations with explicit actions for violations.** Identify the process and people with the trust, knowledge, and authority to effectively address problems and resolve issues.

5. Communication and growth: Everyone is different, and what is not offensive to one person may be offensive to another. What makes one person feel included may make another feel discouraged. Therefore, **activities that promote communication and understanding, including conflict resolution, should be adopted at all organizational levels. Periodic surveys, anonymous reporting, and methods to evaluate community health need to be adopted.**

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