



Exploratory Assessment of Advocates & Allies Workshops at a Midwestern STEM-Focused Institution

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Abstract: Advocates and Allies (A&A) programs, designed to educate individuals from demographic majority groups to become more centrally involved in equality endeavors, have been introduced to more than twenty U.S higher education institutions with the support of NSF ADVANCE grant funding. Most evaluations of the impact of these programs have been through indirect measures, such as self-reports of satisfaction with the training. We analyzed data across five years and several iterations of A&A workshops at a research-active, public Midwestern, predominantly White, STEM-dominant university to determine changes in participants' perceptions of equity at the institution. Results suggest that participants left the workshops with more perceptions of local inequity at the institution than they reported before the workshop. Effects were found for both perceptions of racial equity and perceptions of gender equity but were stronger and more consistent for the latter. The effects of the workshops varied across time. Implications of the results for scholarship and practice for the improvement of advocacy programs are discussed.

2 Exploratory Assessment of Advocates and Allies Programs

Advocates and Allies (A&A) programs were conceived to facilitate education and support for actions that promote equality in academia (Anicha et al., 2020) since there are many indications that discrimination in academia still exists, particularly in STEM, meaning Science, Technology, Engineering, and Math fields (Casad et al., 2022). Discrimination and inequity in STEM higher education includes the pervasiveness of stereotypes, unwelcoming environments, exclusionary behaviors, salaries, and differences in career promotion/advancements on the basis of gender, race, nationality, ability, and other factors. A&A programs were originally framed around gender equity but have been expanded to include racial/ethnic and other forms of equity (Minerick et al., 2024). In the context of these programs, *allies* refer to faculty members from the majority demographic group¹ who have undergone training on equity and have committed to learning more, and *advocates* are faculty members who actively support equity at the institution (Bilen-Green et al., 2015). Both allies and advocates are drawn from members of the majority demographic group, meaning the group that has been historically and systematically advantaged and holds power and influence, such as over norms, that other groups are expected to follow. A&A programs include various levels of participation to accommodate varying commitment levels.

Primary objectives of A&A programs are to increase awareness of unconscious bias and gender/other disparity among faculty, encourage men² to be centrally involved in gender equality endeavors, foster opportunities for constructive dialogue and problem-solving, as well as educate and support individuals from the majority or dominating demographic to become effective allies (Anicha et al., 2015). A&A programs involve educating cis-male faculty members on the subject of gender (and other) inequalities, introducing strategies conducive to positive transformation,

¹ An identity group that has historically held a numerical majority and, by default, holds greater power and influence in defining normal practices and policies.

² Use of gender-inclusive language differs between institutions; originally, the program focused on the impact of training men faculty specifically to be supportive of women faculty's equity (Bilen-Green et al., 2015).

and establishing a supportive and engaged network of men advocates and allies for the benefit of all faculty members (Anicha et al., 2015; Anicha et al., 2018).

The reasons for the development of A&A programs are two-fold. First, individuals from majority groups are often unable to see how the status quo maintains historic privilege and sustains inequities (Drury & Kaiser, 2014). As a result, they are unlikely to take actions that challenge the system (Radke et al., 2020; Teixeira et al., 2020). Second, when individuals from marginalized groups advocate for themselves, it is discounted, and they often face backlash; however, advocacy by individuals from majority groups on behalf of the marginalized is both perceived as more credible and more often rewarded (Hekman et al., 2017).

Thus, A&A programs aim to increase awareness among faculty from majority groups of both inequities in higher education and the role they play in maintaining the inequities. Additionally, they seek to motivate these individuals to take action that will benefit marginalized individuals leading to improved success for everyone. In the learning process of A&A programs, allies typically hear about the experiences of marginalized groups which gives them an opportunity to interrogate their beliefs (Broido, 1997). This can be accomplished through face-to-face interactions (Tropp & Barlow, 2018) or through learning initiatives, such as diversity literacy training (Goltz & Sotirin, 2014; Lehman et al., 2023) and A&A workshops (Anicha et al., 2020). Following increased awareness, advocates and allies are better able to provide three types of support to marginalized individuals, namely voice (e.g., pointing out structures leading to inequities), action (e.g. changing those structures), and emotional support (Cheng et al., 2019).

A&A workshops differ from diversity literacy training, also commonly used in higher education settings, in two ways: 1) there is a depth of education on university-specific data and 2) the focus is on actions and advocacy as a skill in that participants start practicing advocacy tools during the workshops. This contrasts with diversity training sessions offered in the workplace (e.g., Bezrukova et al., 2016) which are more limited in their scope in that they present minimal institutional data in a one-way fashion and do not have an advocacy focus. Therefore, it is thought that the

4 Exploratory Assessment of Advocates and Allies Programs

emphasis of A&A programming on taking action as an advocate has the potential to lead to more robust, lasting effects on the campus community (Bezrukova et al., 2016).

Previous studies have primarily focused on how A&A as a program functions within the academic institution, with scholars frequently discussing the reasons behind program elements rather than the direct impact on the participants themselves (e.g., Anicha et al., 2015). Also, measures of A&A program effectiveness tend to be indirect, such as self-reported interest in the material (e.g., Anicha et al., 2020), participant satisfaction with the program (e.g., Bilen-Green et al., 2015), and whether participants believe they now have tools for effective allyship (see Anicha et al., 2020; NDSU ADVANCE Program, 2016). Furthermore, several of the university A&A programs profiled by Bilen-Green and colleagues (2015) did not report measures directly from participants.

In contrast to these past studies, our exploratory research—conducted at a predominantly White, predominantly male, STEM-dominant doctoral institution—shifts the focus from participant beliefs about training effectiveness to whether the workshop content affects participant perceptions of equity—a stated goal of A&A programming. Given the paucity of the previous A&A literature with regard to this dependent variable, we posed three research questions rather than specific hypotheses. The first research question we examined was: *What is the effect of the A&A workshops on participants' perceptions about equity at the institutional level?* To answer this, we measured the impact of A&A workshops on participants' perceptions of equity. (More than 50% of participants identified as faculty and ~23% as non-faculty with roughly 50/50 women and men.)

The second research question we investigated was: *Are the effects similar across perceptions of gender and race/ethnicity?* Unlike previous A&A workshops at other institutions, several of the workshops that we studied presented racial data in addition to gender data, allowing us to examine the impact of the workshops on perceptions of racial inequities. This is a unique feature of our workshop that is consistent with NSF ADVANCE's increased emphasis on equity in STEM in terms of

race and ethnicity in addition to gender (National Science Foundation [NSF], 2020). This extension of allyship builds from historical foundations; individuals from majority groups becoming allies to marginalized individuals and groups originated in the 1990s with individuals with privileged identities called upon to be allies for people of color and the LGBTQ+ community (Bourassa, 1991; Washington & Evans, 1991).

Our third research question was: *How might effects change over time considering the organic evolution of workshop content/emphasis?* Our A&A adaptation included regular workshops that discussed how discrimination manifests in universities using national data presented in parallel with institutional data to illustrate that similar issues occur at our university. Once an initial team of advocates was trained (by members of the university that originated the program), the advocates conducted the workshops on campus themselves. The faculty advocates took responsibility to continuously learn via a Journal Club shared with an A&A Advisory Board (A3B) and to improve workshop content with each offering (Minerick et al., 2024). The workshops formed part of the advocate's responsibilities; they also worked on campus in other ways to increase equity by advocating for changing the culture and structure. This continuous improvement approach embedded in the A&A structure provided a unique opportunity to study a program with a commitment to being dynamic and evolving.

Further, the presenters of the workshops, the content of the workshops, and the demographics of participants changed over time, with later workshops being attended by more new employees. These were organic changes incurred as the workshop evolved, which is to be expected in any series of A&A workshops but are worth examining to determine their impact on program effectiveness. For example, changes in participants' perceptions as a result of the workshop could affect how well they might serve as allies and advocates in the future. Therefore, this project combines data collected over six workshops, conducted from 2019 to 2023, to examine the effects of A&A workshops at an institution over time.

In summary, the contributions of this exploratory study to the literature are threefold: 1) Changes participants' perceptions of equity were examined beyond

measuring materials generated or participant satisfaction; 2) Effects of the workshop on perceptions of both gender and racial inequities were examined; 3) Data were collected across several workshops, providing for a repeated cross-sectional examination of effects.

Method

Institutional Context

Our university, where we conducted this study, is a STEM-dominant doctoral institution that is internationally recognized for both its research productivity and education. We are classified as a research active (R2 transitioned to R1), predominantly White institution (PWI), and predominantly male institution (PMI) that must continually address the challenges of underrepresentation at both the student and faculty levels. For example, 2001 institutional data indicated that women faculty comprised 16% of STEM faculty, which rose to 30% in 2024. Women students were 25% in 2001, with their percentage rising to 30% in 2024. Institutional data in 2001 indicated that racially/ethnically underrepresented faculty (African American, American Indian/Alaskan Native, Hispanic, and Multiracial) made up 2.7% of STEM faculty members, rising to 4.2% in 2024³. The student population rose from 6.9% racially/ethnically underrepresented students in 2014 to 9.6% in 2024.

The A&A program was introduced to our campus as the result of an NSF ADVANCE Adaptation grant which was awarded in Fall 2018 and further supported by an NSF ADVANCE Partnership grant awarded in 2019. The A&A program was designed prior to the national and global impacts of the COVID-19 pandemic, i.e. social distancing and remote learning that shifted definitions of essential services and work life balance. In the inaugural workshop offered in Fall 2019, there was an overwhelming response. More than 100 total participants were in attendance, the largest population of participants in any one workshop to date at our institution. This workshop was facilitated by faculty from the A&A founding institution, North Dakota

³ Categories selected to be consistent with NSF and federal reporting.

State University in partnership with the ADVANCE PIs, some of whom are co-authors on this manuscript. A follow up workshop and the second phase of the Advocates team training was planned for early April 2020, which was cancelled due to the onset of the global pandemic. (This will be key to understanding the organic evolution of the A&A program.)

Participants and Survey Administration

A total of 248 primarily faculty registrants/attendees were recorded from 2019-2023 across six workshops, coming from five colleges and several non-degree units at the university. For context, our institution had 297 tenure-track faculty and 101 instructional and research track faculty in 2023-2024. Prior to each workshop, participants completed a pre-workshop survey; following each workshop, participants completed a post-workshop survey. 194 participants completed one of the surveys and 124 completed both the pre- and post-surveys. There were relatively few repeat attendees. Of the 124 participants who provided demographic information, there were 47 women and 44 men, as well as 63 participants in faculty positions and 28 in non-faculty positions. Non-faculty participants included academic administrators such as department chairs and deans and professional staff. While the participants who completed both pre- and post-surveys indicated their genders as either women or men, the demographic options included a third option for attendees to self-describe a different gender identity (33 individuals chose this option). Given the low numbers of racial and ethnic minoritized individuals at the institution (~4%), our IRB did not allow for the collection and reporting of data on race and ethnicity.

The survey distribution techniques differed across the workshops because of efforts to increase survey completion rates. In 2019, participants were given iPads to complete the pre-survey at the workshop and then were emailed a link to complete the post-survey, yielding a pre-survey and post-survey response rate of 11.88%. From 2021 to 2022, participants were provided paper questionnaires and time during the session to complete both surveys, increasing the response rates to 75%-100% of attendees. In 2023, a QR code with a link to the survey was utilized along with

8 Exploratory Assessment of Advocates and Allies Programs

multiple email reminders leading up to and following the workshops, resulting in a response rate ranging from 19.35%-46.67%.

Because attendees at five of the workshops were fewer than 40, we aggregated the responses for all six workshops, with a total response rate of 42.7%, in order to perform the statistical analyses presented here. This group of 124 who participated in the surveys is the data included in this article; these respondents may not be representative of the entire population of attendees.

Materials and Procedure

Participants in the A&A program attended a 1.5-hour workshop created and presented by the advocates team and A3B members. Attendees who belonged to majority groups attended the workshop presented by the advocates team in one room; attendees who belonged to marginalized groups attended the Advocate and Allies' Advisory Board (A3B) presentation in a nearby room. The two workshops contained the same content and occurred simultaneously. Workshop slides were created in consultation with the university's ADVANCE PI team and the A3B. These presentations were updated prior to each workshop and highlighted national data on faculty equity in STEM alongside institutional data. (For example, salary discrepancies controlling for longevity/rank, research space allocation, time in rank, student credit hours taught, etc.) Workshops were typically presented twice a year, once in the fall semester and once in the spring semester. In Fall 2019, Fall 2021, Spring 2022, and Fall 2022, the workshop content was introductory, meaning that the presenters assumed that this was the first time attendees would be exposed to equity literature and discussion of equity data. However, starting in Fall 2022, by participant request, workshops provided introductory content in the fall and deep-dive content in the spring. Workshops followed this format thereafter. In contrast to the introductory workshops, deep-dive workshop goals focused less on educating participants on inequities and more on nuances of how inequities present in professional situations (e.g. faculty meetings) and practicing the questioning prejudice responses (CPR)

approach using question/interrupt, arouse dissonance, express emotions/harm, or disagree advocacy tools (Ashburn-Nardo, 2008).

The pre- and post-workshop surveys were developed to assess attendees' perceptions in three areas: 1) Perceptions of general campus climate for faculty; 2) Perceptions of gender equity for faculty on campus; and 3) Perceptions of racial/ethnic equity for faculty on campus. Refer to Appendix A: Table 1 for the questions used to assess 1-3. The pre- and post-surveys were made up of the same 15 Likert-scale items, shown in SI Table 1, with the exception of the first workshop, which excluded some post-survey questions in error. Three items were related to campus climate. Six were related to gender equity, encompassing perceived support for gender equity and perceived inequity in campus processes. The final six were related to racial/ethnic equity and support, encompassing perceived support for racial equity and perceived inequity in campus processes. Additionally, there were nine open-ended questions on the post-survey; these were used to understand participants' contextual knowledge and to improve future workshops.

The pre-survey was completed immediately before the 1.5-hour workshop, and the post-survey was distributed to participants immediately afterward. Responses for all items were given on a Likert scale from 1 (completely dissatisfied) to 7 (completely satisfied). There were also several demographic questions given concurrently in a separate questionnaire. To maintain anonymity from the demographic questions while still matching pre-and post-surveys, participants identified themselves with a constant identifier code (Burnett et al., 2021).

Scale Validation

To validate the survey tool, we conducted an exploratory factor analysis (EFA) on the pre-test and post-test data. The results supported the five themes that the measure was created to assess: Climate, Gender Support, Gender Inequity, Racial Support, and Racial Inequity. Factor loadings for each survey question were above 0.5, which indicates strong relationships between the questions and their corresponding themes (See Supplemental Information for more details).

Analyses

We collected pre- and post-surveys for all six workshops given between 2019 and 2023; due to the smaller survey participation number per individual workshop ($n < 30$), we pooled the data to examine overall effects on themes. We also separately examined effects over time. Consistent with results from the factor analysis, individual questions were grouped into five themes: Perception of Climate (3 items, $\alpha = 0.74$); Perception of Gender Support in policies (3 items, $\alpha = 0.69$); Perception of Gender Equity on Campus (3 items, $\alpha = 0.78$); Perception of Racial Support in policies (3 items, $\alpha = 0.69$); and Perception of Racial Equity on Campus (3 items, $\alpha = 0.88$). Cronbach's alpha, α , values are all at or above 0.7 indicating internal consistency or reliability within the survey themes.

We retained all participants in our analysis who answered more than 75% of the total questions, and to handle missing data within these surveys, we collapsed participants' responses for each group of perception questions (Campus Climate, Gender Support & Equity, and Racial Support & Equity) by taking the mean. (Note: Some questions in the Gender and Racial categories were reverse-scored. All items were adjusted such that a lower score indicates a less favorable perception of the theme, with a higher score indicating a more favorable perception.) To assess the workshop's impact on participants' perceptions, we used a combination of Linear Mixed Models (LMM) and ANOVA of the LMM, Cohen's d , Violin Plots, and Dumbbell Plots, which have the ability to handle the survey data complexity and variability. Incorporating various forms of data and storytelling techniques ensures a comprehensive understanding (Matei & Hunter, 2021), therefore, we also incorporated data visualization tools to help us clearly identify patterns and trends.

Linear Mixed Models (LMM)

Linear mixed models (LMM) are an alternative to repeated-measures ANOVA analyses, particularly in complex survey data (Magezi, 2015). There are several key advantages of an LMM approach. First, LMM allowed us to specify random effects, such as differences between participants and semesters, alongside fixed effects,

which represent the primary variables of interest, such as the pre- and post-workshop scores (Baayen et al., 2008). Second, LMM is more robust in handling missing data compared to repeated-measures ANOVA. We ran linear mixed model analysis in R (version 4.2.3) using the lme4 package (Bates et al., 2014). The dependent variable was participants' perception scores across different themes (Climate, Gender Support, Gender Inequity, Racial Support, and Racial Inequity). We included fixed effects for the pre- and post-workshop scores, as well as random effects for participants and semesters. This allowed us to account for within-subject correlations and variability across different time points and groups. Significance was calculated using the lmerTest package (Kuznetsova et al., 2017), which applies Satterthwaite's method to estimate degrees of freedom and generate *p*-values for mixed models.

Perception Score~Test+(1|Participant)+(1|Session)+(1|Gender)+(1|Faculty) Eqn (1)

We then performed a one-way ANOVA on the LMM model to determine the overall statistical significance of the fixed effects using the sjstats and effectsize packages in R.

Data Visualization

According to Matei and Hunter (2021), storytelling with data is effective because it counters audience expectations, prompting them to re-evaluate their assumptions. Effective data storytelling helps highlight key insights, enhancing comprehension. Thus, by presenting unexpected shifts in perceptions through our plots, we were able to answer the research questions using a narrative that not only highlights the workshops' impact but also fosters deeper understanding and reflection on equity issues. Split violin plots and dumbbell plots were chosen for their ability to visually represent the distribution and changes in participants' scores. Violin plots highlight the distribution of scores and the variability in responses. Split violin plots were created using the ggplot2 package (Wickham, 2011) and integrated a custom function modified from Allen and colleagues' (2019). Dumbbell plots were generated using the ggplot2 and customized to illustrate the changes in scores between pre-

and post-workshop. These plots depict the direction and magnitude of changes, making it easy to compare results across different semesters.

All analyses were conducted using IBM SPSS Statistics (Version 26; IBM Corp, 2019), and all pre-processed visualizations, Linear Mixed Models, ANOVA, and Cohen's *d* effect calculations were created using R, with the following packages: lme4, lmerTest, effectsize, ggplot2, plyr, dplyr, devtools, and introdataviz. All coding data are archived [here](#) (Colbert, 2024).

Results

Overall, results of the repeated measures ANOVA and LMM analyses suggested that in all six workshops, for all theme groups, there was a significant decrease in participants' perception responses to the surveys from pre- to post-workshop. This trend was consistent across the themes of Climate, Gender Support, Gender Inequity, Racial Support, and Racial Inequity. Participants took both surveys either immediately or within 48-72 hours of the workshop, such that changes can be attributed to the information presented.

Perceptions of Campus Climate

After attending the workshop, participants had less favorable perceptions of the campus climate (inclusiveness, consistency, quality) than they did going into the workshop. As shown in Table 1, the ANOVA revealed a significant main effect of the pre- and post-workshop variable on participants' perceptions of climate ($F(1,77.75)=36.03$, $p<0.001$, $\eta^2=0.32$), indicating approximately 32% of the variance can be attributed to the workshop intervention. The LMM fixed effects model confirmed this finding (Estimate=-0.48, SE=0.08, $t(77.75)=-6.003$, $p<0.001$).

Whereas significant variability was found among participants using the LMM random effects analysis (Variance=0.79, $SD=0.89$), there was small variability between sessions (Variance=0.10, $SD=0.31$) and no significant variability observed due to gender (Variance=0.00, $SD=0.00$) or faculty status (Variance=0.00, $SD=0.00$). (See Table 1 for the fixed and random effects from the LMM.)

The dumbbell and violin plots illustrate the shift in perceptions due to the workshop and the response distributions for participants. The pre-survey response distribution is relatively symmetrical with some skewness towards higher scores (Median=4.33, Mean=4.42). The post-survey distribution shows a broader spread, with most responses clustering around the middle but shifted slightly towards less favorable (Median=3.84, Mean=3.88).

There were some session-specific anomalies, as revealed by the dumbbell plot for the Climate theme, including for Fall 2023, where the average change in pre- and post-workshop scores was significantly less (-.08) than the changes observed in other sessions (-.027 or more). This anomaly highlights the importance of these visual tools in uncovering trends that may not be evident from statistical models alone.

Collectively, the analyses of the Climate questions helped answer our first research question, which asked whether the A&A led workshop changed participant perceptions of climate. Results indicated that workshops modified individual perceptions to be less favorable regarding campus climate, which more accurately reflected institutional data.

Table 1.

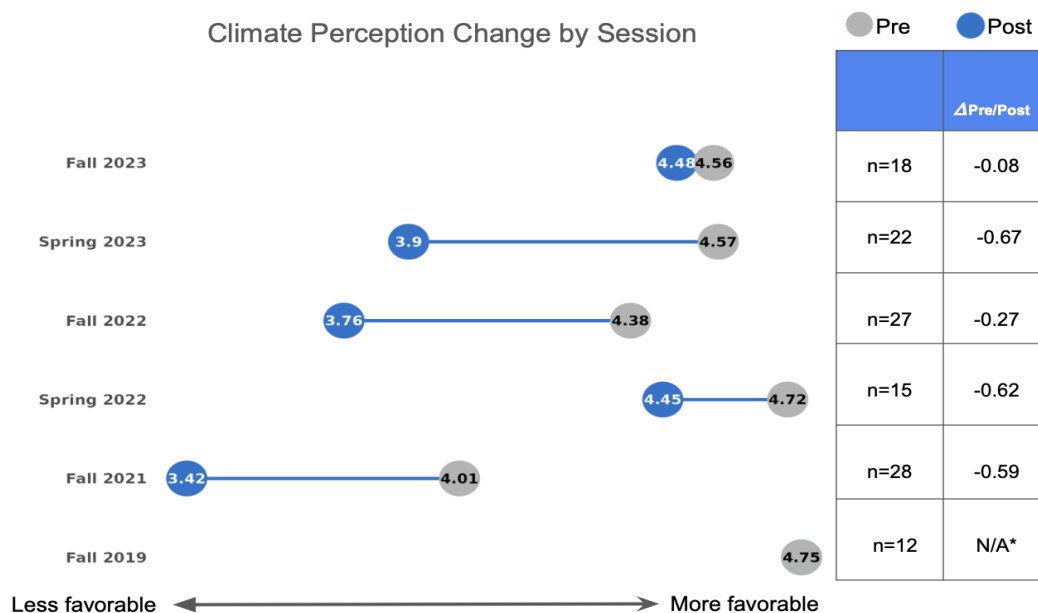
ANOVA results of the linear mixed effects model for participants' perceptions of campus climate pre- to post- workshop.

Fixed Effects	Estimate	Std. Error	df	t-value	Pr(> t)		
Intercept	4.50	0.16	6.01	27.55	<0.001		
Variable (Climate)	-0.48	0.08	77.75	-6.00	<0.001		
Random Effects		Variance			Std. Dev.		
Participant		0.79			0.89		
Session		0.09			0.31		
Faculty		0.00			0.00		
Gender		0.00			0.00		
Residual		0.249			0.49		
ANOVA Results	Sum sq.	Mean sq.	Num df /Den df	F-Value	Pr(>F)	η^2 (partial)	95% CI
Variable (Climate)	8.98	8.98	(1,77.75)	36.04	<0.001	0.32	[0.18,1.00]

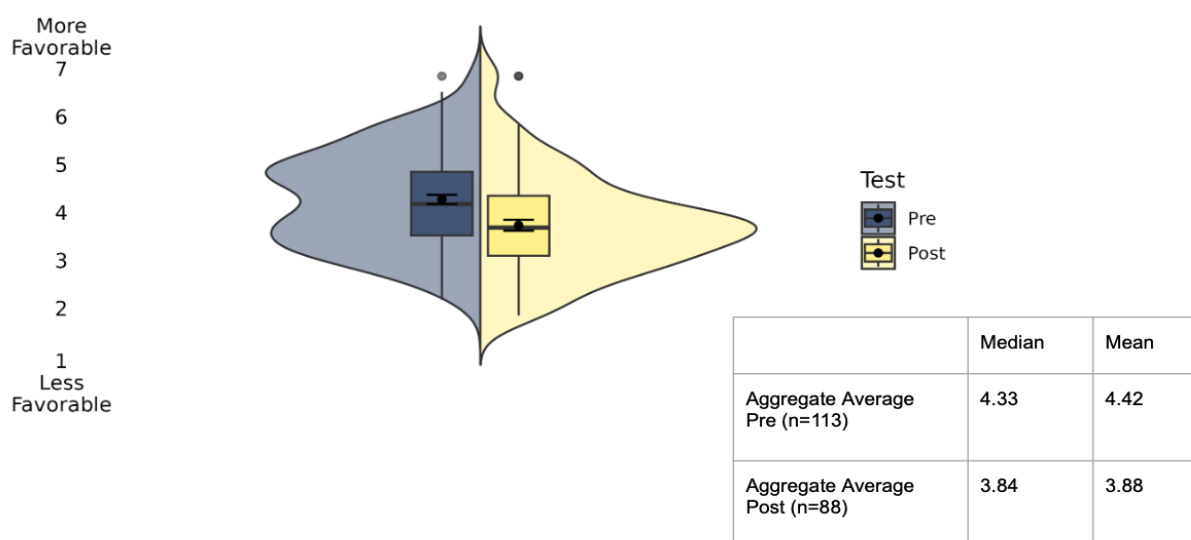
Note. In all tables, variable names are defined as follows: "Participant" refers to individual respondents. "Session" refers to a particular A&A session (e.g., Fall 2022). "Faculty" refers to respondents' status as a faculty member or non-faculty member of the university. "Gender" refers to respondents' self-reported gender as men or women.

Figure 1.

Dumbbell plot of participants' perceptions of campus climate, depicting less favorable post-workshop perceptions in all sessions except Fall 2023.

**Figure 2.**

Violin plot depicting participants' pre- and post-survey response distributions regarding their perceptions of campus climate



Perceptions of Gender Support and Equity

The survey items regarding gender (SI Table 1) can be divided into two subcategories: 1) perceptions of support for gender equity on campus, which refers to participants' opinions on the support shown by men on campus as allies and advocates for gender equity, and 2) perceptions of gender inequity in academic processes on campus, which refers to participants' opinions on the way gendered inequalities such as pay or tenure/promotion differences exist on campus.

Support for gender equity

After attending the workshop, participants perceived men colleagues' support for gender equity less favorably than they did previously. As shown in Table 2, the ANOVA analysis of the Gender Support theme revealed a significant main effect of the pre- and post-workshop variable on participants' perceptions ($F(1,78.84)=25.66$, $p<0.001$, $\eta^2=0.25$), indicating that approximately 25% of the variance in perception scores can be attributed to the workshop intervention. The fixed effects model confirmed this finding (Estimate=-0.46, $SE=0.09$, $t(78.841)=-5.07$, $p<0.001$).

The random effects analysis showed significant variability among participants (Variance=0.79, $SD=0.89$). However, there was small variability between sessions (Variance=0.02, $SD=0.12$) and no significant variability observed in gender (Variance=0.00, $SD=0.00$) or faculty status (Variance=0.00, $SD=0.00$).

The dumbbell and violin plots illustrate the shift in perceptions and response distributions for participants for the Gender Support theme. The large effect size during Spring 2022 (Cohen's $d=1.08$) is clearly visible in the dumbbell plots, for example. The violin plots show the increased variability in post-workshop scores, suggesting diverse reactions to the workshop.

Table 2.

ANOVA results of the linear mixed effects model for participants' perceptions of support for gender equity

Fixed Effects	Estimate	Std. Error	df	t-value	Pr(> t)		
Intercept	4.19	0.12	7.22	35.66	<0.001		
Variable (Gender Support)	-0.46	0.09	78.84	-5.07	<0.001		
Random Effects		Variance		Std. Dev.			
Participant		0.79		0.89			
Session		0.02		0.12			
Faculty		0.00		0.00			
Gender		0.00		0.00			
Residual		0.33		0.57			
ANOVA Results	Sum sq.	Mean sq.	Num df /Den df	F- Value	Pr(>F)	η² (partial)	95% CI
Variable (Gender Support)	8.44	8.44	(1,78.84)	25.66	<0.001	0.25	[0.12,1.00]

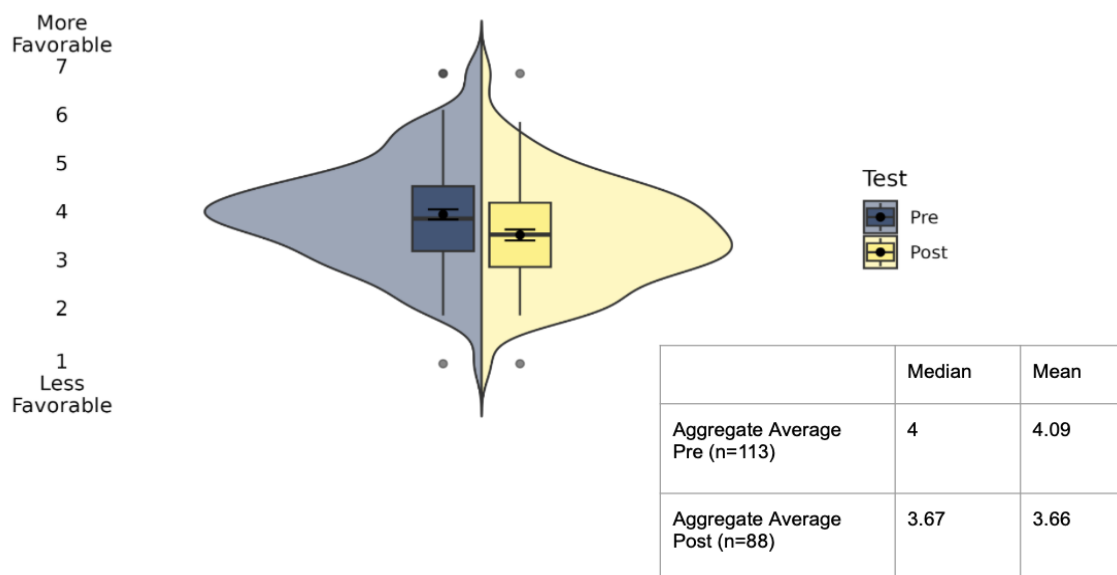
Figure 3.

Dumbbell plot of participants' perceptions of colleagues' support for gender equity, depicting less favorable post-survey perceptions in all sessions



Figure 4.

Violin plot depicting participants' pre- and post-survey response distributions regarding their perceptions of colleagues' support for gender equity



Gender inequity in processes

The questions about Gender Inequity in processes asked about campus dynamics, pay, and promotion and tenure (SI Table 1). Notably, there was a trend from 2019-2023 towards less favorable pre-workshop perceptions, which also held for the post-workshop results; pre and post workshop differences in perception of gender inequity were smaller in 2023 than in any prior years.

Means revealed post-workshop scores decreased significantly from pre-workshop scores: 3.87 to 2.87 in Spring 2022 and 3.56 to 2.72 in Fall 2022, with Cohen's d values of 1.022 (large) and 0.723 (medium), respectively. This indicates that participants developed a view of gender inequity at the institution that was more consistent with compiled institutional data.

As shown in Table 3, the LMM and ANOVA analysis of the Gender Inequity theme revealed significant main effect of the variable (pre- vs. post-workshop scores) on participants' perceptions (Estimate=-0.79, $SE=0.13$, $t(86.96)=-6.10$, $p<0.001$), indicating that post-workshop scores were significantly lower than pre-workshop scores. Perceptions of gender-based equity in pay, promotions, and similar processes were less favorable following the workshop than they were before. The ANOVA results supported this finding with a significant main effect ($F(1,86.96)=37.2$, $p<0.001$, $\eta^2=0.30$), suggesting that approximately 30% of the variance in perception scores can be attributed to the workshop intervention. The random effects analysis indicated substantial variability among participants ($\sigma^2=0.718$), minimal variability between sessions ($\sigma^2=0.000$), and some variability in gender ($\sigma^2=0.014$).

Visual data storytelling tools further illustrated these shifts: the dumbbell plot (Figure 5) highlighted that participants' perceptions in Spring 2022 had the largest decrease (-1.00) to less favorable perceptions of gender inequities compared to other sessions. Further, the violin plot (Figure 6) depicted a broader and more skewed distribution of post-workshop scores, signifying increased variability of perceptions of university processes with regards to gender inequity issues.

Table 3.

ANOVA results of the linear mixed effects model for participants' perceptions of gender inequity in processes

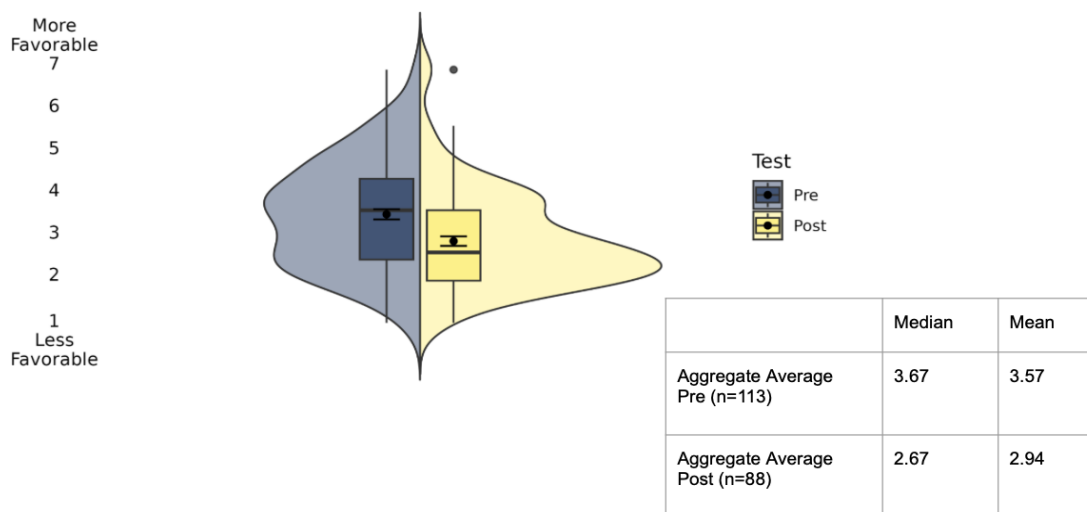
Fixed Effects	Estimate	Std. Error	df	t-value	Pr(> t)		
Intercept	3.7419	0.1483	1.474	25.236	<0.001		
Variable (Gender Inequity)	-0.7879	0.1292	86.955	-6.099	<0.001		
Random Effects		Variance		Std. Dev.			
Participant		0.72		0.85			
Session		0.00		0.00			
Faculty		0.00		0.00			
Gender		0.01		0.12			
Residual		0.75		0.87			
ANOVA Results	Sum sq.	Mean sq.	Num df /Den df	F-Value	Pr(>F)	η² (partial)	95% CI
Variable (Gender Inequity)	27.97	27.97	(1,86.99)	37.20	<0.001	0.30	[0.17,1.00]

Figure 5.

Dumbbell plot of participants' perceptions of gender inequity in campus processes, depicting less favorable post-survey perceptions in all sessions

**Figure 6.**

Violin plot depicting participants' pre- and post-survey response distributions regarding their perceptions of gender inequity in campus processes



Thus, results indicate that the answer to our first research question about whether A&A workshops affect perceptions of equity is that workshops are effective in influencing participants' views on equity at the institutional level, modifying them to more accurately reflect institutional data.

Perceptions of Racial/Ethnic Support and Equity

The survey items regarding race and ethnicity (Appendix A, Table I) were written to parallel the wording of the two themes regarding gender. The first—perceptions of support for racial/ethnic equity—refers to participants' opinions about the level of support shown by men from majority groups on campus as allies and advocates in support of racial and ethnic equity. The second category—perceptions of racial/ethnic inequity in campus processes—refers to participants' perceptions regarding the existence of inequalities in campus dynamics, pay, or tenure/promotion differences based on race or ethnicity at the institution.

Support for racial/ethnic equity

Participants' perception of racial support became less favorable but more aligned with national data after the workshops as indicated by post-workshop scores which were significantly lower than pre-workshop scores. The particular session attended by the participant, their gender, and faculty status did not significantly impact outcomes. As depicted in Table 4, the fixed effects model indicated a significant main effect of the variable (pre- vs. post-workshop scores) on participants' perceptions (Estimate=-0.32, $SE=0.10$, $t(76.811)=-3.124$, $p<0.001$). The ANOVA results supported this significant main effect ($F(1,76.81)=9.76$, $p<0.001$, $\eta^2=0.11$), indicating a moderate effect size. The random effects model revealed variability among participants (Variance=0.75, $SD=0.87$), with a residual variance of 0.41; however, there was no variability due to session, gender, or faculty status (all variances=0.00).

Table 4.

Table of ANOVA results of the linear mixed effects model for participants' perceptions of support for racial/ethnic equity

Fixed Effects	Estimate	Std. Error	df	t-value	Pr(> t)		
Intercept	4.16	0.11	135.92	38.77	<0.001		
Variable (Racial Support)	-0.32	0.10	76.81	-3.12	<0.001		
Random Effects		Variance		Std. Dev.			
Participant		0.75		0.87			
Session		0.00		0.00			
Faculty		0.00		0.00			
Gender		0.00		0.00			
Residual		0.41		0.64			
ANOVA Results	Sum sq.	Mean sq.	Num df /Den df	F-Value	Pr(>F)	η² (partial)	95% CI
Variable (Racial Support)	3.98	3.98	(1,76.81)	9.76	0.002	0.11	[0.03,1.00]

Figure 7.

Dumbbell plot of participants' perceptions of colleagues' support for racial/ethnic equity, depicting less favorable post-survey perceptions in all sessions except Spring and Fall 2023

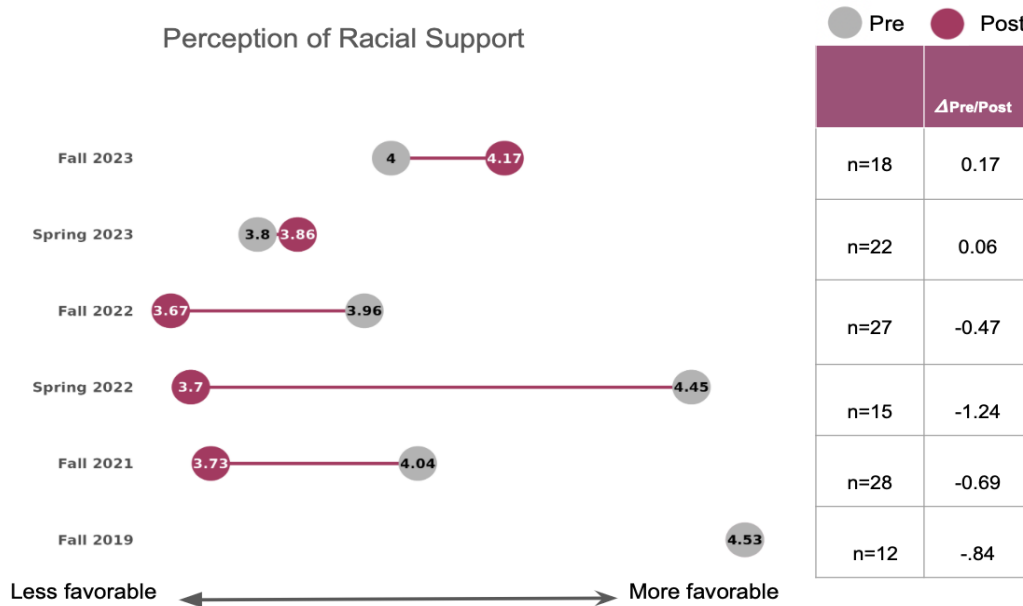
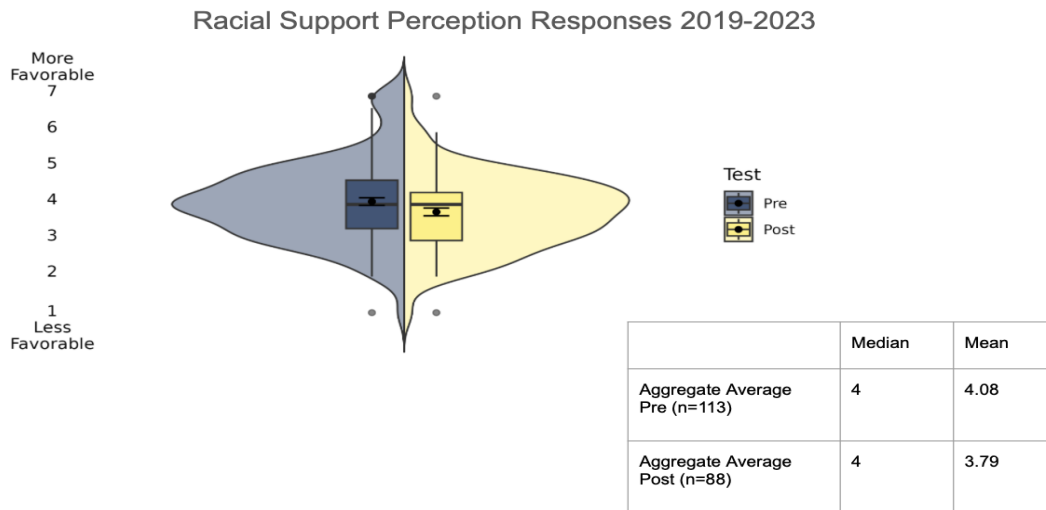


Figure 8.

Violin plot depicting participants' pre- and post-survey response distributions regarding their perceptions of racial/ethnic support on campus and from colleagues



The data visualizations help illustrate the shift in perceptions from pre- to post-workshop as well as anomalies in the effects. For example, the dumbbell plot in Figure 7 showed that in Fall 2023 there was an average positive change in perception of (specify), significantly different from the negative changes observed in other sessions. However, Figure 8, which aggregates the data, indicates pre- and post-distributions were similar overall, and also indicates that post-workshop responses skewed slightly towards less favorable perceptions of racial support.

Racial/ethnic inequity in processes

The Racial Inequity theme examined participants' perceptions of systemic racial inequities and biases on campus (see SI Table 1). Results indicated participants' perceptions regarding racial and ethnic equity in processes like pay and promotion were less favorable following the workshop. The Linear Mixed Models (LMM) analysis (Table 5) revealed a significant main effect (Estimate=-0.68, $SE=0.13$, $t(88.45)=-5.225$, $p<0.001$). The ANOVA results supported this significant main effect ($F(1, 88.45)=27.29$, $p<0.001$, $\eta^2=0.24$).

The random effects model showed variability among participants (Variance=1.08, $SD=1.04$) but no significant effects due to session, faculty status, and gender.

The data visualization methods illustrate these effects. The dumbbell plot in Figure 9 revealed that Spring 2023 had an average change of -0.06 in pre- and post-workshop scores, an anomaly compared to other sessions. The violin plot in Figure 10 indicates a broader distribution of post-survey responses skewing towards less favorable perceptions.

Recall that our first research question is whether A&A workshops serve to change perceptions of equity. Previously we reported that the study indicated it does change perceptions of gender equity. The analyses of the perceptions of racial support and equity also suggest that workshops are effective in influencing participants' views. However, our second research question was whether the workshop effects are similar across perceptions of gender and race/ethnicity.

Although both gender equity and racial equity themes showed significant decreases in post-workshop scores, effects were smaller for the racial equity themes.

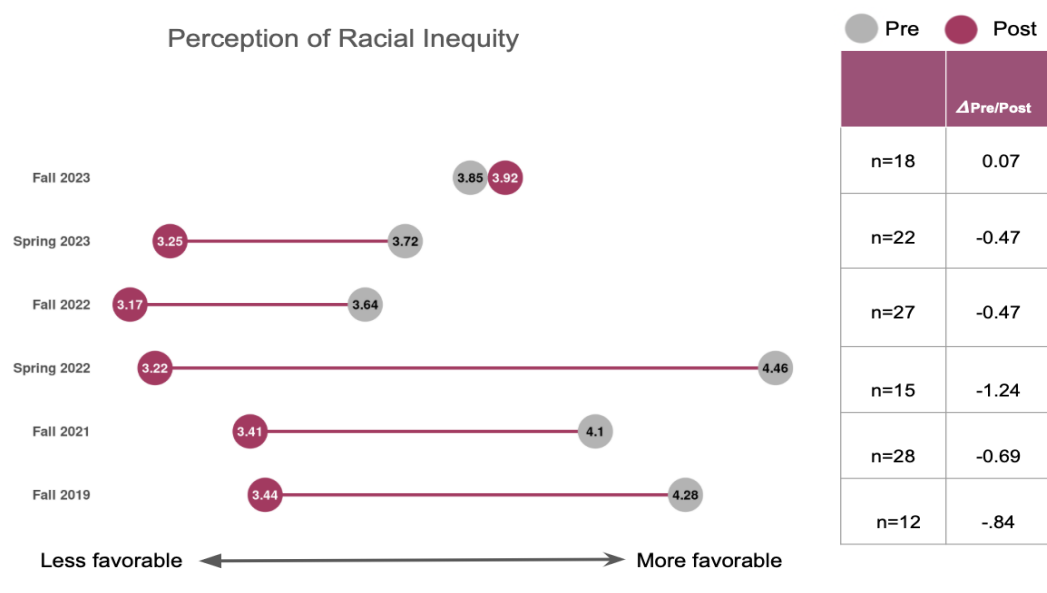
Table 5.

ANOVA results of the linear mixed effects model for participants' perceptions of racial/ethnic equity inequity in processes

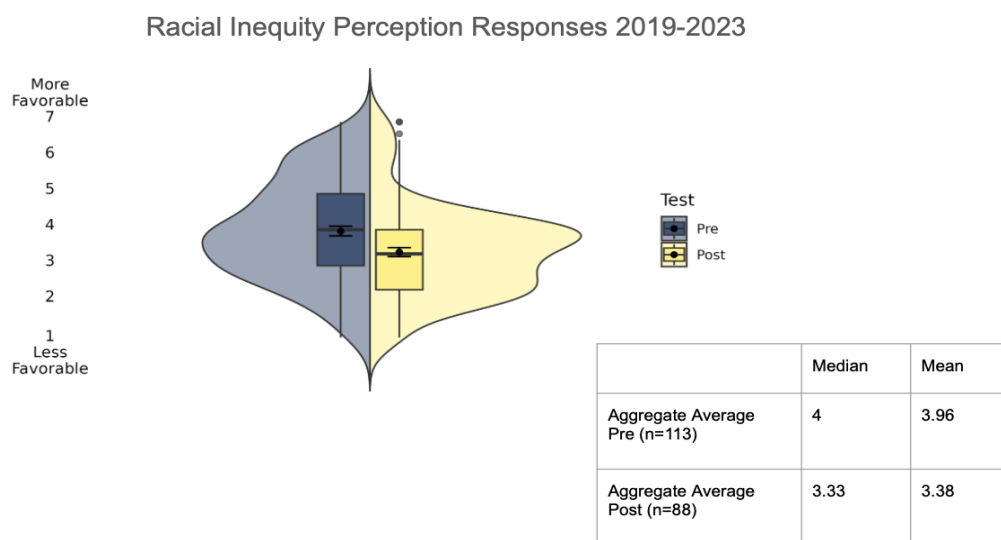
Fixed Effects	Estimate	Std. Error	df	t-value	Pr(> t)		
Intercept	4.06	0.14	151.47	29.76	<0.001		
Variable (Racial Inequity)	-0.68	0.13	88.45	-5.23	<0.001		
Random Effects		Variance		Std. Dev.			
Participant		1.08		1.04			
Session		0.00		0.00			
Faculty		0.00		0.00			
Gender		0.00		0.00			
Residual		0.76		0.87			
ANOVA Results	Sum sq.	Mean sq.	Num df /Den df	F-Value	Pr(>F)	η² (partial)	95% CI
Variable (Racial Inequity)	20.69	20.69	(1,88.45)	27.29	<0.001	0.24	[0.12,1.00]

Figure 9.

Dumbbell plot of participants' perceptions of racial/ethnic inequity in campus processes, depicting less favorable post-survey perceptions in all sessions except Fall 2023

**Figure 10.**

Violin plot depicting participants' pre- and post-survey response distributions regarding their perceptions of racial/ethnic inequity in campus processes



Effects Across Workshops

The third research question was how effects change over time within the natural evolution of a workshop. To answer this question, we were interested in the effect sizes as measured by eta squared (η^2) in the ANOVA analysis, which quantifies the proportion of the total variance in the perception scores attributable to pre- vs. post-workshop changes across all sessions. We used Cohen's d effect size (Eqn 2) to identify anomalies in specific sessions that provided insight into which workshops were more effective and potentially how the effect was evolving over time.

$$d = \frac{\text{Mean pre} - \text{Mean post}}{SD_{\text{pooled}}} \quad \text{Eqn (2)}$$

The Cohen's d effects are presented in the Figure 11 heatmap. Positive values indicate pre-means were greater than post-workshop means, a shift to less favorable perceptions, whereas negative values indicated a shift to more favorable perceptions. The findings from the different themes suggest that the workshops had a varied impact on participants' perceptions of equity. Although the general trend indicates a decrease in post-workshop perception scores, the magnitude of change varied across themes and sessions.

All workshops but one demonstrated moderate to large effect sizes on participants' perceptions of campus climate in general. The exception was Fall 2023, which showed a negligible effect size ($d=0.08$), indicating minimal change in perceptions compared to other sessions.

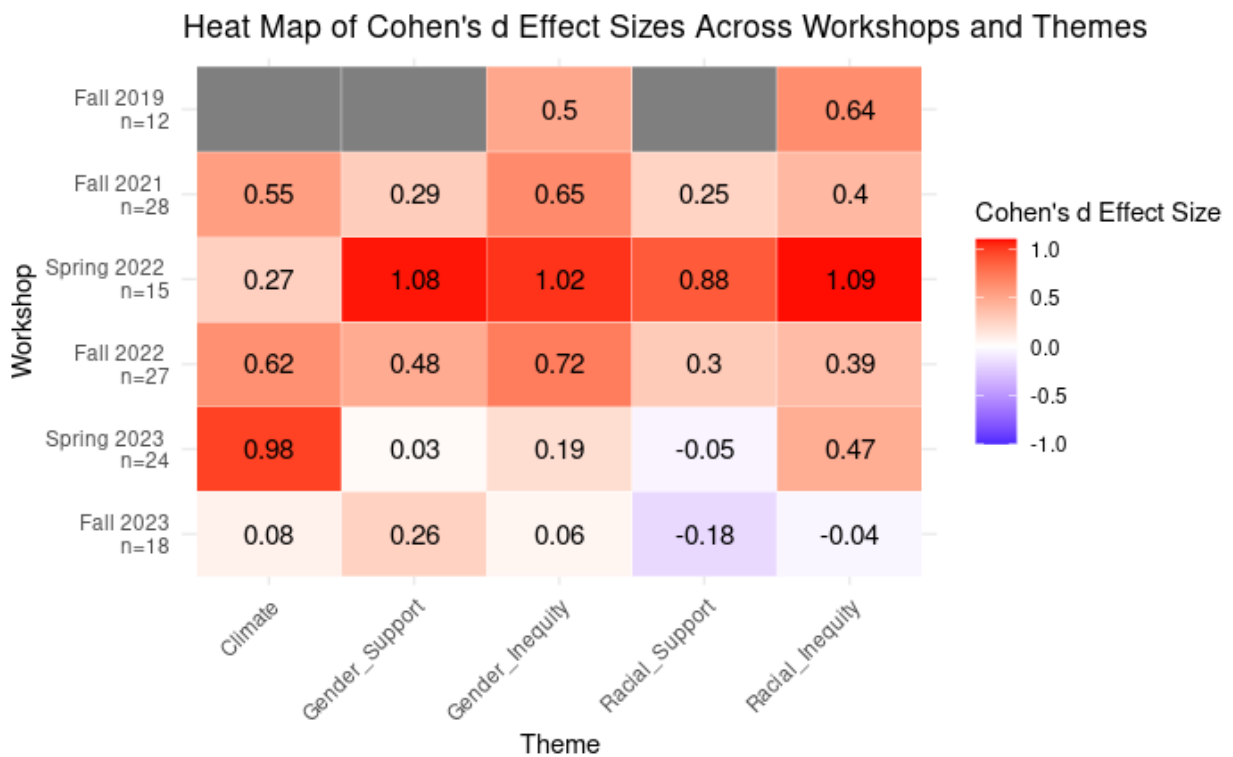
Only one workshop showed a large effect size on participants' perceptions of support for gender equity—in Spring 2022 ($d=1.08$). In Fall 2019, Fall 2021, and Fall 2022, there were small to medium effects ($d=0.50$ – 0.72), whereas Spring 2023 and Fall 2023 showed negligible effects ($d=0.06$ – 0.19). Perceptions of racial and ethnic support at the institution showed a similar pattern. The Spring 2022 session had a large effect size ($d=0.88$), while Fall 2021 and Fall 2022 had small effects ($d=0.25$ – 0.30), and the remaining sessions' effect sizes were negligible ($d=-0.05$ to -0.18).

Together, these results indicate the answer to our third research question: although the workshop was found to be effective across time, the effect sizes of the workshops varied. This could be due to a number of reasons: context of current events, the content emphasized, and the presenters. Notably, the workshops were more effective at changing perceptions of campus climate than perceptions of gender and racial equity. Furthermore, regarding participants' perceptions of racial and ethnic inequity in campus processes, only one workshop showed a large effect, Spring 2022 ($d=1.09$), which included content emphasizing race and which was attended predominantly by new faculty. Finally, we note that the heatmap illustrates how effects of the workshop decreased over time, with the Spring and Fall 2023 yielding the smallest effect sizes overall.

Figure 11.

Heatmap of effect sizes (Cohen's d) across workshops, by all question themes.

Positive values indicate a shift to less favorable perceptions post workshop, whereas negative values indicated a shift to more favorable perceptions.



Discussion

Both our own experiences as faculty members and findings in the literature (Allen et al., 2022; Dancy & Hodari, 2023) indicate that faculty often believe their institution is unique and the racial and gendered bias and inequity reported in studies is unlikely to exist on their own campus. These findings have resulted in A&A workshops being intentionally designed to include data specific to the host institution. Since most previous studies on A&A have not measured whether workshop content influences participant perceptions, the effectiveness of this kind of A&A programming has remained unclear. Results of our study suggested that the answer to our first research question—*What is the effect of the A&A workshops on participants' perceptions about equity at the institutional level?*—is that the workshops change participants' perceptions to more accurately reflect the actual state of equity (consistent with data) at the institution. Participants' ratings of perceived campus climate, gender support/equity, and racial support/equity consistently and significantly decreased from pre- to post-workshop responses. In other words, after the workshop the participants' opinion of their campus climate became less favorable. This trend was consistent across the themes of Climate, Gender Support, Gender Inequity, Racial Support, and Racial Inequity. For example, participants' perceptions of the support provided to faculty of different genders as well as their perception of the equity of processes and practices shifted significantly after all workshops; and this trend did not vary between workshops even though there were contextual differences such as the Pandemic, the hiring of a Vice President of Diversity at the institution, and changes in workshop facilitators and workshop content.

Although content of workshops varied, there was a strategic effort to share published studies and internal data consistently across workshops that were designed to make participants feel comfortable in discussing the evidence of gender and racial inequities. Therefore, we believe the effect—shift in perception—could be explained by participants becoming more aware of campus-specific data, including negative effects of lack of equity and non-inclusivity on people from marginalized groups during the workshop. Notably, these effects were found regardless of the

gender and faculty status of the respondent. However, we do not know if there were any effects of race/ethnicity of the respondent since the IRB did not allow for the examination of that data.

Our results indicated that pre-workshop participant's rate their perceptions of equity on campus fairly high on the 7-point scale and that post-workshop ratings are generally in the middle of the scale. This declining rating of equity suggests participants' movement toward a perception that the institution's equity climate is more or less comparable to that of other campuses through participation in the workshops (Allen et al., 2022; Dancy & Hodari, 2023). Therefore, we encourage administrators to view participants' more realistic post-workshop perceptions not as a negative but instead as a method for helping institutions to see the need to improve structures and processes that, while perhaps familiar and comfortable, also institutionalize inequities.

Organizational change cannot occur until there is sufficient awareness of existing problems that serves to mobilize people to action (Appelbaum et al, 2012). Indeed, although anecdotal, we have noticed a shift in the culture at our institution: faculty now support equity initiatives that when proposed years ago had garnered a great deal of resistance. For example, mentoring and leadership workshops are now more frequently implemented by administrators without resistance. Also, there is quantitative evidence that gaps in both retention rates and promotion rates for women and racially/ethnically underrepresented individuals as compared with individuals from majority groups have improved since ADVANCE grants were first instituted.

Our second research question asked whether the workshop would effectively communicate both gender and racial inequities. Results indicated that, although perceptions of both gender and racial inequity were typically heightened because of the workshops, the workshops appeared to be more successful at getting across the point about the existence of gender inequities than racial inequities since perceptions of Racial Support had the least change in perception from pre- to post-workshop.

These different perception shifts with regard to gender and racial inequity might be related to a couple of factors: the workshop content presented, and also level of engagement depending on the presentation content. From a workshop content perspective, there was a strategic effort to include racial data and advocacy strategies (Chaudhary & Berhe, 2020) in Spring 2022, but this content has slowly been cut back and removed from workshop presentations. However, we also observed that being at a predominantly White institution (PWI) makes it more difficult to present data on racial inequities. There is little data from underrepresented demographics to report and presenting it risks identifying individuals. A further obstacle may be less interest in such data by participants. For example, we have observed that the topics selected by the A&A team for the Journal Club (an additional educational activity) tend to focus more on gender inequities, and further that the gender-related topics appear to result in greater engagement during discussions as compared to race/ethnicity-related topics.

The workshops appeared to generate larger attitude changes for some themes than for others. For example, ratings indicating perceptions of gender equity changed; the increased awareness of differences in gender support were smaller than the awareness of inequalities in policies. This was also the finding for racial equity and support. Perceptions shifted notably for equity but not support. These differences in perception among the themes may be the result of emphasis on certain data more than other data in the workshops. Alternatively, it is possible that respondents were unclear about the meaning of support as compared with the meaning of equity. Future research could examine these possibilities.

Our last research question examined whether effects of the A&A Program would be consistent over time, particularly given the organic evolution of workshop content. Results indicated that over time, the effect of workshops on equity perceptions decreased. The large effect sizes observed in earlier semesters (e.g., Spring 2022) compared to negligible effects in later semesters (e.g., Fall 2023) suggest an evolution in workshop impact. Interestingly, the perceptions of gender and racial support and equity prior to attending the workshop (pre-workshop surveys)

declined over the course of the grant. These results suggest that broader conversations, such as national media on higher education or discussions with colleagues, may have helped educate participants about gender and racial inequities. This trend may have also been due to an overall increase in awareness about these issues at our institution itself, which would suggest that ADVANCE and related diversity programming, whether local or national, may have had the intended impact.

Since the present study was not designed in a way to conclusively answer reasons for these changes in perceptions, this remains a topic for future research. Specifically, a question for future research is whether this type of A&A programming generally achieves its goals of increasing campus awareness of inequity within a specific time frame, with further increases in awareness being much less likely after that period. We observed that workshop benefits go beyond the increased awareness of participants to include the learning that occurs for the A&A workshop presenters as they prepare for the workshops. We therefore recommend that future research build on our work and look at multiple measures of workshop effectiveness to holistically determine their impact. As part of this, future research should also assess what the role of this type of workshop should be in the ecosystem of institutionalized efforts to increase and maintain equity over the long term.

Aside from the decreased effect on perceptions of equity over time, results indicated some variability in post-workshop scores, which suggests a need for continuous assessment and refinement of workshop content. For example, the significant impact observed in Spring 2022 for both Gender and Racial Inequity themes suggests that specific content or delivery methods used during this semester were particularly effective. Understanding the factors contributing to this success can help replicate it in future workshops. In contrast, the Spring 2023 deep-dive session showed significantly different results in the Racial Support theme, with a smaller change in pre- and post-workshop scores compared to other sessions. We suspect that this may have been because the deep-dive workshop was primarily created for repeat participants who desired a focus on practicing advocacy tools rather than additional examination of inequity data.

Limitations and Future Directions

We acknowledge that one limitation of the present study was that it did not utilize an experimental design. Future research should consider incorporating methodologies in which participants are randomly assigned to groups that are presented with slightly different material, and the resulting perceptions of inequities are then examined. Additionally, multiple measures would be useful. Relying on single and traditional measures when working in the equity and advocacy space can leave practitioners without the tools to gain necessary support and buy-in from campus stakeholders. Multiple measures can greatly enhance data storytelling to engage stakeholders and support data-driven decisions that move inclusion and equitable support of all faculty forward.

Also, when addressing the program's effects across time over the workshop sessions, we did not examine the effects of individual participants attending multiple workshops. Numerous studies have shown the benefits of repeated exposure on learning (e.g., Spreckelsen & Juenger, 2017; Kiewra et al., 1991; Wiklund-Hörnqvist et al., 2014, Bezrukova et al., 2012, 2016; Roberson et al., 2001). It is reasonable to wonder if attending multiple A&A workshops would have a stronger impact on participants' perceptions, perhaps making their perceptions less favorable (but more calibrated to university data) than participants who attend a single session. We did not explore this potential relationship because only eight of the 124 participant respondents attended more than one A&A workshop (and only three attended three or more). Since prior research demonstrated that repeated participation in implicit bias training programs affected the learning outcomes (Lehman et al., 2023), additional research examining the impacts of frequent attendance is warranted.

Another limitation is the lack of understanding of the effects of various degrees of representation from different colleges and units within the university. Although efforts were made to include a diverse cross-section of participants, with multiple modes of advertising workshops used, and self-selection was a factor, our sample may not be representative of the entire faculty and staff population. Separate

attendance data indicates that some units were more active in ADVANCE programming than others and it remains unclear whether we are reaching those whose pre-workshop perceptions could most benefit from an increased level of awareness.

A specific challenge in analyzing the A&A program data was that our IRB did not allow for separately reporting participants' racial/ethnic data due to low population numbers at the institution. This limitation impacted the granularity and specificity of our analysis and highlights the broader issue of diversity within faculty. Future studies should examine the effects of race on perception changes since it is likely that faculty of color would enter an A&A workshop with more awareness of campus inequities.

While our study is limited by participation rates, representativeness, control groups, and constraints in racial and ethnic data analysis, it still contributes significantly to the literature through the use of a rigorous quantitative approach over time, and advanced analytical techniques. It is also notable that this study is based on one of the largest engaged populations in an A&A program when compared to other universities (personal communication, R. Green⁴, August 2023). Thus, this contribution offers insights that are robust and actionable.

The three broad, desired goals of advocacy programs such as A&A include: 1) increasing majority group members' awareness of institutional inequalities, 2) convincing majority group members that actions to address these inequities are possible and beneficial, and 3) supporting marginalized group members directly and indirectly (e.g., Anicha et al., 2015, 2018; Cheng et al., 2019; Jenkins, 2009). The present study addressed the first goal by examining attendees' increased awareness of the inequities facing marginalized faculty members at our institution and of majority group members' roles in influencing those inequities. Although our study cannot make causal inferences about the workshops' impact, its strength lies in the fact that changes in participants' perceptions of equity were directly examined, distinguishing it from previous studies of A&A programming. We have evidence now that workshop

⁴ Dr. Roger Green of North Dakota State University, one of the original proponents of the Advocates & Allies program began.

training can increase awareness; even in individuals with some working knowledge of inequities, perceptions can still shift. We have observed that the workshops can move a group from relative consensus to a distribution of varying degrees of awareness as they grapple with new knowledge, though the actual content, delivery, and implementation method could be studied more deeply to understand content and delivery nuances that are directly attributed to perception shifts.

This study did not address the second and third goals of advocacy programs, which are concerned with participant behaviors. The natural next step for future A&A research should be to measure attendees' motivations or intentions to make changes to address inequities at their institution. This would help reveal the workshops' tangible effects in improving the institution for marginalized faculty members. We also note that an increasing population of individuals at this PWI reviewed and discussed literature and university data on inequities resulting in requests in Fall 2023 for a deeper dive. The A&A leadership responded by developing content for a spring workshop to explore additional nuances of bias coupled with ally tools to disrupt bias. The big picture is that our institution now has a critical mass of participants who have been exposed to literature evidence and institutional data about gender and racial inequity. More research is needed into this dynamic process of meeting individuals where they are. This is applicable to their awareness of equity as well as their skillset for translating that awareness into actionable steps for increased social justice.

Conclusions

Our analysis of the Climate, Gender Support, Gender Inequity, Racial Support, and Racial Inequity perceptions across five years provided valuable insights into the effectiveness of Advocates & Allies workshops at a PWI, PMI, R1, STEM-focused institution. Specifically, we found that following A&A workshops, participants had less favorable perceptions of:

- 1) the general campus climate.
- 2) men colleagues' support of women and faculty members who are racial/ethnic minorities.

3) structural inequities involving gender and race.

Effects were fairly consistent across workshops. Also, we found that awareness of gender-based inequities does not translate into similar awareness of racial/ethnic inequities. This finding highlights the importance of including specific workshop content regarding both gender and racial/ethnic equity.

While the overall trend across the six workshops showed increased awareness of inequity, the variability in effect sizes suggested that other factors, such as content and workshop delivery influence workshop effectiveness. Whereas we have contributed to A&A research by measuring participants' changes in perception rather than workshop satisfaction, future research can go further in measuring workshop impacts. Research is needed to more deeply explore the impacts of including (or not including) specific content in A&A workshops on participants' perceptions.

Ultimately, this program aims to engage individuals from majority groups in advocacy. Results indicate the workshops succeeded in challenging participants' pre-existing knowledge and promoting critical thinking regarding equity issues on campus, as demonstrated by changes in perceptions before and after the workshops. Also, observed cultural changes on campus across time regarding the acceptance and implementation of equity initiatives suggest that the A&A workshops can be one effective way to gradually shift attitudes and behaviors at STEM-dominant institutions.

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38 Exploratory Assessment of Advocates and Allies Programs

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Appendix A

Table 1: Complete text of the 15 questions asked in the pre- and post-surveys, sorted by their perception group.

Perception Group	Question Text
Perceptions of campus climate	What is your current level of satisfaction with the campus climate?
	What is your current level of satisfaction with the degree of inclusiveness at the university, such as through both formal and informal networks?
	What is your current level of satisfaction with the consistency and quality of the faculty review process across the university?
Perceptions of support for gender equity	To what extent do you believe that the men on the [university] campus are playing a central role in deconstructing (breaking down/alleviating) gender inequalities?
	To what extent do you believe that men on the [university] campus demonstrate ways to support gender equity?
	To what extent do your men colleagues promote policies and practices that support gender equity?
Perceptions of gender inequity in academic processes	To what extent do you believe that the [university] campus dynamics are characterized by gender inequalities?
	To what extent do you feel gender pay inequity exists at [university]?
	To what extent do you feel that women and men are disproportionately promoted/tenured at [university]?
Perceptions of support for racial/ethnic	To what extent do you believe that men on the [university] campus are demonstrating ways to support racial and ethnic equity?
	To what extent do your men colleagues promote policies and practices

equity	that support racial and ethnic equity?
	To what extent do you believe that the [university] campus dynamics are characterized by racial and ethnic inequalities?
Perceptions of racial/ethnic inequity in academic processes	To what extent do you feel racial and ethnic pay inequity exists at [university]?
	To what extent do you feel that there is a racial and ethnic bias in promotion and tenure at [university]?
	To what extent do you believe that the men on the [university] campus are playing a central role in deconstructing (breaking down) race inequities?

Exploratory Factor Analysis Results

To validate the survey tool and the predefined themes, an exploratory factor analysis (EFA) was conducted on both the pre-test and post-test survey responses. Using maximum likelihood extraction with Varimax rotation, five factors were retained based on eigenvalues greater than 1, a scree plot inspection, and theoretical alignment with the survey's conceptual framework. These factors corresponded to the predefined themes: Climate, Gender Support, Gender Inequity, Racial Support, and Racial Inequity.

The EFA on the pre-test data explained 71.1% of the variance across five factors, with factor loadings for most items exceeding 0.5. The EFA on the post-test data explained 74.4% of the variance, with factor loadings similarly supporting the predefined themes.

46 Exploratory Assessment of Advocates and Allies Programs

Question	Theme	Pre-Test Loading	Post-Test Loading
What is your current level of satisfaction with the campus climate?	Climate	.90	.72
To what extent do your men colleagues promote policies that support gender equity?	Gender Support	.82	.86
To what extent do you feel gender pay inequity exists at [university]?	Gender Inequity	.88	.62
To what extent do you feel racial and ethnic pay inequity exists at [university]?	Racial/Ethnic Inequity	.90	.90
To what extent do your men colleagues promote policies and practices that support racial and ethnic equity?	Racial/Ethnic Support	.85	.91

Author Biographies

Karen Colbert is the General Education Department Chair and Lead Math Faculty at Keweenaw Bay Ojibwa Community College. She is completing her Ph.D. in Computational Science and Engineering, with research focused on faculty retention, program evaluation, computational data visualization, and data storytelling. A passionate advocate for STEM equity in Tribal College communities, she has advanced quantitative and computational literacy through national leadership roles and currently serves as a Virtual Visiting Research Scholar for the NSF/WEPAN ARC Network. Colbert is also a national keynote speaker and a member of the Faculty Advisory Committee for the American Indian College Fund. She has presented nationally at conferences, including the AAAI Spring Symposium at Stanford University and DREAM 2025.

Dr. Betsy Lehman is an instructor in the Department of Psychology and Human Factors at Michigan Tech, where she received her Ph.D. in Applied Cognitive Science and Human Factors. Her research explores sensemaking and social cognition in multiple contexts, with particular interest in how people question their theories. Her research has appeared in journals such as Cognitive Processing and Journal of Higher Education Policy and Management, and been presented at international conferences including the Society for Judgment and Decision Making.

Dr. Sonia Goltz is Mickus Endowed Faculty Fellow in Business Impact in the College of Business at Michigan Tech. She received her Ph.D. in Industrial/Organizational Psychology and teaches organizational behavior and organizational change. Her research examines topics such as organizational change, social power, and gender equity. Her research has appeared in business and applied social sciences journals including: Human Relations, Journal of Applied Social Psychology, Decision Sciences, Journal of Small Business Management, and Journal of Organizational Behavior Management.

Dr. Adrienne R. Minerick is a Distinguished Professor of Chemical Engineering and previously served as Director of ADVANCE at Michigan Technological University. She earned her B.S. from Michigan Tech and her M.S. and Ph.D. from the University of Notre Dame. Adrienne completed her Presidential terms with the American Society for Engineering (ASEE) in 2023 and is a fellow of the American Association for the Advancement of Science (AAAS), ASEE, and, most recently, the American Institute of Chemical Engineers (AIChE). Her research is in nonlinear electrokinetics in microfluidic devices for point-of-care diagnostic purposes.