



## **Promoting an Inclusive Lab Culture through Custom In-Person Trainings within an Engineering Department**

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Creating diverse, inclusive, and respectful environments is the #1 recommendation of the 2018 National Academies of Sciences, Engineering, and Medicine report on “Sexual Harassment of Women” [1]. To accomplish this goal, the report suggests that academic institutions cater their training to specific populations, use qualified, in-person trainers, and instruct participants how to intervene. These recommendations motivated a chemical engineering department at a technical institute to develop a custom in-person training program in collaboration with the Title IX and Bias Response (T9BR) and the Violence Prevention and Response (VPR) offices.

The in-person trainings, entitled “Promoting a Professional and Inclusive Lab Culture,” were mandatory for all laboratory groups in the department, including faculty, staff, and trainees. To promote discussion and interaction within the context of individual lab cultures, training sessions were small (~20 participants) and grouped lab members together. The trainings were facilitated by members of the T9BR and VPR offices and covered aspects of a culture (including values and beliefs, verbal expressions, and behaviors), contexts of power, methods of intervening, and resources/support. The 120-minute sessions included presentation, interactive activities, and realistic example scenarios customized to the department with the goal of promoting respectful work behavior.

Approximately 480 individuals participated in the training, representing 33 lab groups in a total of 28 sessions held over the course of 8 months. Exit survey results indicate that 95% of participants felt there was a good mix of presentation and interactivity and 93% felt that the content was neither too basic nor too advanced. In the follow-up survey, greater than 85% of respondents “strongly agreed” or “agreed” that these trainings sent a positive message about departmental values and would recommend the trainings in other departments. We believe that custom in-person trainings such as the one described here have the potential to positively impact the culture of an engineering department.

## Introduction:

Increasing diversity in STEM has long been a priority of institutions of higher education. Although the gender gap in STEM fields has narrowed in recent years, women still hold a disproportionately low percentage of engineering degrees and faculty positions [2] - [4]. In 2018, 21.9% of bachelor degrees and 23.6% of doctoral degrees in engineering were awarded to women with only 17.4% of tenured/tenure-track faculty positions being held by women [5]. Chemical engineering programs have above-average representation of women as compared to engineering overall but experience a gradual decline throughout the academic pipeline (35.4% of bachelor degrees, 29.5% of doctoral degrees, and 19.8% of faculty positions in 2018) [5]. In 2018, the Department of Chemical Engineering at MIT (hereto referred to as “the department”) was comprised of approximately 30% female graduate students and 14% female active faculty members. These data suggest there is an opportunity to better retain women in academic career paths.

One of the most consistently cited barriers to the persistence of female engineers in academia is the existence of a “chilly climate,” or a culture consisting of both subtle and overt discrimination [6] - [10]. Several strategies have been implemented to improve this culture, for example by establishing peer mentoring programs [11] - [15] or creating more inclusive classroom environments [16] - [20]. In contrast to undergraduate engineering students who predominantly take classes, however, senior doctoral and post-doctoral engineering students spend the majority of their time in a “lab” environment—i.e., the environment of the research group, whether computational or experimental. Therefore, to create a warmer climate for these students and mitigate the drastic drop-off of women from doctoral programs to faculty positions, here we focus on promoting a more inclusive lab culture.

The pervasiveness of sexual harassment in the workplace is a primary contributor to the chilly climate experienced by female engineers [1], [21], [22]. Recent studies indicate that female graduate students are 1.5 to 2 times more likely to experience sexual harassment than their male counterparts [23], [24], and the underrepresentation of women in academia has been correlated with a higher prevalence of gender harassment [25]. In a survey of 525 graduate students (324 female), 58% of female graduate students reported that they experienced sexual harassment by *other students* as compared to 39% of males [23]. In the Pennsylvania State University System, 42.6% of female graduate students (compared to 22.3% of male graduate students) reported experiencing sexual harassment by *faculty or staff* [24]. Moreover, female engineering majors in the University of Texas System were more likely to experience sexual harassment than their female counterparts in science or non-STEM fields [24].

Diversity trainings are frequently implemented to promote inclusivity and reduce the occurrence of sexual harassment with mixed results depending on the definition of training effectiveness [26] - [28]. Learning outcomes are generally classified as affective-based (measuring attitude), cognitive-based (measuring knowledge), and skill-based (measuring behavior) [29]. Diversity trainings often have larger effects on cognitive- and skill-based outcomes relative to affective-based outcomes [28], although implicit bias training has also been shown to improve the attitude of faculty toward women in STEM [30], [31].

In 2018, the National Academies of Sciences, Engineering, and Medicine (NASEM) issued a report entitled “Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine” with a list of evidence-based recommendations for institutions of higher education [1]. Since the organizational climate, or the perceived practices and policies within an organization, is the strongest predictor for sexual harassment to occur, the primary recommendation of the 2018 NASEM Report is to create diverse, inclusive, and respectful environments. Within this recommendation, academic institutions are urged to cater their training to specific populations and train participants how to intervene when inappropriate behavior occurs. The report also recommends engaging the entire community (students, faculty, and staff) in their diversity and inclusion efforts [1]. Following these recommendations and implementing other best practices through the use of qualified, in-person trainers and active instruction [28], here we develop and implement custom trainings, covering aspects and behaviors that contribute to an inclusive culture.

## **Methods:**

### *Determination of Department Climate*

To gauge and improve the climate in the department, the student-run graduate student advisory board (GSAB) writes and administers annual “Quality of Life” surveys. To ensure anonymity, students do not identify the lab group to which they belong, precluding correlations between lab climate and training effectiveness. Students are incentivized to complete the survey by being entered in a raffle to win 1 of 4 \$25 gift cards. In 2018, the survey response rate was ~56% of graduate students (n = 127), with 35% of respondents being female. The analysis of anonymized aggregate data was conducted by GSAB and suggests that overall dissatisfaction rates are low amongst the graduate student body. However, there was a marked discrepancy between the responses of female and male students. For example, 24% of females and only 2.5% of males disagreed with the statement: “My relationship with my advisor is based on mutual respect.” Here, “advisor” is defined as the student’s principal investigator (PI) and primary mentor. These results prompted GSAB to recommend that the department focus on creating a more inclusive environment.

### *Logistics of Implementing Multiple Trainings*

In-person sexual harassment trainings hosted by the institute’s Title IX and Bias Response (T9BR, which became the Institute Discrimination and Harassment Response Office in 2020) and Violence Prevention and Response (VPR) offices were mandated in a department of similar size at MIT during the spring semester of 2018. These trainings demonstrated the logistical feasibility of such an approach and set the precedent for similar trainings in other departments. As a result, the Department of Chemical Engineering set out to develop customized trainings entitled “Promoting a Professional and Inclusive Lab Culture” and implement them during the spring semester of 2019.

According to a meta-analysis of diversity training outcomes, best practices include 1) training that lasts > 4 hours, 2) in-person workshops, 3) external expert facilitators, 4) active participation, and 5) customized content [1], [28]. Due to the logistics of training almost 500 people, we developed trainings that were 120 minutes in duration and complemented this mandatory workshop with other optional, on-going activities including a 60-minute equity seminar and “Faculty Roundtables,” or discussions between students and faculty on topics such

as advising relationships. In alignment with the recommended best practices, the in-person workshops were facilitated by staff from the institute’s T9BR and VPR offices. Each training had at least 2 facilitators out of a total of 4 staff members who were trained to conduct the workshops. A summary of the training logistics can be found in Table 1.

**Table 1.** Logistics of trainings.

Duration of training	120 min
Number of facilitators per training	2+
Average number of participants per training	17
Total number of trainings	28
Total number of lab groups trained	33
Total number of participants	~480
Total time of program completion	~8 months

To encourage active engagement of all participants, we kept the group sizes relatively small (~20 people). We felt that it was important to have lab groups train together and mandated that all full-time lab members (students, postdoctoral scholars, staff, and PI) attend, as all members contribute to the lab’s unique culture and must agree upon, implement, and uphold any change mutually. Thus, students or postdoctoral scholars who are co-advised by two PIs were required to attend trainings for both labs. Additionally, we decided that it was critical to include the PI in these trainings to explicitly show their support and add accountability, as research has shown that faculty play a key role in creating an inclusive climate in an academic setting [32] - [34]. Furthermore, the 2018 NASEM Report highlights the importance of leadership in creating inclusive and respectful organizational climates [1]. A potential drawback of this approach is that lab members who experienced a chilly climate may be unwilling to express themselves in this setting. To overcome this limitation, the facilitators, as well as the PIs, encouraged participation by promoting a safe space and welcoming environment. Furthermore, the training included resources for seeking support and reporting problematic behavior such that those who were uncomfortable speaking in this group setting could still be heard.

Prior to developing the training materials, graduate student focus groups were held by members of the T9BR and VPR offices to 1) assess the main issues and concerns students felt important to cover in workshops on this topic, 2) discuss “agree-disagree” statements, and 3) begin constructing department-specific scenarios. To establish buy-in by the faculty, the trainings were first discussed in a fall faculty meeting, and the department continued discussion at its faculty retreat in January 2019, at which a half-day was focused on the GSAB findings and the need to address climate within the labs. The T9BR and VPR offices presented the outline and described the generalized content of the training to the faculty at this retreat, who then voted a mandate to move forward with training in every lab in the department. The workshop was revised to include faculty feedback, and the Department Head’s lab group then participated in the training in late January 2019. After a second round of feedback and iteration, the trainings were rolled out to the entire department and completed over an 8-month period. To form groups of ~20, we combined smaller lab groups into a single training or divided larger groups into multiple trainings when necessary (groups with ~30 people attended a single training together). This led to a total of 28 trainings comprising 33 lab groups and a total of ~480 participants. To facilitate scheduling, we held the trainings during the regularly scheduled group meetings when possible.

### *Structure and Content of the Trainings*

The agenda for the training included 6 sections: 1) Aspects of Welcoming and Unwelcoming Environments, 2) What Creates a Culture, 3) Contexts of Power, 4) Methods of Intervening, 5) Resources/Support, and 6) Conclusions and Wrap-Up. The sections were developed to educate participants on *why* behaviors need to change to create inclusive environments and *how* to change their behaviors. As opposed to addressing individuals who engage in harmful behaviors, this training took a broader group approach—focusing on group dynamics and behaviors that shape a culture in addition to methods of intervening to collectively improve chilly climates.

The facilitators began *Section 1: Aspects of Welcoming and Unwelcoming Environments* by asking everyone to think about an environment or interaction that felt inclusive. Each person was then asked to share a one-word description of that environment. This exercise required everyone to participate early-on in the session, set a positive tone for the rest of the training, and also highlighted the ultimate goal of the training: to create inclusive environments. Next, the facilitators introduced the concept of “(un)intentional harms.” The definition—potentially offensive or discriminatory statements or actions—is synonymous to that of “microaggressions.” The term “(un)intentional harm” was used to diffuse any resistance or reactivity to the term “microaggression” so that this important topic could be openly discussed, and the impact of such behaviors could be highlighted regardless of intention behind them. After providing an example of an (un)intentional harm, the facilitators asked participants to identify a possible underlying message of the statement and discussed different interpretations of these messages. This activity concluded by summarizing potential psychological, academic, and department-level impacts of such harms [35]. To humanize these concepts and reinforce the negative impact that (un)intentional harms may have, this section ended with a recording and corresponding transcript of a former undergraduate student in the department sharing their experience of sexual harassment by a lab member (with a computer-altered voice for anonymization).

In *Section 2: What Creates a Culture*, the facilitators introduced the concept of a “culture pyramid” in which core values and beliefs (pyramid base) influence verbal expressions and behaviors (top of the pyramid). Next, aspects of a culture were discussed in the context of recent department climate data and conclusions from the 2018 NASEM Report, which then transitioned into *Section 3: Contexts of Power*. This section began with an “agree-disagree activity,” where one wall in the room represented “agree,” the opposite wall represented “disagree,” and the exact center of the room represented “neither agree nor disagree.” Participants were then asked to stand up and walk over to the point on the spectrum which best represents their opinions on certain statements such as “I think it’s okay to compliment a colleague on their appearance.” Some participants were subsequently asked to volunteer to explain their choices. This exercise was a visual indication of the culture of the lab in which every member was required to participate, as well as an opportunity to understand the range of perspectives and opinions within the group. For example, some group members did not previously realize that their peers had negative experiences with receiving “compliments.” Additionally, this exercise provided an opportunity for participants to move around and regain attention for the latter half of the training. Once participants returned to their seats, the facilitators discussed the importance of context in the “agree-disagree” statements as well as power dynamics.

*Section 4: Methods of Intervening* focused on the power of the bystander, identifying means of intervening. The facilitators defined and discussed the 4 Ds of bystander intervention, a framework that consists of four categories of intervention strategies: direct, distract, delegate, and delay [36]. To practice these skills, the facilitators had the participants count off and form groups of 3-4 to encourage interaction between lab members who were not initially sitting together. The groups were each given a specific scenario and associated question regarding methods of intervention. These scenarios were customized for the department and based on true stories. After discussing in groups, one person from each group reported a summary of the scenario and resulting conversation back to the larger group. These discussions represented a substantial portion of the training (~30 minutes) and emphasized the importance of taking action in the creation of inclusive climates.

The facilitators began to wrap-up the training with *Section 5: Resources and Support*. They described the resources available at MIT including both confidential and private resources, as well as the difference between the two. With a discussion of Title IX resources, sexual harassment was defined in the context of quid pro quo and hostile environments, and information was provided regarding anonymous and non-anonymous reporting of harassment, discrimination, bias, or hate crimes. The final section (*Section 6: Conclusions and Wrap-Up*) included major takeaways from each of the agenda items and a call to action: to create expectations, visibly display them in the lab, and hold all lab members responsible for the creation of an inclusive culture. To provide participants with concrete steps to accomplish these goals, GSAB developed and distributed a “Creating a Positive and Inclusive Lab Culture” Guidebook after the completion of the trainings in all lab groups. This guide detailed methods for creating and enforcing lab culture and provided best practices and example documentation.

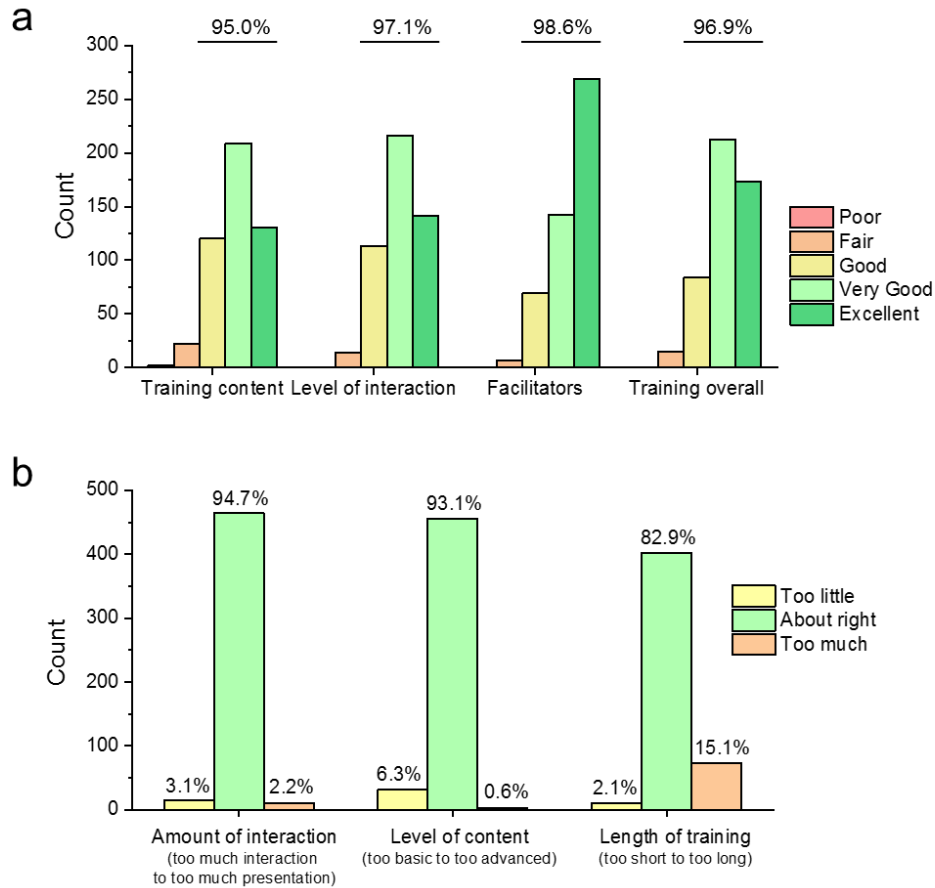
### **Results and Discussion:**

The primary results of this initiative come from the administration of two anonymous surveys: 1) an in-person post-training survey to gauge immediate reactions of the participants to the workshop content and format and 2) an on-line follow-up survey which was administered ~6 months after the last training to better understand its impact.

#### *Post-Training Survey Responses*

In total ~480 participants were trained throughout this program. Since co-advised students attended multiple trainings and completed a survey for each, there are a total of 490 post-training survey responses. The purpose of this survey was to gauge the immediate satisfaction and takeaways of participants regarding the format of the workshop, and it was completed on paper at the end of the training. Participants were asked to rate a variety of training aspects on a 5-point scale: poor, fair, good, very good, and excellent. Categories included training content, level of interaction, facilitators, and overall training. For each of these categories, at least 95% of participants rated them good or above, indicating the overall positive immediate perceptions of the training (Figure 1a). Furthermore, participants were asked their opinions on the amount of interaction, level of content, and length of training. Survey results indicate that 94.7% of participants felt there was a good mix of interaction and presentation, 93.1% of participants felt the content was neither too basic nor too advanced, and 82.9% of participants felt that the training was the right length of time with 15.1% of respondents indicating it was too long (Figure 1b). These post-training survey results suggest participants viewed the training format and

content positively. The survey also included free response questions so that participants could suggest improvements to the training, or indicate a useful aspect or takeaway of the training.



**Figure 1.** Trainings were perceived well by participants in immediate post-training surveys. a) Extent of satisfaction of training content (n = 483), level of interaction (n = 484), facilitators (n = 487), and training overall (n = 484). Percentages indicate the sum of “good,” “very good,” and “excellent” responses. b) Perceptions of amount of interaction (n = 490), level of content (n = 490), and length of training (n = 485).

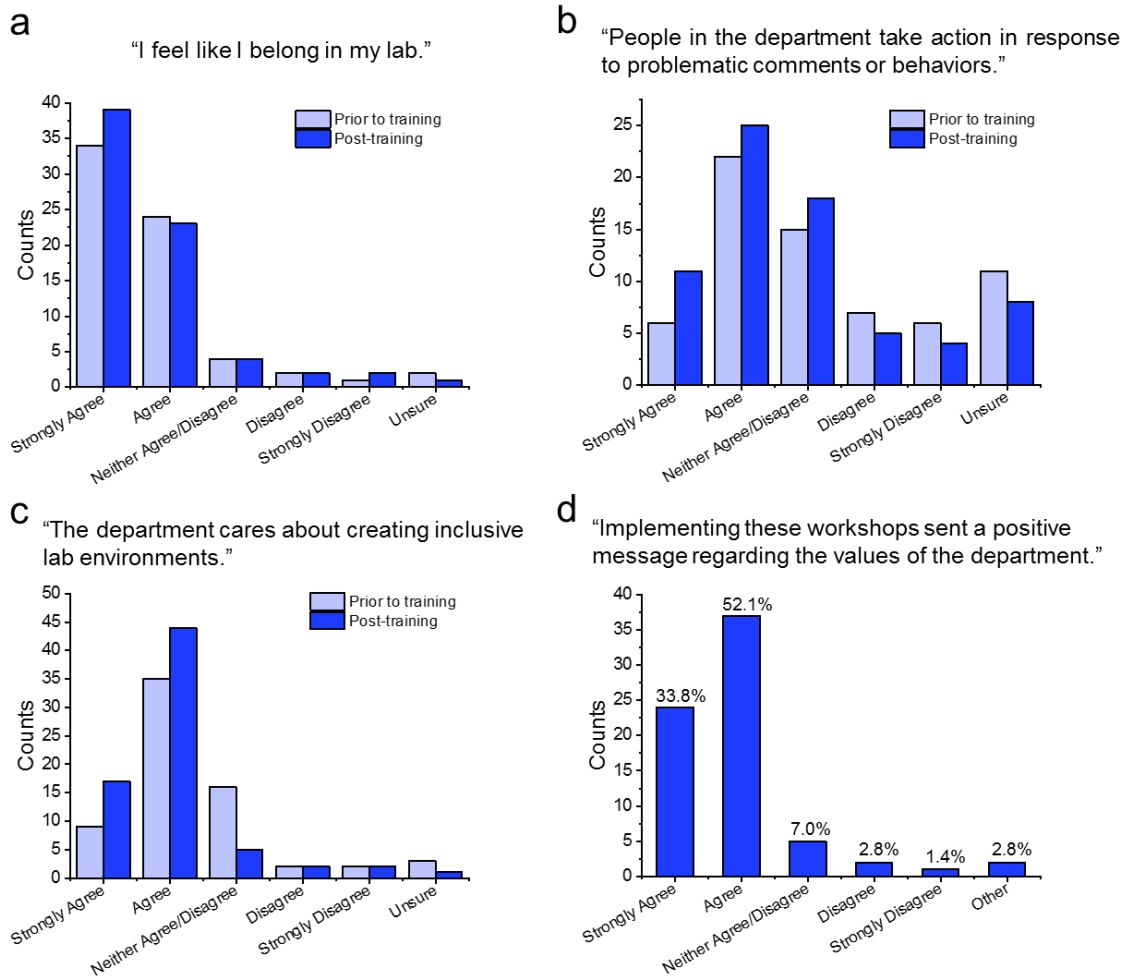
### *Follow-up Survey Responses*

The online follow-up survey was sent to the target population (graduate students, faculty, and staff in the department) ~6 months after the last training. A total of 104 people completed the survey, 97 of whom participated in the training (although the training was mandatory, some people did not participate due to extenuating circumstances such as travel). All questions were optional such that not all survey responders answered all questions. The aim of this survey was to assess the impact of the trainings on lab culture and measure affective-based, cognitive-based, and skill-based outcomes.

The survey was comprised of several different parts. In the first part, respondents were asked to indicate the extent to which they agree with each of a list of several statements. To better understand the direct impact of the trainings, we analyzed survey responses for a set of statements that asked respondents to indicate their extent of agreement both “currently, since going through the workshop” and “prior to going through the workshop” (Figure 2). The first



statement we analyzed, “I feel like I belong in my lab” was designed to determine affective-based outcomes of the training (Figure 2a). About half (50.8%) of respondents indicated that they strongly agreed with this statement prior to going through the workshop, consistent with general satisfaction results from the Quality of Life Survey, and the percent of respondents who strongly agreed rose slightly (54.9%) since going through the workshop.

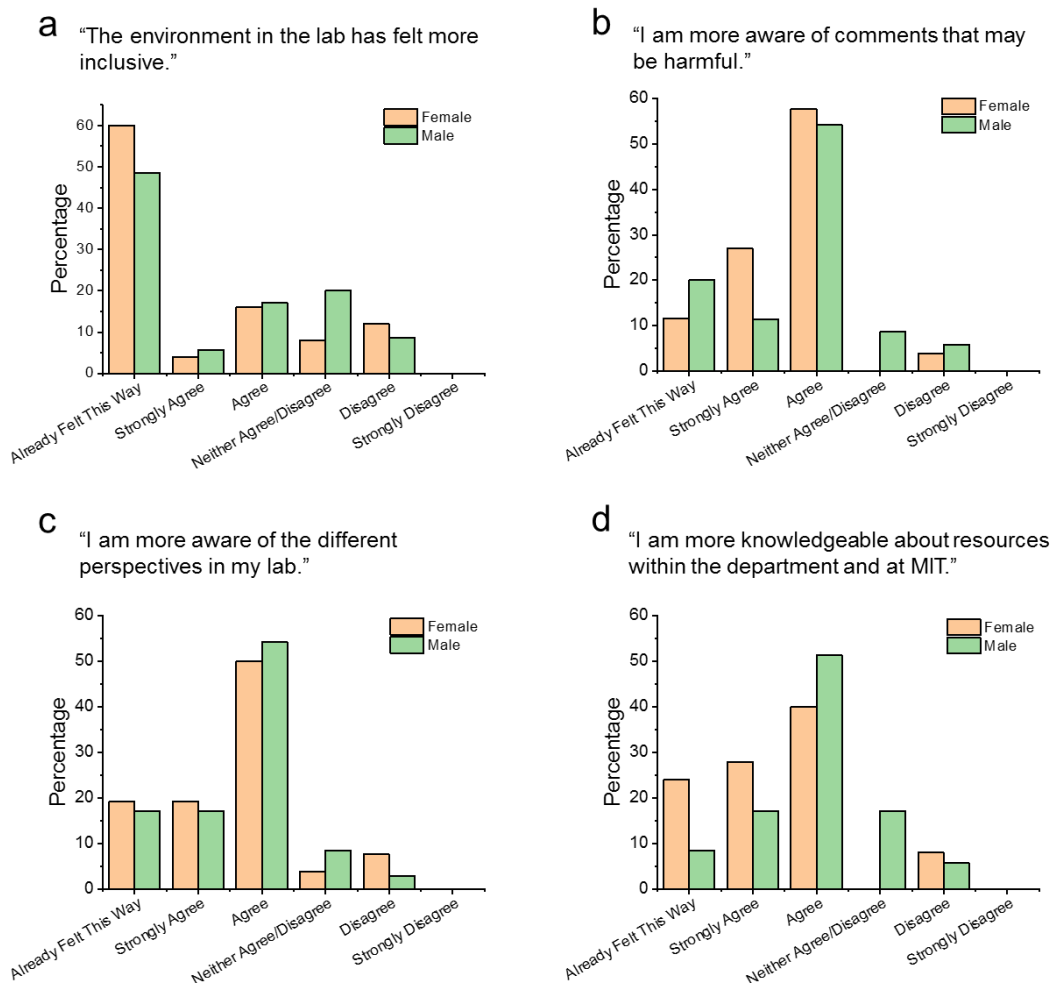


**Figure 2.** After the training, there was an increase in the perception of inclusivity and positive values in the department. Extent of agreement with the following statements since going through the workshop (n = 71) and prior to going through the workshop (n = 67): a) “I feel like I belong in my lab.” b) “People in the department take action in response to problematic comments or behaviors.” c) “The department cares about creating inclusive lab environments.” d) “Implementing these workshops sent a positive message regarding the values of the department.”

The next two statements involved the perception of the department’s tolerance for problematic behaviors (Figure 2b,c). For both of these statements, the number of respondents who “strongly agree” and “agree” that the department does not tolerate problematic behaviors increased after the training. Importantly, 85.9% of respondents “strongly agree” or “agree” that these trainings “sent a positive message regarding the values of the department” (Figure 2d). Since the perception of tolerance for sexual harassment (i.e., the organizational climate) in academia is the strongest predictor for sexual harassment occurring at an institution [1], creating a greater

awareness in the community that the climate is intolerant to harassment is critical in the formation of an inclusive culture.

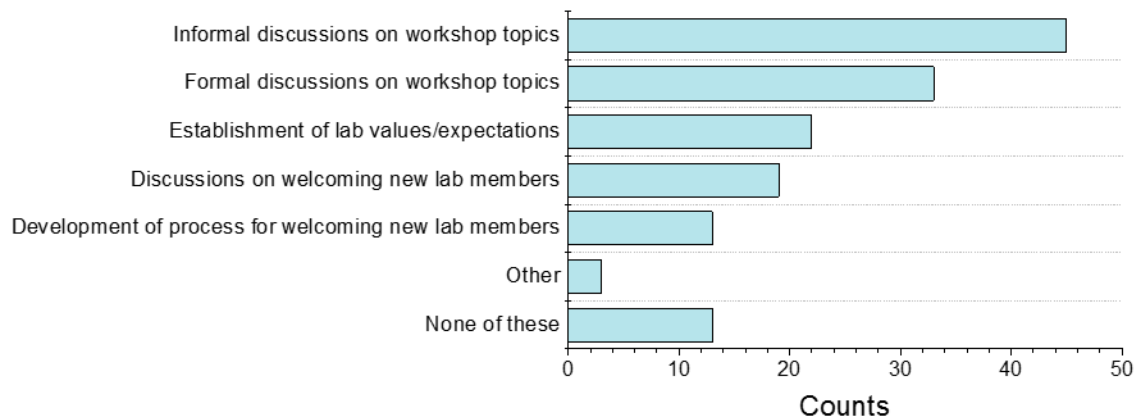
To see if the trainings impacted females and males differently, we next analyzed the responses to 4 of these statements “since going through the workshop” by gender (Figure 3). For this analysis, we only considered the 61 participants who voluntarily identified as female ( $n = 26$ ) or male ( $n = 35$ ). No students identified as non-binary or chose to self-describe. In response to the statement, “The environment in the lab has felt more inclusive,” which is the main goal of the training, 60% of females and 49% of males indicated that they “already felt this way” prior to the training (Figure 3a), paralleling results from the statement in Figure 2a (“I feel like I belong in my lab”). Only ~10% of both females and males disagreed with this statement, and no respondents strongly disagreed, indicating that the training had a net neutral to positive effect on overall lab culture according to this population.



**Figure 3.** Differences between female and male responses about the impact of the training were small, and the results were overall positive. Extent of agreement with the following statements by gender (female:  $n = 26$ , male:  $n = 35$ ) since going through the workshop: a) “The environment in the lab has felt more inclusive.” b) “I am more aware of comments that may be harmful.” c) “I am more aware of the different perspectives in my lab.” d) “I am more knowledgeable about resources within the department and at MIT.”

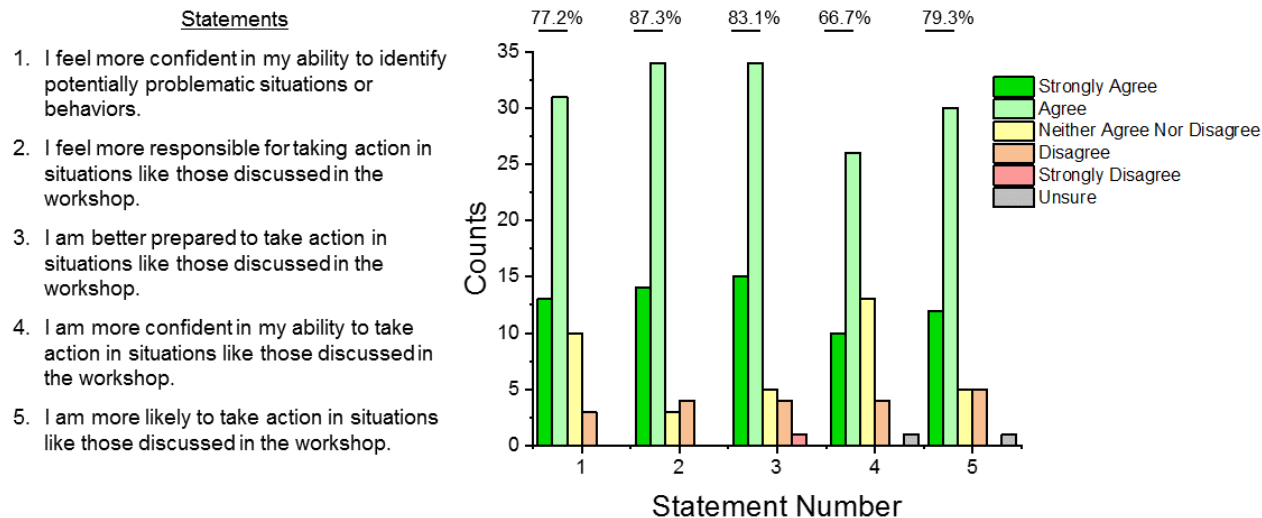
To measure cognitive-based outcomes, we also looked at responses to statements regarding participants' awareness of harmful comments and different perspectives (Figure 3b,c). Females and males responded to these statements similarly, with the majority in each case indicating they "agree" that they are more aware of these aspects after participating in the training. The final statement we analyzed by gender involved participants' knowledge of resources (Figure 3d). This statement had the largest discrepancy between female and male responses, with twice the number of females than males (52% vs. 26%) either already knowledgeable about resources or strongly agreeing that they are more knowledgeable since going through the workshop. These results could potentially indicate that females place a higher value on learning this information (either prior to or since going through the workshop.)

The training ended with a suggested method to move forward: to discuss and establish lab expectations. Therefore, the next part of the survey asked respondents about activities in the lab that occurred as a result of the training (Figure 4). The most common activity was informal discussions on training topics, followed by formal (PI-led) discussions, and the establishment of lab values/expectations, indicative of some direct and immediate impacts of the training.



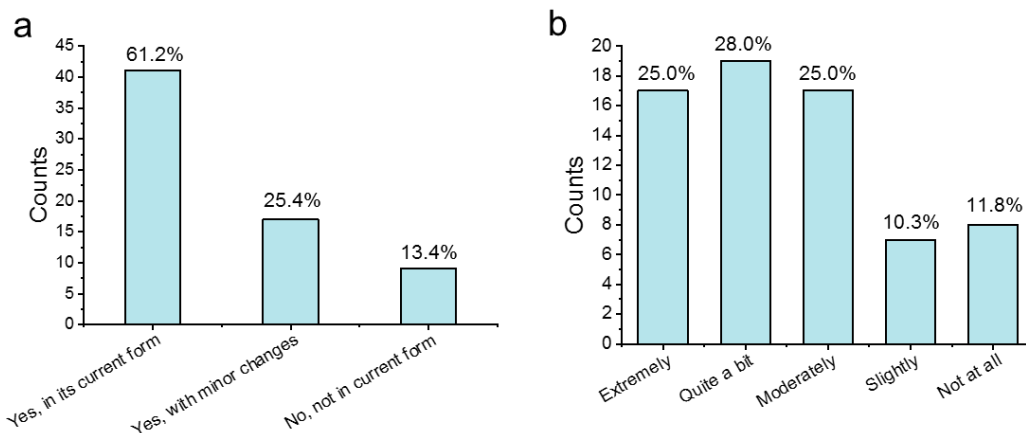
**Figure 4.** Several actions were taken to enhance inclusivity in the lab as a result of the trainings (n = 148 total counts), the most common of which being informal discussions on workshop topics.

The subsequent survey section included questions surrounding bystander intervention. Respondents were asked their extent of agreement to statements regarding their behavioral intentions: 1) their ability to identify problematic situations, 2) their responsibility to take action, 3) their preparedness to take action, 4) their confidence in taking action, and 5) the likelihood that they intervene (Figure 5). The combination of "strongly agree" and "agree" responses was over 75% for all of these statements, with the exception of the respondent's confidence in taking action (Statement 4) which was over 65%. To more directly measure skill-based outcomes, participants who witnessed uncomfortable or problematic situations since undergoing training were asked whether they took action. Importantly, 64.5% of these respondents (n = 76) indicated that they took some sort of action in response to the situation (data not shown).



**Figure 5.** Over 65% of respondents strongly agree or agree with all statements surrounding bystander intervention. Percentages indicate the sum of “strongly agree” and “agree” responses (n = 53 - 59).

The final questions of the survey focused on the perceived value of the training (Figure 6). When asked if they would recommend this training to other departments, 86.6% of respondents indicated that they would with no or minor changes (Figure 6a). In line with their recommendations, 78% of respondents indicated that the training was “extremely,” “quite a bit,” or “moderately” valuable (Figure 6b). Overall, the results are extremely positive with dissatisfaction rates around 10%.



**Figure 6.** Survey respondents generally recommend the training to other departments and believe the training has value. a) Responses (n = 67) to the question: “Would you recommend these trainings be implemented in other departments?” b) Extent to which survey respondents (n = 68) found the training valuable.

### Conclusion:

Here we have presented methods and results of implementing inclusivity trainings in a chemical engineering department. By addressing factors that contribute to the organizational climate, such as leadership messaging (e.g., stating values), action (e.g., implementing the workshops), explicit discussion of group norms (e.g., participating in agree-disagree activities), and consensus-

building around appropriate behaviors (e.g., establishment of expectations), the trainings were able to promote a positive change in lab culture. Additionally, these trainings were well received: greater than 85% of participants who completed the online follow-up survey “strongly agree” or “agree” that these trainings sent a positive message about departmental values and would recommend the trainings in other departments.

Questions that still remain include: “How often should these trainings be implemented?” and “How can we scale these trainings up to include all departments in a school or even an institution?” The answer to the first question relies, in part, on the answer to the second question. If given the resources, the trainings would ideally be repeated every 2-3 years with updated content. In this way, each postdoctoral scholar would go through the training approximately once and each graduate student would go through the training approximately twice. When determining the frequency of the trainings, it is important to consider the size of the lab and the rate of turnover to find an optimal interval. However, if the trainings cannot be scaled to include every department that wants to participate in a university due to limited staff and resources, implementing more frequent trainings might be infeasible. To overcome this problem, it may be necessary to hire external contractors or to train a set of “ambassadors” (e.g., faculty, staff, or graduate students) to conduct the trainings on behalf of the Institute Discrimination and Harassment Response and Violence Prevention and Response (or equivalent Title IX) offices.

In conclusion, we believe the methodologies presented here to gauge and improve laboratory climate can be easily adapted by other departments and external institutions that aim to create their own customized, in-person inclusivity trainings. By following best practices established in the literature, we were able to promote positive changes in the organizational climate and individual laboratory environments within the department.

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