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# Perspectives of interpersonal interventions at conferences to promote broader inclusion

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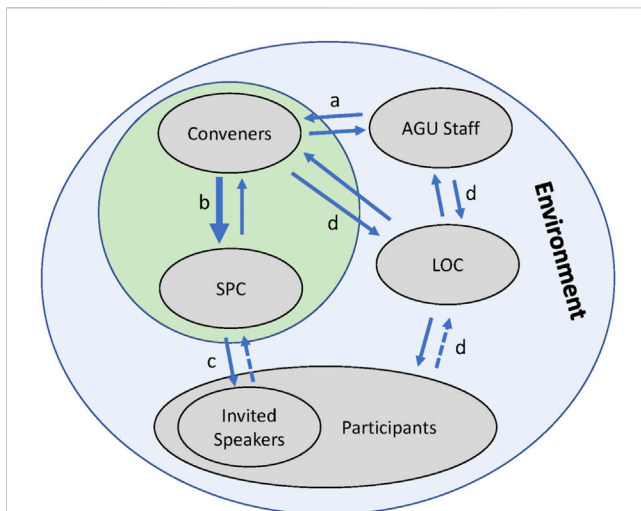
Conferences require a variety of interpersonal interactions starting with conference inception, leadership development, and progressing through organization, the dynamics of invitation, and participation. Thoughtful reasoning along with social connections at the interpersonal level are exemplified in the conference setting where ideas are exchanged and knowledge is shared. This engagement within a welcoming (warm) climate that promotes all voices being heard is essential in broadening inclusion for developing and recognizing a diverse cadre of scientists. Broader inclusion at the interpersonal level can be examined by applying the framework of the social cognitive theory, which considers interpersonal interactions based on many individual personal factors while engaging in an environment and impacting behavior. In this perspective, we share anecdotal experiences from our own involvement hosting (together with colleagues) four small, topically focused Chapman conferences between 2011 and 2016 as part of the American Geophysical Union (AGU). To promote broader inclusion and ethnographically observe outcomes in the conference environment, we look retrospectively at interactions of organizing leadership and participants with respect to diversity, e.g., geographical and cultural diversity, perceived gender, ableism, and disability. Focusing on interpersonal relationships within the conference environment, we highlight where interpersonal interactions and the climate that results can impact inclusive behavior. It is through observation and recognizing the successes and pitfalls that we identified potential key intervention targets.

## KEYWORDS

interpersonal relationship, diversity and inclusion, intervention, conferences science, equity

## Introduction

Conferences require a variety of interpersonal interactions starting with conference inception and progressing through organization, invitation, and participation. There are increasing calls to promote broader inclusion of diversity in sciences<sup>1, 2, 3, 4</sup> (Purity et al., 2017; Else, 2019; NSF, 2021), including conferences with broader demographic reporting. Identifying key areas at each interaction that can be targets for intervention to improve inclusion begins with observation followed by action. At each interaction with others, these interpersonal relationships play an important role in individual development. Based on Vygotsky's work, self-development involves the reflective and psychological process of the individual through thoughtful reasoning along with social connections at the interpersonal level. Together, with others, ideas are



**FIGURE 1**

The three factors of the SCT (interpersonal, environment and behavior) are applied to our depiction of the conference within the context of AGU organizational structures supporting Chapman conferences. The environment is the large (lightly shaded ellipse). Within, and part of, this environment are the members (in smaller darker shaded ellipses) and their interpersonal interactions (shown with arrows). Within the environment, the convener team engages with leadership (label a), the centralized leadership of conveners invites science program committee (SPC) (label b) and together the team invites speakers (label c). Arrows as interpersonal factors of individual cognitions can be weighted with unidirectional selection or bi-directional interplay and with dashed lines showing potential development. With increased interpersonal engagement at intervention targets, AGU Chapman staff with variable engagement in the environment relying on local organizing committees (LOC) (label d) become more involved forming networks with bi-directional arrows representing interplay within teams. All parts of this environment impact the resulting behavior (inclusion) while engaging individuals in interpersonal interactions to promote diversity.

exchanged and knowledge is shared (Vygotsky, 1962; Vygotsky, 1978) which is exemplified in the prime setting of a scientific conference. When engaging individuals within a collective, broader inclusion can be promoted; thus, these relationships are prime targets.

This development of interpersonal relationships is also shaped by the environment. In this context, the environment is not just the location but encompasses the people with whom one interacts. Abilities to engage in communities, such as a scientific conference, can be examined under the framework of the social cognitive theory. This theory explores the dynamic interpersonal interactions based on many individual personal factors while also examining how engaging with others socially in an environment impacts behavior (Bandura, 1986). Fundamental to engaging interpersonally is the influence of dynamic interactions between individuals through the process of observation, imitation, and modeling with learned cognitions eliciting behavior change. For our purposes, the conference setting and interpersonal interactions within provide the environmental factors that shape those involved at different levels of the conference, i.e., leaders and participants (Figure 1). To broaden inclusion, we must recognize how the diverse makeup of engaged members contributes to these

interactions and that many of the outcomes sought are only achievable in a collective (Bandura, 2000).

We need diversity at the leadership levels to improve the collective. Evidence supports that engagement in interpersonal relationships aids in advancing diverse scientists and that collective intelligence with more diverse teams improves scientific outcomes (Woolley et al., 2010). Collaboration is paramount for scientific rigor and the development and retention of diverse scientists with a variety of perspectives and identities (Nielsen et al., 2018). The collaborative context can be within a team in research or co-authorship in publication (Hanson et al., 2020). Networking helps build scientific career advancement (review Hall et al., 2018). There is a need for cross-gender social ties in teams to prevent exclusion from the benefits gained professionally (Cyr et al., 2021). A welcoming culture and warm-climate promoting all voices is essential for inclusion to happen (Biggs et al., 2018), and this is achieved at the interpersonal level. Particularly as the scientific society moves to promote inclusion, this social exchange within the environment of scientific conferences is a key point to observe what has worked and what falls flat in fostering an interpersonal culture where scientists share and develop scientific knowledge. Then, interventions can target key gaps.

Likewise, until the recruitment and retention of diversity of the collective is addressed, we will continue to have lower numbers of women and other underrepresented groups in the talent pool that could move into the leadership roles (Seymour and Hewitt, 1997; Seymour et al., 2019). We see from the AGU data that from recruitment of STEM majors in colleges/universities, attrition begins as early as the first transition point to early-career scientists and at each subsequent step in the career pathway.<sup>1,5</sup> The top-down model of diverse leadership is not fully supported until the bottom-up model is addressed to increase the pool of talent. This pool of individuals can be over-tapped if the pool remains limited raising this as a key AGU strategic goal.<sup>4</sup> Regardless, increased recruitment and retention must be addressed at all levels as broader diversity benefits the collective.

Building on the SCT, which focuses on individual and interpersonal exchanges, another model, the social ecological model (SEM), provides a broader framework to explore how the lower levels of individual and interpersonal relationships fit within a broader structure (McLeroy et al., 1988). Within this multilevel framework, the interpersonal level is a key intervention point for behavior change (Golden and Earp, 2012). Taken together, it is especially useful for both models to document observations including anecdotal reports and then develop and implement interventions targeting a key determinant to change behavior within the conference environment. While what we observed can apply to many different types of conference settings, we focused on those of the American Geophysical Union (AGU) with their small, topically focused Chapman conferences.

Since AGU is committed to promoting an inclusive environment with a focus on diversity, equity, and inclusive (DEI) practices and policies, this search for understanding lies within AGU's strategic diversity plan.<sup>4</sup> This involves tracking demographic data<sup>5</sup> for members and other means since 2014 to understand our demographics, including scientists with global affiliation and international perspectives from 147 countries.<sup>1</sup>

Another goal is to educate membership about broader objectives in diversity, equity, and inclusion.

Here, in this perspective, we share anecdotal experiences from our own involvement hosting (together with colleagues) four AGU Chapman conferences between 2011 and 2016. To better understand broader inclusion and better outcomes in the conference environment, we look retrospectively at interactions of organizing leadership and participants, e.g., perceived gender (woman/man and other LGBTQ identities), geographical and cultural diversity, ableism and disability, and noted challenges faced even when inclusive efforts were made. From within, we ethnographically explored the roles of engagement and dynamic interplay that is possible at the interpersonal level of conference leadership and organization with steps to develop a culture and create more welcoming climates as being critical in retention of diverse participants. Since conference participation and networking, and more so, invitation to participate on the science program committee (SPC) or as an invited speaker are linked to recognition in tenure and promotion (Kalejta and Palmenberg, 2017; Klein et al., 2017; Hall et al., 2018), the conference environment that impacts diverse participation is a significant area to investigate.

Through this process, we identified points we considered successful, as well as instances where the conference environment fell short and potential key intervention targets for the future. We focused on interpersonal relationships encompassing the SCT personal factors (interpersonal), environment, and impacts on behavior. This conference environment continues from conference inception, leadership development, invitation dynamics, and participation with the various players involved. It not only includes the structural location but also encompasses the people who make up the environment, their interpersonal interactions, and the climate resulting from these interactions.

## Inception and convener leadership

At the level of conference inception by a convener, or convener team, proposals are made to AGU Chapman. Some interpersonal interactions at this level include discussions among the AGU committee for selection of proposals. Exactly how the larger organization selects proposals, approves how many they can support in a given year, and seeks locations for hosting the accepted proposals could be intervention targets. Different models exist for the level of exchange between the supporting administrative staff and the convener leadership (Figure 1, label a). It could be at this point that some intervention training could take place for conveners. For example, the proposal onset is a good time for AGU administration to start by building rapport and trust with the proposing convener(s), understanding the levels of inclusivity with which the conveners are familiar, and presenting opportunities for training against bias. Enhancing relationship building between administrative and convener levels could already promote inclusion. For example, simply raising awareness, providing resources, and helping conveners consider their next steps in selection could be an intervention target to promote diversity. Offering resources and training is one approach, but better interpersonal interactions would play a greater role in the information being perceived by conveners as supportive rather than top-down demands. This is especially true

if the proposal has less diverse representation than would be recognized as being inclusive. In this case, nudging from the administrative level for the conference leadership team to be more inclusive and diverse may be needed, e.g., seek more balanced gender or racial/ethnic representation on the SPC.

Through observation, imitation, and modeling of how to counter bias and reach beyond for a more diverse team, the leadership team develops cognitions which results in behavior change as applied to Bandura's SCT. As an example, suggestions could be better received if the conveners have ideas of how to counter bias and learn and think about their choices of invited SPC, and ultimately the team's decision would also impact the diversity of the speaker roster. If a convener makes all top-down decisions, then there may be more potential for bias and for missing out on all the creative ideas a diverse team collective could bring. If a team is diverse and made aware of bias, this also could enhance greater accessibility. However, interpersonal connections with AGU staff are also valuable. If the relationships break down between these organizing levels, efforts for inclusion can disintegrate. For example, conveners themselves may have carefully planned efforts for inclusion that do not go forward when administrative oversight fails to support them, e.g., accessible locations, icebreaker activities, on-site access, and funding support distribution. In either case, this impact on inclusion and diversity comes through interpersonal interventions.

What is meant by inclusion can vary. From our perspective, as part of organizing teams for all four Chapman conferences, we inherently knew that enhancing diversity was important but still this involved a learning process. Through our growing experience, we saw the value of understanding how key environmental and structural factors such as geographic location, cultural (racial/ethnic) diversity, range of gender representation, and on-site universal access accommodations for those who identify as disabled would benefit inclusion of diverse participants. Recognizing the global reach of the space physics community, we sought locations that would support broad geographic and cultural diversity, representing the diversity in our scientists from around the global community.

Thus, as part of our convener proposals, specific structures within the conference environment were planned with interpersonal interactions as represented in Figure 1, labels a–d. Conference locations were proposed after we had already inspected them with the local organizing committee (LOC). Not all conference models use this process of site selection or fully support networking activities as proposed, but the interpersonal interaction therein is part of the structural environment in the SCT. Furthermore, within the SCT, the structural environment included interdisciplinary scientific participation among solar and heliospheric scientists, and magnetospheric and ionospheric scientists for Earth and other planets. By bringing together scientists from three interdisciplinary areas, unique relationships could be built. Conveners representing different interdisciplinary fields were invited. With this merging of these distinct areas, icebreaker activities were planned as necessary in building interpersonal interactions across disciplines. Often these activities included excursions, cultural programs at banquets integrated from the different geographic regions the conference would take place, and at our most recent Chapman conference, even specific inclusive

learning opportunities were proposed and implemented. The LOC engaged with conveners and participants to facilitate both individual needs and interpersonal interactions.

We proposed and intuitively incorporated accessibility in various ways, such as collective access transport arranged for those in need but available to all. However, as society was progressively learning more, we were also learning more and increasingly felt the need to be more intentional in our efforts toward inclusive efforts for diversity. What might have initially been wishful thinking for inclusion produced more happenstance leadership teams, diverse in some ways but lacking in others. The process of invitation now involved a closer look at inclusion of more women, diverse speakers and participants from geographic locations and cultures, provision of access for disabilities, and conference construction to promote a warm climate for all intersectional identities including racial, ethnic, gender, and sexual identities identifying as non-binary or LGBTQ. Knowing we could always learn more, and even now in the midst of organizing a fifth Chapman conference, observations were made and strategies employed as each conference posed new challenges and ways that interpersonal interventions could be used to promote inclusion of diverse participants.

Certainly, as the administrative host is engaging with the initiating convener and the developing convener team, this is a key interpersonal target. Even as inception may begin with one convener and the invitation and merging of ideas results in a convener team, one must observe how this interpersonal process occurs to be aware of, and perhaps prevent, homophily with an all-one-trait leadership team and downstream, homogenous speaker rosters from occurring. Not only is the phase from proposal acceptance a key time for education of the initiating convener, but also anti-bias training of all conveners and their whole leadership team. These early steps are key interpersonal interactions worthy of intervention.

## Convener selection of the science program committee

The recruitment of scientists to develop the SPC and the interpersonal relationships within while developing the science program are key intervention targets. AGU Chapman conferences follow a centralized model (Figure 1, label b). This is centralized in the sense that conveners invite SPC and together the leadership team invites conference speakers, as opposed to a decentralized model at a larger meeting with many teams, and each separate convener team is independent in decision-making inviting their own speakers. Together the conveners with the SPC form the conference organizational leadership and act as a decision-making team. Through team effort, the SPC assisted with the scientific theme, identified and invited speakers, later selected speakers and created the program, and often acted as chairs conducting the session. This is a key intervention point to not only enhance interpersonal relationships between leadership team members themselves but also increase diverse representation and promote all having a voice when working on the program development task which will ultimately impact the downstream participants.

Within this structure, interpersonal relationships between these leadership levels could create interplay with all voices heard and on task to enhance inclusion. We applied the SCT framework to Figure 1 to suggest with bi-directional arrows that interpersonal relationships at several key points in conferences can be key targets for interventions. For inclusion to occur, we advocate that steps could be taken to build community first before the task of selection occurs. At this stage, we advocate for training in anti-bias selection for greater diversity and inclusion.

At this stage of convener invitation of SPC, it is easy to fall into the pattern of thinking first of those one knows. This includes work colleagues, those who rub elbows at conferences, by referral from someone else, or simply by a paper read recently which could additionally lead into the trap of falling into citation bias in which underrepresented groups may have lower acceptance rates and fewer citations (Lerback et al., 2020). Inexperience may lead one to think that selection is solely based on merit and is sufficient but could be problematic in resulting in its lack of diversity since these systems are flawed in bias as well. Based on a modeled heuristic by Tversky and Kahneman (1973), this selection choice results simply by who comes to mind first and can result in a form of bias. When faced with many choices, the natural instinct is to simplify the decision. Since demographically, fewer underrepresented choices exist, the probability is higher that the person making the choice defaults to their more likely choice of someone like themselves and homophily perpetuates (Lazarsfeld et al., 1954; McPherson et al., 2001). In addition, the higher probable number of choices who come to mind are increased by the frequency of repetitions of encounters. Known as the *Matthew effect*, those who get invited to speak more, are cited more, gain more fame, and are invited more. This results in a positive feedback pattern that perpetuates when scientists with advantage and success tend to have more advantage and success over time and a widening gap with those having more initial disadvantage (Merton, 1968). To counter this bias at the stage of invitation to SPC or invited speakers, proactively creating ranked lists of expert, speaker, and potential reviewers can help (Nielsen et al., 2017; Nielsen et al., 2018; Vallence et al., 2019). Lists can highlight those in the community with strengths and consider many more qualified possibilities for invitation that can often be overlooked if selection is made based on those who come to mind first.

Since the scientific leadership plays a key role in achieving diversity/inclusion goals, this convener/SPC relationship is an important target. If a community culture is developed in which all team members have a voice and are tasked with responsibilities, then together while determining programming and creating a warm climate, inclusion of diversity can be better achieved. This social structure is central to Bandura's SCT that behavior is influenced by the interpersonal interactions and the environment making it another key intervention point. Key steps in building interpersonal relationships can include starting a collaboration with conversations of identity, work styles, and communication styles to build community. In starting the conversation (Smith-Keiling et al., 2020), some identities may still remain hidden, but it is helpful to know if any additional accommodations for disability are needed such as extra time on tasks with migraine, visual screen readers, or other needs. Sometimes identities are shared upfront, such as being the primary childcare or eldercare provider, but sometimes identities remain hidden. By knowing work/life



constraints that people are more willing to share, such as teaching semesters or grant deadlines, timing can be better planned. In the case of working teams, starting the conversation about projects, identifying strengths and weaknesses in certain tasks, and recognizing the biases we hold are useful to increase community.

The SPC also needs to have a level of understanding of bias as well as strategies. Tying in Bandura's theory of the individual to the interpersonal, each SPC member's individual level of increased knowledge and increased skill in reducing bias becomes an intervention target. Interventions at this SCT level target not only the level of individual training and knowledge of bias but also the self-efficacy (ability) of the individual to act (Bandura, 1986). Training in how to be more inclusive, recognize and resist bias, and create inclusive interpersonal communities can increase knowledge in an individual, but through teams, the social support enhances the collective ability to increase inclusion. Thus, if training is introduced in the form of an interpersonal intervention, then as the team together attempts to broaden inclusion while working on the task of program development and invited speaker selection, the challenge of inviting a broader diversity of speakers can seem less daunting. Building interpersonal relationships includes crossing cultural boundaries—especially since inclusion and bias can have different understandings in different cultures.

Cross-cultural, anti-bias, and inclusive training, not described here, is beyond the scope of this perspective, yet even here we recognize that we felt ill-equipped to provide this training ourselves early on and a diverse leadership team was not as fully realized as one would hope. For example, while our convener and SPC leadership teams were diverse in some sense of geographical and cultural makeup, the number of women was lower than hoped. Of our four Chapman conferences, only one had a woman convener. Efforts to increase women on the team often fell flat. We also encountered cases when we lost a woman as convener, or lost women SPC members on the leadership team after recruitment. We questioned ourselves. Had the team built more community at onset, perhaps this would have prevented loss. Alternatively, women as underrepresented members were simply over-recruited and became over-committed. As often happens in populations that are in the minority, being over-tapped can lead to lower acceptance of speaking presentations or other opportunities when invited (Else, 2019). Even when the leadership team was prompted to seek additional women, it was not enough to simply ask the team to think of more women to invite without providing tools in how to do so. Again, earlier intervention is essential.

Of the leadership including SPC, not all of our four Chapman teams had women. One with no women at all was the earliest planned team and fell into the homophily trap of inexperience and inviting those the convener knew. The other three (and a fifth currently being organized) had increasing numbers of women, but still lacked certain ethnic representations. Without having any firm data for comparisons at the time for gender, we were limited to how our gut feeling target and our average number of women of approximately 20% might fit with the true demographic. Knowing there was literature on attrition of women in space science, even these numbers were based on perceptions (only considering binary man/woman gender perceived woman, or female presenting) since we had not asked identities at the time.

Because of lack of self-reported identity, only perceived binary gender, racial ethnicity, and other demographics were inferred by name and by our personal contact at our conferences. Demographic data were not collected for Chapman conferences. This lack of self-identified data is within a changing paradigm with an imminent need for better identity-based data collection. Current omission leads those of non-binary gender identities and racial/ethnic identities to often feel excluded, and even violated. Certainly, we advocate for the changes now being made to rectify this erasure, and many scientific societies have begun to identity collection as anti-racism and anti-othering approaches to inclusion (Segurra-Totten et al., 2021; Burnett et al., 2022).

Before 2014, gender and other demographic data were neither collected by AGU, nor for Chapman. Numbers based on the AGU membership 2018 section demographics report,<sup>5</sup> as referenced by the Honors Diversity Report,<sup>6</sup> provided us the best snapshot to compare our retrospective analysis with current demographic data of self-identified women. With AGU membership (2014–2018) of approximately 60,000 members, women make up between 26% and 30% in both Earth and Space sciences and range approximately 23% in space sciences (early career students to experienced career stages) with attrition increasing with advancing career stage. For example, attrition from the mid-career stage (18%–23%) to experienced women (around 9%–13%) shows significant drops in the fields of Planetary sciences, Solar and Heliophysics, and Magnetospheric physics, representative of the Space science fields that attended our Chapman conferences. For our four conferences overall, women matched membership data of approximately 20% for participants and scientific organizing committees but not always for invited speakers and not at the convener level. This step in invitation is a prime interpersonal intervention target.

As we examined some of the challenges faced in engaging and retaining a number of women above this 20% mark for our own conferences, we recognized the career stage with lower proportions of experienced women (9%–13% in areas) was the pool from which we would invite. With the disproportional attrition of female scientists in space physics fields as academic rank progresses, this “leaky pipeline” (Alper, 1993; Popp et al., 2019) helped us better understand why we often struggled to get more women involved at the leadership levels and suggested looking toward invitation from the higher proportion pool of early-career scientists. Another factor playing a role in interpersonal relationships is the concept of reaching “critical mass” with sufficient numbers of underrepresented identities to promote social support. Teams need more than simply the ‘token’ numbers of underrepresented peoples. Even if we reach critical mass for effective teams between 15% and 30% (Cain and Leahey, 2014), the collective intelligence of the team is lower if a few people dominate rather than turn-taking (Woolley et al., 2010). Sometimes having enough overall diversity can circumvent feeling like the token representative, but if, for example, all members are white-presenting regardless of other identities such as gender or non-binary gender representation, then this also poses a gap in diversity along the ethnic/racial identities. Needless to say, we found difficulties in reaching numbers of women and other identities that would either reach critical mass or reach an equitable mark of AGU membership. Just as we continue to build inclusion and grow our community to be closer in equity of women and other underrepresented scientists, we

will hope that as the community grows, so will our pool of available leaders as conveners and SPC members who will continue to act as mentors for the ongoing and future generations. Again, we suggest building early-career networks as a target. Evidence for supporting early-career networks lies not only in the benefits of mixed teams but also in the benefits of long-lasting impacts of networks (Lerback et al., 2020). The 2018 data<sup>5</sup> for the AGU section of space physics and aeronomy reporting (female students of 35.57% to male students of 64.18% in space physics) suggests lower recruitment, and taking into account the attrition of experienced women who are more likely in leadership roles while recognizing the higher participation of women students at the transition point to early career suggests the need to promote early-career interventions for their retention. Thus, interventions increasing women leadership participation is vital now to provide the mentoring needed for retention and is a key interpersonal intervention point at conferences for future invitation and growth of our leadership talent pool.

We questioned how our leadership gender distribution compared to other Chapman conferences. Investigating 60 Chapman conferences (spanning 2007–2019), which included our four conferences, we found that the presence of women conveners leads to more women present on the SPC (Keiling and Smith-Keiling, 2023). When there was at least one woman as a convener, it increased the number of women SPC members and the likelihood of all-men SPC was reduced. On average (perceived binary gender by name), the women proportion was less for conveners (17%) than for the SPC (24%). On average, mixed convener teams, as opposed to all-men convener teams, selected more equitable women representation among the SPC members. It was shown in another study that looking at invited speakers in a decentralized model, where many sessions at a larger conference were independently organized by different convener teams, more women in the SPC led to more women in the invited speaker roster (Casadevall and Handelsman, 2014). Taken together, one can see that the interpersonal leadership levels are a key target.

Perhaps 20% of the self-identified women in the leadership would indeed be representatives of equity based on membership data, but this is a far cry away from parity 50:50, nor would this take into account other non-binary gender demographics and other underrepresented groups with varied intersectional identities (Cech, 2022). Diversity of the SPC included members representing global, cultural, gender, and other diversity. It can be advantageous to have people in your team you know, but it can be equally rewarding to have people in your team you do not know. We advocate for the latter to reach the unexpected and to increase the collective intelligence, and take advantage of the trickle-down effect of more women and other diverse groups at the top conference leadership impacting downstream efforts in inclusion.

## Leadership team selection of invited speakers

As selection of the SPC by the conveners creates a positive, welcoming “warm” climate of the team, this invokes an interplay or two-way exchange of ideas and can reduce bias within. Subsequently, their actions in the selection of invited speakers

also increases diverse representation and participation downstream (Figure 1, label c). Since the number of women comprising the conveners appears to impact the composition of the number of women on the SPC (Keiling and Smith-Keiling, 2023), and when there were more women on a selection team, more invited women speakers resulted (Casadevall and Handelsman, 2014), then the broader impact of the team on downstream effects is important. Despite both studies only looking at proportions of women based on perceived gender and binary man–woman scale, these data demonstrate how important the training is in early stages of formation and potential for bias in the invitation of speakers.

Numerical proportions are one way to consider these impacts but another is to consider the interpersonal dynamics within the team. Just because women are on the team, does not mean there is no bias, or that by increasing the number of women on the organizing team, all would have a voice. It is also important to specifically give each responsibility and power to complete the task to find speakers. For example, since our SPC represented global, cultural, gender, and other diversities, as well as represented the interdisciplinary conference themes, shared voice was especially important. Conveners asked SPC to invite speakers from their respective fields. Conveners alone did not always have sufficient expertise and ability to pull together a diversely represented program alone. Hence, the centralized model utilizing the expertise of a multidisciplinary scientific program committee was invaluable, and it was vital to have leadership team members who could strongly lead to knowing their respective communities, invite speakers, and develop the program with inclusion in mind.

Just as a non-gender-biased speaker list can be valuable in inviting leadership, a methodological approach with lists could be employed for invited speakers (Nielsen et al., 2017; Nielsen et al., 2018; Vallence et al., 2019). However, we may still hit roadblocks of reaching equity with the same challenges in lower numbers of speakers that we saw in leadership. For example, sometimes, even when the convener asked the program committee for broader gender representation, we only gained a few more names at most. Sometimes, the invitation went to women, but our anecdotal evidence stems in the lack of positive response and even retracted commitment and withdrawal by women to act as conveners, SPC, and invited speakers who outweighed responses compared to men. Another example when conveners requesting input from the SPC and continuing not to hear any emails back, may indicate that some were no longer participating, resulting in discussions for their removal from the SPC list. Again, community-building may have mitigated this loss. Several studies document that some underrepresented groups tend to be invited less, but also some when submitting abstracts, tend to request posters over talks (Ford et al., 2018; Else, 2019; Ford et al., 2019). We considered who in our conference programs had declined invitations or withdrew participation, and primarily they were women as an underrepresented group.

Thus, as with leadership selection and interpersonal team development, then selection of invited speakers could also be an intervention target by enhancing mentoring. This is represented in Figure 1 with a bi-directional dashed line as those in the leadership role model positions could act as *de facto* mentors in new interpersonal relationships. Since conference participation and

networking are beneficial for career advancement and retention, several studies have reported on this level for intervention (Casadevall and Handelsman, 2014; Kalejta and Palmenberg, 2017; Klein et al., 2017; Ford et al., 2018; Hall et al., 2018; Hanson et al., 2020; Zellner et al., 2022). All of the interdisciplinary fields represented at our four conferences were comparably limited in the numbers of mid-career to experienced women. AGU demographic data provided some reasons why gender balance was a struggle to get higher numbers from the pool of experienced women scientists. The invitation of early-career scientists would help solve this challenge of attrition, making it easier to find speakers, which also provides an opportunity for early-career scientists' career advancement. These experiences showed how valuable the SPC was in inviting diverse speakers for inclusion, but we posit that interventions enhancing knowledge and skills, and that all have a voice will achieve the impacts we seek in broader inclusion and greater diversity. This begins at the early student recruitment stage, increased student and early-career funding to conferences, and promoting interpersonal networking opportunities to support their next transition.

## Interpersonal engagement of the local organizing committee

Conveners and SPC themselves build their own interpersonal relationships along with administrative staff and local organizing committee (LOC) consisting of non-AGU staff who are all part of the environment (Figure 1, label d). The LOC helps integrate the conference into the physical environment of place and the cultural setting in which the attendees will engage. We, acting in this role, along with local representatives, provided pre-conference support by providing insights into the inner cultural workings of the society in which the conference was being held. We acted on-site in an interpersonal manner with participants. When brought into the conversation about inclusion, some LOCs have been instrumental in planning inclusive events and providing access accommodations that promote inclusion as a key intervention point. Interpersonal strategies at our four conferences included icebreaker activities with an icebreaker event, shared meals, and specific scientific social hours for networking. These interpersonal interventions targeted all participants.

How might the LOC in charge of local logistics improve inclusion can vary with the level of experience and what is being asked. For example, conveners can request accessible locations. To pre-ascertain conference participant needs, a pre-survey at registration that helps prepare for case-by-case accommodations, e.g., bus transport, lactation room, and gender-neutral bathroom, as is typically carried out for dietary needs but could be expanded. We employed the concept of universal design with collective access. For example, bus transport planned for everyone in case of rain was valuable even for individuals with limited walking ability who used it but still provided collective universal access for all while also reducing stigma for the person with disability. In cases where larger buses did not need to be arranged in advance, then smaller shuttles and taxis were pre-planned in case of need. One cannot always plan for everything, such as surprises in the case for mandatory Ebola monitoring or additional measures for COVID-

19, both of which we encountered. The LOC as part of the environment through interpersonal interactions can provide several intervention points to broaden inclusion and diversity.

## Summary: tying together the interpersonal within the environment

Diversity at conferences cannot always be happenstance and should take a more concerted inclusive effort as we learned firsthand with each conference having different challenges with successes and pitfalls. Several examples within the SCT have been presented for how all these interpersonal interactions within the conference environment can impact behavior. The structures, the people involved, and the processes of communication all play a role. Even with the best intentions, goals are not always realized.

One may attempt to promote diversity of underrepresented groups by being inclusive, but while having success in one manner, fall short in another. In one of our own conference examples, when it was recognized that we had no woman convener or woman SPC member, then at any point an intervention could have prompted conveners to keep looking for more diversity and promoting inclusive practices. This unfortunate lack of representation at the leadership was actually the earliest conference proposal made by the lead conveners who at that time were focused on broader inclusion of a new geographic cultural location and their first time hosting this magnitude of conference. Due to this change of location and focus on cultural diversity, the focus on gender diversity on the leadership team was missed. Moreover, homophily played a strong but unintentional role in invitation. Although there were still women invited speakers comparable to our other conferences, it was clear that conveners were so focused on geographical and cultural diversity, that gender was missed at leadership levels. Thus, at these early stages of conference planning, when there was no AGU Chapman staff oversight nor policy in place, an intervention would have helped.

Likewise, sometimes the focus on gender inclusion can obscure other inclusivity even when attempts are made to include diverse voices. For example, in another conference series (with which the first author has great familiarity), the Society for the Advancement of Biology Education Research (SABER), the organizers were so focused on including women and inclusive LGBTQ identities in leadership, that ethnic and racial identities were missed. This conference society was initiated primarily to address a gender gap. With more women in leadership and participation, this was a great boon in addressing gender disparities compared to many other societies (M. P. Wenderoth, personal communication, 10 July 2022). However, even while the leadership at its 2010 inception of this new scientific society strived to incorporate diversity from a range of career stages, editors, and a wide US geographic range for input, some inclusion was missed. The group of 29 initially invited scientists comprised over 70% women (Offerdahl et al., 2011), looking good on the surface. This initiative may have countered the lack of representation of women found in other scientific societies; however, it also raised awareness that all members of these early conversations of the organizational meetings were white-presenting (with no individual ethnic or racial identities). This recognition of the lower ethnic and racial diversity in the

growing membership of this new conference society, along with dramatic 2020 societal events, further propelled demands for broader inclusion and justice for other marginalized groups, leading to a response by taking an anti-racist approach to greater inclusion (Segurra-Totten et al., 2021). Thus, while here we are raising issues focusing on women, and even raising up the need to be more inclusive to all genders, this example highlights similar challenges that other STEM fields face. Even when focusing on one aspect of inclusion but overlooking another, this gap in cultural humility awareness no longer provides an excuse if we are mindful at the onset of these traps in not addressing broad inclusion.

It is important to consider gender-presenting proportions with the available data, despite still lagging even as identity-based data collection increases. Analyses based on limited gender data available is a starting point, but we need to emphasize the importance in taking the next steps in data for promoting broader inclusion of underrepresented groups. In addition, AGU has extended gender identities and other demographics in membership data<sup>1</sup>. Lessons learned for participation of women can be more broadly applied toward inclusion of non-binary gender identities and racial and ethnic underrepresented groups and provide universal collective access that benefit those who identify with disability but access available to all even if identities are not disclosed. The bigger picture considers all racial, ethnic, and cultural representations on a global scale and takes anti-racist approaches (Ali et al., 2021).

This perspective highlighted key points where intervention strategies could help meet several goals and conferences overall develop more inclusive measures at the level of interpersonal interactions. It may be that what one remembers from a conference is the science, but more so, it includes the interpersonal interactions experienced combined with the feeling and knowing that they belong. However, without an inclusive system promoting the equitable sharing of diverse viewpoints, many creative ideas and perspectives are lost to the broader community. We need broader participation, and we propose that by enhancing interpersonal relationships, increased inclusion and diversity will follow in attempts for equity.

1 American Geophysical Union. (2022). AGU's Diversity, Equity and Inclusion Dashboard. Retrieved from [https://www.agu.org/-/media/Files/Learn-About-AGU/AGU\\_DEI\\_Dashboard\\_2021\\_baseline\\_demographic\\_snapshot.pdf](https://www.agu.org/-/media/Files/Learn-About-AGU/AGU_DEI_Dashboard_2021_baseline_demographic_snapshot.pdf)

2 Retrieved from <https://www.nsf.gov/od/oecr/diversity.jsp>

3 Retrieved from <https://www.agu.org/Learn-About-AGU/About-AGU/Diversity-and-Inclusion>

4 American Geophysical Union. (2018). AGU Diversity and Inclusion Strategic Plan. Retrieved from <https://www.agu.org/-/media/Files/Learn-About-AGU/AGU-Diversity-and-Inclusion-Strategic-Plan-2019.pdf>

5 Retrieved from [https://www.agu.org/-/media/Files/AGU\\_Membership\\_Demographics\\_2018.pdf](https://www.agu.org/-/media/Files/AGU_Membership_Demographics_2018.pdf).

6 American Geophysical Union. (2019). AGU Honors Diversity Report. Retrieved from <https://www.agu.org/-/media/Files/Learn-About-AGU/2014-2019-Honors-Program-Diversity-Report.pdf>

## Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

## Author contributions

BS-K and AK documented anecdotal observations. BS-K was the primary author and led the conceptual application of theory for the manuscript. Both co-authors contributed to editing and refining the document. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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