

Dialogues Toward Gender Equity: Engaging Engineering Faculty to Promote an Inclusive Department Climate

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Abstract

Departmental climate is a critical variable for the success of women and other underrepresented engineers. Recruitment, retention, and promotion strategies have generally focused on individuals, instead of group-level processes. We designed a process called *Dialogues* to emphasize inclusive and participatory departmental interactions by intentionally structuring iterative conversations and activities. Our approach builds on the *strengths* of engineering culture, such as teamwork and problem solving, to transform group dynamics and mobilize departments toward gender equity.

Rationale for the work and contribution to research in engineering education

Engineering is a challenging place for faculty diversity efforts because of the low numbers of women in departments and a highly masculinized culture. Academia, in particular in the engineering and science disciplines, remains inhospitable to the representation, advancement, and inclusion of women.^{1,2} Many, if not most, diversity efforts focus on students instead of faculty. Arguments for a student centered-approach include the idea that the pipeline of possible underrepresented faculty members must increase in order for there to be successful recruitment. However, women tend to disproportionately drop out of the pipeline, so that fewer apply for jobs at institutions than are present in postdoctoral positions or graduate schools. Our work focuses on gendered dynamics in departments. Our goal is to foster inclusive practices in departments, regardless of whether underrepresented faculty are present, so that the departmental climate is inclusive.

We designed a process called *Dialogues* to emphasize participatory departmental interactions by intentionally structuring iterative conversations and activities. Our work was embedded within a university wide initiative that engaged with gender and also with mechanisms to support women directly. However, *Dialogues* itself focused on gendered climate, and particularly on supporting the types of climates that would appeal to underrepresented faculty, thus it did not explicitly engage with information about gender or about women. Our approach represents a modification of a dual agenda method, tailored to address issues that the literature has highlighted around that approach.^{3,4}

In contrast, many current approaches emphasize attracting women, providing mentoring and support to help them succeed, addressing work-life practices and policies to make a healthy balance attractive and attainable, and training for search and evaluation committees on unconscious bias and other factors that may lead to the devaluing of female candidates and faculty compared to their male peers⁵. Less attention is paid to the dynamics of the current departments into which they will eventually be embedded. If those environments are not attractive and supportive, women will either continue to not pursue faculty careers or leave the institutions.

There is a critical need for strategies to prepare organizations to receive diverse members by supporting positive work group environments. Overall, our work answers the call that greater “attention must be given to understanding and mediating group dynamics that may accompany demographic change brought about by affirmative action” to effectively fulfill broad, long-run objectives of reducing inequality in organizations (p. 576).⁶ In fact, the increase of women and minorities in male-dominated work organizations may lead to more negative group dynamics.^{6,7,8,9} Persistent inequality should include institutional efforts to make micro-climates, or groups, more collegial, egalitarian, equitable, and transparent to increase organizational awareness of diversity and inclusion issues.^{10, 11, 12, 13}

In short, it is imperative to develop strategies to work with the culture that exists in engineering, especially in male dominated areas where there may not be any women, to make sure that a culture into which women are introduced is hospitable. It is of critical importance to engage directly with the majority faculty to foster departmental climates that will be attractive and supportive to underrepresented faculty whether or not they are already present in the department. This research aims to proactively address the climate in which those women will be embedded to increase their attractiveness and ability to support faculty who differ from the majority currently present.

Feminists working within engineering education argue for an approach that moves beyond emphasizing women to a consideration of the gender dynamics of the profession.^{14,15,16} Many of these researchers have conducted qualitative work examining how beliefs of and about engineering are gendered, by both men and women, or works which use various feminist theoretical frames to explicate engineering’s gendered dynamics. We contribute to this research agenda within engineering education by providing a quantitative study that examines the impacts of an intervention that includes all faculty men and women and compares its effects in engineering and non-engineering departments. In this paper, we present the changes in faculty perceptions of department climate after a facilitated series of sessions to engender participatory decision-making processes and outcomes that we call *Dialogues*.

Dual agendas: Strategies to link gender equity with other positive outcomes

The dual agenda approach argues that gender equity can be best achieved by linking the attainment of equity to the achievement of something else of value to the organization.^{3,4} For example, calls to support more women and minorities in STEM in order to increase U.S. competitiveness and global economic productivity would represent the dual agenda of linking gender equity to economic progress, instead of focusing on the moral imperative of making sure that all have the opportunity to succeed in STEM.¹⁷

Acker acknowledges the contrast between dual agenda approaches and most gender equity efforts that “identify the equity problem as rooted in differences between men and women in career-relevant characteristics, in structural opportunities, or in basic personality orientations” (p. 625).⁴ In contrast, dual agenda approaches “[...] use the notion of gender as systemic, the idea that organizations are fundamentally gendered” and they “articulate a tie between gender and the organization’s most fundamental values and practices and, in addition, argue that this tie

contributes to problems such as inefficient decision-making, unclear expectations, and excessive controls” (p. 625).⁴

Although it would seem that the dual agenda approach would be effective, especially in majority male environments like engineering, where appeal to the goals of the dominant group would be a necessary condition for change, in practice dual agenda efforts have been limited in their success. Acker posits a “series of contradictions between their goals and the organization’s goals and methods that are both tools and targets of change” has limited the success of the dual agenda approach (p. 626).⁴

Addressing the dual agenda contradictions: Implementing dialogues process

Dialogues was structured to address the eight points of Acker’s critique.⁴ The following section outlines how Acker’s eight respective contradictions are explicitly addressed through the Dialogues process. This section outlines the Dialogues process and the specific implementation activities.

Dialogues was grounded in an institutional strategic planning process and occurred as part of a range of gender equity activities implemented during an NSF funded ADVANCE project. The ADVANCE program provides significant funding to institutional change efforts that recruit, retain and promote women faculty in science, technology, engineering and math fields. The *Dialogues* process consisted of a series of sessions (ranging from three to eight) that engaged departmental faculty in a total of eight hours of facilitated reflection activities and discussions about implementing the university’s strategic plan to meet the vision of the respective department. At each meeting, facilitators guided faculty through a series of activities aimed at defining the departmental vision, identifying specific action items, developing practices to achieve the action items, and documenting a collective strategy as well as individual actions.

Acker’s first group of examples occupy a category around *the contradiction that change agents have to accept in order to engage with multiple levels of an organization while negotiating power differentials*. We acknowledge the inevitability of this contradiction in dual agenda efforts, as well as other change projects. We employed a multi-pronged strategy to work within it and to demonstrate support by University, College, and Department administration. One, the project was part of an NSF funded ADVANCE grant with the university president as PI. The president designated the provost as the lead administrator. Prior to beginning work, the provost met with the entire faculty or with the chair and other faculty representatives of to introduce the work. The *Dialogues* implementation team included facilitators and the ADVANCE Center Director, who is a faculty member with a high level of political capital across the institution and extensive experience as a chair. Prior to the *Dialogues* process commencing in each department, the facilitators and the ADVANCE Center director met separately with the chair and with well-respected faculty members of the respective department to develop an implementation plan aligned with the goals of the department. Thus, the chairs and respected faculty were also engaged as allies prior to implementation.

Finally, facilitators explicitly acknowledged and discussed the contradiction with faculty members during the *Dialogues* process. We attacked the contradiction head on by making it part

of the work. The department was asked to address the contradiction among department level goals, individual faculty goals and administrative goals throughout the process. This became explicit because the university level strategic plan was the starting point for the first draft of the department's goals. First, individual faculty were asked to select three goals, including one connected to supporting diverse faculty, from the university plan's list of action items. Anonymous votes were tallied and made visible on a whiteboard. Faculty were then placed in three groups of three to seven, depending on the size of the department and were asked to come to a consensus of three selected goals within their small groups. They were instructed to use the votes for information, not as a determination for selection. The small groups were allowed to edit (or combine) university action items. The small group selections were placed on the board. Where consensus existed, the action was selected. In areas of disagreement, the full group discussed ways to drop, edit or combine actions until consensus was achieved. The process was successful in all cases within a 3-hour time frame. Thus, the conflict among various administrative entities, and how to negotiate articulating departmental desires within institutional constraints, became the bedrock of the planning efforts.

Acker's second contradiction concerns examples where *change agents occupy different roles and may hold less power within an organization than those they are trying to encourage to adopt change practices*. Rather than being a static method, *Dialogues* is a process that is continually adjusted to the implementation context and the needs of new participants. Further, like the targeted participants, the development and implementation teams consisted of faculty members, who were advised, trained, and (rarely) replaced by external consultants. The external consultants were used after the funding agency requested that the ADVANCE team speed up the number of departments in order to finish the facilitations earlier in the grant period. After more faculty were trained, these additional faculty were used instead of the external consultants.

Three of the sixteen departments (two in engineering and one in social and behavioral sciences) were facilitated by external consultants; the remaining thirteen were facilitated by faculty members from the institution but outside of the targeted department. Thus, *Dialogues* change agents, in this case facilitators, maintain a dual insider/outsider role. As faculty members at the same institution, they share an institutional history and similar organizational roles to their fellow faculty members in the department. Yet, they are not members of the targeted department and thus they are neutral outsiders to specific departmental issues and dynamics.

Two faculty members facilitated the initial eight departments over a two-year period. An external consultant with experience with STEM disciplines had collaborated with one of them on a prior project. She came to campus to conduct a week-long training in basic facilitation techniques with these two faculty members prior to the start of the project. Afterwards, the two faculty members incorporated some of these basic exercises into *Dialogues*. The two faculty members then developed the basic *Dialogues* structure of three stages: 1) Envisioning the ideal department; 2) selecting and editing actions based on institutional planning; and 3) drafting a plan to meet these actions.

Over the first two years, the two facilitators facilitated eight departments (four in engineering and four in science and math). Participating departmental faculty were asked to complete written assessments at the end of each session, answering two questions: 1) What worked? and 2) What

could be changed to make things work better? To demonstrate that targeted faculty insights were important to the project, the results were shared back with the department at the beginning of the next session, resulting in adaptations to the current work. Additionally, the feedback was used by the facilitators to refine the specific exercises and processes for future implementation.

After the completion of the *Dialogues* process with the first eight departments, the external consultant and a colleague were asked to work with some departments in order to speed up implementation in the remaining departments. The consultants were trained on the *Dialogues* process. After three departments, it became apparent that the consultants' lack of experience as faculty members, their unfamiliarity with academic institutions, and their lack of understanding of the research process were disadvantageous. At this point, one of the initial faculty facilitators trained three additional faculty members on the *Dialogues* process. This group facilitated the final five departments. The teams continued to seek input from targeted faculty and tailor the process to new contexts. Further, one of the new facilitators had a background in facilitation and introduced new ways of encouraging individual accountability and making the overall process more quick and efficient.

Thus the *Dialogues* method was based on successful facilitation techniques, developed specific exercises and was refined in-house by people with a stake in the future of the institution. Critically, it was developed by faculty facilitators whose primary role was akin to the targeted group – other faculty members. The process was refined in an iterative manner based on the feedback and insights of the faculty participants through the *Dialogues* sessions.

Acker's third category involves a direct critique of the foundational strategy of dual agenda efforts to *integrate gender equity concerns within a framework of attaining the broader organizational mission because gender equity will be overshadowed and may disappear*. The *Dialogues* project was completed in the context of a larger gender equity project. Although most *Dialogues* meetings didn't explicitly focus on gender equity, there were a few key points where this was an explicit part of the mission. Also, *Dialogues* occurred in the context of other activities that were explicit in their gender focus. Further, messages around gender equity and inclusivity came from multiple points during the time of the program.

In her initial meetings with all departments or key representatives, the provost employed a dual agenda message, linking completion of the work to the department's ability to contribute to the overall institutional mission (and their consequent access to resources) and emphasizing that in order to achieve this goal, academic departments needed to be inclusive places attractive to diverse, productive faculty. Although gender was not the explicit topic during the meetings, departments were required to select a university action item that specifically concerned recruiting, retaining and further supporting a diverse faculty.

Dialogues occurred simultaneously with multiple activities where gender equity was the explicit target. This included a speaker series on "Why Diversity Matters," development and implementation of work-life practices including lactation and parental leave, participation of female and other underrepresented faculty in a Sponsorship program that paired them with external mentors, trainings for search committees on unconscious bias and on equitable practices, the development of the ADVANCE director position into a campus wide advocate for faculty

and liaison among faculty, chairs, deans and other administrators, and monthly training sessions/luncheons for female and other underrepresented faculty. The university also became a member of the National Center for Faculty Development and Diversity, and the provost's office began providing funding to support faculty members completing their online mentoring program. The ADVANCE director and staff coordinated the implementation of this program.

Many faculty members from the targeted departments participated in these events. In particular, the ADVANCE and institution funded Sponsorship program provided a method to gain buy-in from chairs. The Sponsorship program provided resources to connect underrepresented faculty with research support. These gender equity programs had direct benefits to the chairs' own faculty's research productivity and overall success. Additionally, the National Center for Faculty Development and Diversity sends weekly emails that sparked many discussions around diversity and faculty development. Faculty members who received direct support from these efforts developed goodwill for associated activities, including *Dialogues*. Further, the ADVANCE director became a critical participant in conversations that included faculty diversity in the context of other specific university initiatives and concerns.

Acker's fourth point is that gender equity goals may disappear because of *the lack of congruence between the interests of various organizational members*, meaning that not all parties will benefit by a change to the current system. To address this, the post *Dialogues* process included multiple accountability structures. The ADVANCE director worked with the deans of the two targeted colleges to develop an accountability structure to make sure that the strategic plans developed through the Dialogue process were implemented. After the departments completed their plans, they submitted them to the ADVANCE director, who had to approve them before they went to the deans. At this stage, she made sure that each plan included gender equity in its activities. After that, the plans went to the deans and are incorporated into the annual review of the chairs; in other words, the chair's goals are aligned with those in the departmental plan and the chair's evaluation is linked to completion of those goals.

In addition to the above, departments were also provided with several rewards and other positive motivations. Upon successful completion of the work, each department could apply for a small sum (\$3000) to use for direct support of a gender equity activity. Uses of the funds could include supporting a female faculty member, inviting a speaker to discuss gender equity issues specific to the discipline, or sending a faculty member to recruiting trips, among other activities. Finally, the ADVANCE director also had additional funding to recognize the department that made the most progress on the gender equity goals, by hiring or developing programming to support diverse faculty, based on their plan.

Fifth, Acker argues, given that *gender is embedded within power/class structures*, even individuals who support gender equity may not want to make the associated changes to the underlying power/class structure. One significant gendered power/class structure is the type of faculty appointment. Academic appointments include tenure-track faculty members with research, teaching and service expectations, as well as non-tenurable, but promotable, full-time teaching, clinical and research faculty members who focus on one or two of those areas. In the science, math and engineering disciplines, women were generally overrepresented among the full-time teaching faculty. The aim of *Dialogues* was to encourage faculty to interact across these

faculty-type divisions that might ordinarily keep this apart. Thus, all promotable faculty participated in *Dialogues*. Faculty were not separated by role or differentiated on this basis during the sessions. However, due to the power differentials, these tensions did not generally become an explicit part of the *Dialogues* conversation.

Change agents must simultaneously work to address these power/class structures as well as address gender change. In the case of *Dialogues*, the ADVANCE director linked her work on gender equity issues to the power and class issues within the larger institution, particularly in the area of policies and practices around faculty evaluation and promotion and tenure.

Sixth, Acker highlights problems around conflicts between “*the timing and rhythms*” of *organizations and change efforts*. To address this, we introduced *Dialogues* as a process for managing departmental business and in the context of producing a specific item required by the organization within an organizationally determined time frame. All of the institution’s departments were required to produce strategic plans aligned with the university plan regardless of whether or not they participated in *Dialogues*. Thus, *Dialogues* was presented as a means for departments to receive support in a task they were already required to complete. In addition to in session facilitation, ADVANCE staff helped with tasks such as typing up notes and drafts.

Further, *Dialogues* was designed with a flexible meeting structure so that it could accommodate a variety of faculty meeting sessions. Variations included eight one hour weekly meetings, four two hour monthly meetings, three days in a row of two or three hour meetings, and half day retreats before or after the semester coupled with two meetings during the semester. Meetings were scheduled, where possible, during the regular period for faculty meetings and with family friendly principles (i.e., not meeting past five; trying to avoid conflicts with daycare pick up and drop off) in mind. To achieve this, meetings were scheduled a semester in advance.

Seventh, Acker locates a philosophical problem for the dual agenda approach in *the pervasive cultural representation of organizations as gender neutral*. In *Dialogues* implementation, we were particularly concerned with the issues that Acker raised around perceptions that those who supported gender equity efforts or underrepresented faculty were “whiners and losers” who needed help and couldn’t succeed on their own merits. Thus, we avoided dividing faculty based on categories and calling attention to the ‘outsider’ statues of those not in the majority. Faculty were not placed in groups by gender, race, rank or any other factor and we did not make these categories explicit during the facilitation. All faculty participated and all faculty received the same programming during *Dialogues*.

This is also a major reason we focused on group dynamics and did not conduct explicit gender equity programming. We aimed to shift the conversation away from the ‘needs’ of some groups (and the validity of those needs) to the environment and decision making processes of the department as a group. In this way, we engaged equally with all departments, including those with no women or other underrepresented faculty. Therefore, facilitators focused on the benefits of *Dialogues* to the functioning of the department as a whole and to the success and well-being of all faculty members.

We also emphasized the benefits of other ADVANCE programming for all faculty, including members of dominant groups. For example, the Sponsorship program was piloted with underrepresented faculty, and then extended to everyone through a program embedding funding in start-up funds. Fathers, as well as mothers, could receive parental leave if they were the primary care-giver. All faculty members could apply to the NCFDD program. Thus, we aimed to establish best practices for underrepresented faculty as the norm for all faculty.

Acker's eighth point is that *individuals, male and female, are generally evaluated for success based on their ability to display aspects stereotypically male traits* such as “the ability to control, to act forcefully, and, especially in the headquarters, to play the hero, a strong, assertive, eloquent, results-oriented actor” (p. 631).⁴ We believe that this is a reason to focus on group level processes rather than individual traits. To address this, we made a conscious decision to set up a process designed to encourage the input of ideas from all faculty and to achieve this, we used a variety of formats. Overall, we balanced opportunities for anonymous input with periods of speaking to the group to allow for expression of opinion by those with different comfort levels for speaking.

Within the each of the stages of the *Dialogues* process (envisioning the ideal, selecting/revising actions from the university plan, and drafting a department plan) we followed the same sequence of processes: individual reflection, small group interaction, and large group consensus testing. Within each process, we asked faculty to complete various activities, which included brainstorming, sharing ideas verbally, summarizing ideas visually, ranking and prioritizing both individually and as a whole, discussing in small groups, presenting results to other groups, selecting topics to work on, generating questions, and full group discussions. For example, during the envisioning the ideal exercise, faculty members were given worksheets with three questions: 1) How would you describe the ideal department? 2) What would students say about it? and 3) How would administrators describe it? They completed these items as individuals. They were then placed in small groups to share their responses, compile a group response, and summarize their group response on white boards. At the next stage, each group shared their list and worked on grouping and editing into one list that covered all of the groups' desires, which was summarized on whiteboards. Then each individual faculty member was asked to place three checkmarks next to the areas that were their top priorities. The *Dialogues* facilitators and ADVANCE staff compiled these between sessions into an Ideal Department document. At the start of the next session, faculty reviewed and made final changes the document. Similar activities occurred for the selecting/revising action items and the drafting stages and the same sequence – individual, small group, full group, with prioritization between stages – was followed.

Academic disciplines as a site to test how varying contexts impact success of dual agenda initiatives

Academic disciplines provide an excellent site to test some of the questions Acker raises about what may be blocking the success of dual agenda efforts. In this specific study, we have selected a subset of academic disciplines that have been targeted by NSF funded ADVANCE projects – these broadly include NSF funded areas across the groups of the social and behavioral sciences, the natural and physical sciences and math disciplines, and engineering disciplines. These

disciplines are codified into institutional structures because they form the general basis for the organization of the academic unit in which faculty members are embedded – the department.

Engineering disciplines provide a particularly rich case because they are the disciplines with the lowest representation of women. Further, there exists a body of feminist research, within engineering education, which examines how engineering disciplines (and other STEM fields) are gendered and how lack of attention to gender as a property of institutions (disciplines) has blocked change efforts. These authors make the case, as do dual agenda efforts, that in order for change to occur, there must be a shift from focusing on individual-based change efforts which are sometimes described as ‘fixing the women’ to fit within the current system, to thinking about gendered institutions and how to shift those away from masculinized norms.

In engineering classrooms, male students’ ways of thinking about the world are prioritized; to succeed, women have to fit within these masculinized norms.¹⁸ More recently, scholars have examined how this systematic privileging occurs and how it constitutes engineering, and science and math, culture. Beddoes and Pawley interviewed 19 faculty members across a range of science, technology, engineering and agricultural disciplines. They found that faculty perceive that women “choose” to leave science, engineering and math without any external factors affecting their decision to leave and, therefore, “any impetus for changes to structures of the academy is mitigated by the discourse of individual choice” (p. 1582).¹⁵ In addition, Hough and Pawley found similar notions focusing on individual choice when they examined how women frame their career choices. One of their participants used the metaphor of doors opening and closing to describe her career. They argue that her use of the passive voice “depicts her as a passive actor whose fate is determined by an outsider with the power to open or not open doors at junctures along the career path” (p. 7).¹⁶

The above research indicates that faculty define the problem of representation in terms of choices made by female faculty, especially around children, or in gendered structures of society (family leave policies or the lack thereof). Thus, the choice is presented as outside of the purview of other faculty members. In contrast to this assumption, research on why women stay or leave science, engineering and math fields, as well as on what impacts their job satisfaction, indicates that the reality is that this narrative obscures areas where it is possible for faculty to take action.

Specifically, research indicates that practices to enhance faculty interactions so that women perceive decision-making as inclusive, network with their colleagues, and experience departments as attractive environments have high potential to increase recruitment and retention. Faculty members value the opportunity to have input and influence in departmental decisions and morale is highest when they are able to do so; thus, departmental dynamics affect work-life quality, satisfaction and retention.¹⁹ Female faculty feel they are excluded from interactions with colleagues and are much less likely to feel that they participate in departmental decision-making than their male colleagues.^{20,21,22} Climate concerns persist even when more women enter a field, and even when they occupy positions of authority.²³ Male faculty can also experience negative outcomes from departmental climates hostile to women.²⁴

Callister found that women science and engineering faculty had significantly lower job satisfaction and higher intentions to quit, but that the relationship was moderated by perceptions

of department climate “such that when they experience negative department climates they are more likely to experience lower job satisfaction and consider going elsewhere” (p. 373).²⁵ Fox found that women science and engineering faculty described that they were less likely to speak about their research and they reported less inclusive environments, in addition to more work-family conflict.²⁶ Further, the promotion perceptions of women associate professors in computing were positively impacted by collaboration with faculty in home unit and a stimulating/collegial department climate, as well as age, number of children under age 6 and working at a US university. Factors with a negative impact included children age 6-18, work-family interference, the importance of entrepreneurial activity in reward structure, and a high-paced department climate.²⁷ Beddoes, Pawley and Banerjee found that leading gendered facets of science, engineering and math faculty careers were found to be: (1) socialization and informal social networks, (2) societal gender roles and unconscious biases, and (3) work-family balance. Female participants discussed being excluded from male social networks and a lack of freedom to engage in those networks, even if they wanted to.¹⁴

Overall, previous research indicates that positive departmental climate, especially positive interactions with colleagues and inclusion in decision making and information pathways, is critical to women faculty’s satisfaction and retention in science, engineering and math fields, but that, unfortunately, women report low satisfaction in these areas. *The gap that we aim for our work to fill in the literature is how to intervene in departmental climate to encourage the factors that women identify that they need for success.* To achieve the above, our approach incorporates the dual agenda approach, with attention to prior described barriers, as well as the research on which departmental climate aspects have a potentially significant impact on women’s careers. In the next section, we will use these pieces of the literature to frame our discussion of the *Dialogues* program and our associated research.

Dialogues as a dual agenda approach to support departmental climates that are positive for women

Dialogues aims to foster the type of inclusive and supportive departmental interactions and the participatory and transparent decision making processes that the prior research indicates are critical to the retention of women faculty. One mechanism by which this process has impact is a social psychology concept, “collective efficacy,” which is defined as “a group’s shared belief in their conjoint capabilities to organize and execute the courses of action required to produce the levels of attainments” (p. 476).²⁸ Further aspects of climate that the *Dialogues* process targets include dependence, interdependence and conflict, which are group dynamics identified as affecting women scientists' overall job satisfaction and intention to quit.^{1,25,29,30} Overall, *Dialogues* aim to build collective efficacy and interdependence, while decreasing conflict and dependence. *Dialogues* falls into the category of dual agenda efforts because we fostered inclusive behaviors around decision making processes and congenial faculty interactions in the context of assisting departments as they developed a strategic plan – an action required by the institution. The strategic plans were required to include departmental actions to support diverse faculty. Instead of providing content about issues impeding gender equity, we focused on supporting the behaviors (e.g. the climate variables discussed above) to promote equity. We wanted to see how this indirect dual agenda approach impacted faculty beliefs about their

department's ability to achieve gender equity, as well as their perceptions of other key aspects of departmental climate.

Our research addresses an issue raised by Acker: "Does the sex composition of change agent groups make a difference in the success of projects?" (p. 627)⁴ Our goal was to see if there were differential impacts of the *Dialogues* process on departmental climate measures among academic departments that vary in the percent of women present, specifically comparing engineering (with the fewest women – 12 percent of the faculty at the institution) with science/math (women are 20 percent of the faculty) and the social and behavioral sciences (the most women – 30 percent of the faculty).

Methods

To assess the impact of *Dialogues* on faculty perceptions of department climate and their optimism about attaining gender equity goals, we created and administered a quantitative, Likert-scale survey to each faculty member in each of the sixteen departments. The seven scales in the survey measured constructs associated with changes in the following group properties targeted by *Dialogues*: Affective State toward Change (Affective) (five items), Optimism About Gender Equity (Optimism) (four items), Vicarious Experience of Gender Equity (Vicarious Experience) (four items), Collective Efficacy toward Gender Equity (Collective Efficacy) (three items), Dependence (five items), Conflict (five items), and Interdependence (six items; see the Appendix A for survey questions).^{31,32}

The first four scales (Affective, Optimism, Vicarious Experience, and Collective Efficacy) assess faculty perceptions of their department's ability to improve the recruitment, retention, and promotion of female faculty, and to move female faculty into leadership positions. The Affective scale determined the department's attitudes about change and science, engineering and math field gender equity efforts. The Optimism scale examined the group's expectations about whether their department's efforts would lead to equity. The Vicarious Experience scale measured how aware they were of successful change efforts outside of their department. The Collective Efficacy scale modified Bandura's definition and looked at social cohesion, feelings of agency, the belief in their group efficacy to hire qualified female faculty, promote women to full professor, and advance women faculty into leadership positions.²⁸

The remaining scales (Dependence, Conflict and Interdependence) assessed perceptions of departmental relationships, among the group as a whole, between and among colleagues and groups of faculty, between faculty and chair, and with other administrators. For example, the Dependence scale assessed whether or not the faculty expected the leader or a few core faculty members to solve problems or make decisions. Interdependence looked at their perceptions of their experiences and ability to work together to solve problems and make decisions; for example, do they rely on and encourage each other when solving problems, do they have high expectations of each other, do they cooperate. Conflict examined how faculty perceived their interactions with colleagues, looking at things like whether or not there are 'cliques', if faculty avoid each other, and whether or not discussions are combative, among other factors.

Overall, we expected that participation in *Dialogues* would improve faculty perceptions of their ability to hire, retain and promote women (i.e., significantly higher scores on the Affective, Optimism, Vicarious Experience, and Collective Efficacy scales). We also expected improvements in faculty perceptions of their departmental relationships and interactions (i.e., lower scores on the Dependence and Conflict scales but significantly higher scores on the Interdependence scale).

Faculty members completed the survey prior to and after participation in *Dialogues*. We looked at aggregate-level departmental change. To protect participant identities and maintain confidentiality, responses were anonymous. Thus, we cannot compare pre- and post- responses for individual faculty members. For the first eight departments, pre-test data were collected via group administration at the first meeting in which faculty members were oriented to the departmental work. Post-test data were collected via an online version of the survey at least three weeks after the departmental meetings had concluded. For the final eight departments, both pre- and post- tests were administered online. We have pre- and post-test data on sixteen academic departments: seven engineering departments, six natural science and mathematics departments, and three social and behavioral science departments.

The specific departments within engineering include: Civil and Environmental Engineering, Industrial and Management Systems Engineering, Mechanical and Aerospace Engineering, Petroleum and Natural Gas Engineering, Mining, Chemical Engineering, and Computer Science and Electrical Engineering. Within this group, there were 92 responses to the pre-test and 51 responses to the post-test (total 143). There were 135 faculty participants so the pre-test response rate is 68 percent and the post-test rate is 38 percent. The natural science and mathematics departments are Biology, Chemistry, Geology and Geography, Mathematics, Statistics and Physics. There are 96 responses to the pre-test and 59 responses to the post-test (total 155). There were 150 faculty participants so the pre-test response rate is 64 percent and the post-test rate is 39 percent. The social and behavioral science departments are Psychology, Sociology, and Political Science. This group returned 42 pre-test surveys and 33 post-test (total = 75). With 64 faculty participants, the pre-test response rate is 66 percent and the post-test rate is 52 percent.

Table 1 presents pre- and post-test descriptive statistics by disciplinary group. The majority of respondents in social and behavioral sciences are female (approximately 60 percent); with male respondents in the majority for pre- and post-tests in engineering (pre = 87 percent; post = 67 percent) and natural science and math (pre = 77 percent; post = 66 percent). In engineering and natural science and math, the post-test participation rate increases notably for women. Most respondents in all groups describe themselves as part of the majority racial group. The higher percentages of engineering and natural science and math faculty identifying as minority race are due to a higher representation of Asian faculty in these departments. Most respondents are Full Professors in engineering on both pre- and post- test. In natural science and math they are majority Full Professors on the pre-test and Assistant Professors on the post-test. And in social and behavioral sciences, they are majority Assistant Professor on the pre-test and the post-test.

Table 1. Sample descriptive statistics by discipline

| | Engineering | | Science & Math | | Social & Behavioral Sciences | |
|--|----------------------|------------|---------------------------|------------|---|------------|
| | <i>Frequency (%)</i> | | <i>Frequency (%)</i> | | <i>Frequency (%)</i> | |
| | Pre-test | Post-test | Pre-test | Post-test | Pre-test | Post-test |
| Academic Rank | | | | | | |
| Assistant Professor | 27 (30.34) | 16 (32.00) | 28 (29.47) | 20 (33.90) | 20 (50.00) | 14 (43.75) |
| Associate Professor | 16 (17.98) | 9 (18.00) | 23 (24.21) | 16 (27.12) | 10 (25.00) | 11 (34.38) |
| Professor | 40 (44.94) | 21 (42.00) | 34 (35.79) | 16 (27.12) | 6 (15.00) | 4 (12.50) |
| Other (e.g., Instructor, Lecturer, etc.) | 6 (6.74) | 4 (8.00) | 10 (10.53) | 7 (11.86) | 4 (10.00) | 3 (9.38) |
| Sex | | | | | | |
| Female | 11 (13.41) | 15 (32.61) | 21 (22.83) | 18 (33.96) | 21 (63.64) | 18 (60.00) |
| Male | 71 (86.59) | 31 (67.39) | 71 (77.17) | 35 (66.04) | 12 (36.36) | 12 (40.00) |
| Race^a | | | | | | |
| Majority | 48 (58.54) | 28 (63.64) | 67 (73.63) | 41 (77.36) | 32 (94.12) | 26 (86.67) |
| Minority | 15 (18.29) | 6 (13.64) | 11 (12.09) | 3 (5.66) | 1 (2.94) | 0 (0.00) |
| Prefer not to answer | 19 (23.17) | 10 (22.73) | 13 (14.29) | 9 (16.98) | 1 (2.94) | 4 (13.33) |
| Age | | | | | | |
| Less than 30 years | 1 (1.28) | 3 (6.98) | 1 (1.14) | 1 (2.04) | 1 (3.23) | 1 (3.70) |
| 31-40 years | 22 (28.21) | 12 (27.91) | 33 (37.50) | 18 (36.73) | 20 (64.52) | 12 (44.44) |
| 41-50 years | 21 (26.92) | 6 (13.95) | 16 (18.18) | 11 (22.45) | 5 (16.13) | 9 (33.33) |
| 51-60 years | 16 (20.51) | 8 (18.60) | 20 (22.73) | 10 (20.41) | 3 (9.68) | 5 (18.52) |
| 61-70 years | 17 (21.79) | 14 (32.56) | 16 (18.18) | 9 (18.37) | 2 (6.45) | 0 (0.00) |
| Greater than 70 years | 1 (1.28) | 0 (0.00) | 2 (2.27) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| N | 92 | 51 | 96 | 59 | 42 | 33 |

Notes: The number of responses to each question varies from the total sample size due to missing values.

^a Because of the fairly homogeneous faculty population at WVU, we could not ask individuals about their specific racial/ethnic categories to protect identification.

To assess the effectiveness of our departmental intervention, we compared the values on our seven composite variables from the pre-test administration of the survey before the facilitation started to the post-test collection of data after the facilitation was complete. Table 2 presents these results. For those variables following a normal distribution, a standard independent samples t-test was used while for those with non-normal distributions a Wilcoxon rank sum test was employed.

Results

Dialogues affected faculty perceptions of climate and their optimism around reaching gender equity goals differently across the three groups. In general, engineering most closely matched our expectations, natural science and math saw the least change, while social and behavioral sciences went counter to our expectations. Table 2 presents the impact of *Dialogues* on faculty perceptions of the seven scales. In engineering, there was an increase in Collective Efficacy, or the shared belief that the department can work together and create conditions to hire qualified female faculty, promote women to Full Professor, and advance women faculty into leadership positions. This was due to a shift in distribution of responses, with more faculty clustered in the higher values. Thus, the response was significant even though the difference in mean responses was slight. Engineering faculty's decreased perceptions of Conflict indicate that after participating in the *Dialogues* process, they are not as likely to describe meetings as combative, to believe that subgroups are excluding others, or to think that faculty members are avoiding each other. In addition, levels of faculty Dependence (for example on the chair or other administrators to solve problems and make decisions) decreased significantly, indicating higher faculty engagement in decision-making and other processes. Faculty perceptions of Interdependence, as well as the Affective State, Optimism and Vicarious Experience toward gender equity did not change. For natural science and math, the only significant effect was an increase in faculty perceptions of the Vicarious Experience of gender equity. This means that faculty indicated that they became more aware of other academic departments succeeding in retaining, advancing, and promoting women. Finally, in the social and behavioral sciences, faculty perceptions of Conflict increased and Collective Efficacy decreased.

Implications

Overall, our results indicate the importance of looking at how change efforts vary in their impacts across disciplinary groupings with different progress toward gender equity, histories, and other disciplinary conventions. For the *Dialogues* process, it appears it has particular promise for engineering disciplines. This is significant given that these disciplines have had the least success in achieving gender equity. It also appears that *Dialogues* may provide a fruitful dual agenda method to engage with majority male environments. Changes in faculty perceptions, especially including the increase in Collective Efficacy, may translate into actions. In our future research we intend to examine qualitative faculty responses to the *Dialogues* process to gain further insight into why we saw these differential impacts across groups.

Table 2. Composite scales

| Composite Scales Using Weighted Factor Scores ¹ | | | | | | | | | |
|--|-----------------------------------|--|------------------|-----------------------------------|-----------------------------------|------------------|-----------------------------------|---|------------------|
| Construct | All Engineering Departments | | | All Science and Math Departments | | | Social and Behavioral Sciences | | |
| | Pre-test | Post-test | Cohen's <i>d</i> | Pre-test | Post-test | Cohen's <i>d</i> | Pre-test | Post-test | Cohen's <i>d</i> |
| Affective state toward gender equity | Mean = 3.02 SD = 0.74 N= 83 | Mean = 2.99 SD = 0.66 N= 47 | 0.043 | N/A | N/A | N/A | Mean = 2.93 SD = 0.65 N= 35 | Mean = 3.10 SD = 0.78 N=29 | 0.236 |
| Collective efficacy toward gender equity | Mean = 3.97 SD = 0.15 N= 83 | Mean = 4.04 ^{***†††} SD = 0.18 N= 46 | 0.423 | Mean = 4.10 SD = 0.17 N= 94 | Mean = 4.07 SD = 0.10 N= 52 | 0.215 | Mean = 4.32 SD = 0.08 N= 34 | Mean = 4.18 ^{***} SD = 0.02 N=29 | 2.401 |
| Dependence | Mean = 4.51 SD = 1.14 N= 92 | Mean = 4.09 ^{***††} SD = 1.21 N= 47 | 0.357 | Mean = 4.16 SD = 1.25 N= 91 | Mean = 4.23 SD = 1.20 N= 51 | 0.057 | Mean = 3.88 SD = 1.26 N=39 | Mean = 3.67 SD = 1.10 N=27 | 0.178 |
| Conflict | Mean = 4.47 SD = 1.18 N= 86 | Mean = 3.78 ^{***††††} SD = 1.20 N= 47 | 0.580 | Mean = 4.47 SD = 1.41 N= 86 | Mean = 4.51 SD = 1.25 N= 54 | 0.030 | Mean = 4.01 SD = 1.14 N=38 | Mean = 4.36* SD = 1.05 N=29 | 0.319 |
| Interdependence | Mean = 5.23 SD = 0.90 N= 87 | Mean = 5.40 SD = 0.88 N= 48 | 0.191 | Mean = 5.08 SD = 1.08 N= 91 | Mean = 4.90 SD = 1.08 N= 52 | 0.167 | Mean = 5.04 SD = 0.96 N=38 | Mean = 5.00 SD = 1.02 N=30 | 0.043 |

| Composite Scale Using Summation of Significant Items ² | | | | | | | | | |
|---|-----------------------------------|-----------------------------------|--------|-----------------------------------|--|-------|-----------------------------------|-----------------------------------|-------|
| Construct | Pre-test | Post-test | | Pre-test | Post-test | | Pre-test | Post-test | |
| Optimism about gender equity | Mean = 3.44 SD = 0.98 N= 82 | Mean = 3.53 SD = 0.99 N= 40 | 0.0913 | Mean = 2.63 SD = 0.87 N= 78 | Mean = 2.55 SD = 0.79 N= 44 | 0.096 | Mean = 3.35 SD = 1.31 N= 20 | Mean = 3.42 SD = 1.02 N= 19 | 0.059 |
| Vicarious experience of gender equity | Mean = 2.56 SD = 1.63 N= 82 | Mean = 2.66 SD = 1.68 N= 41 | 0.0604 | Mean = 2.69 SD = 1.07 N= 78 | Mean = 3.47 ^{***††††} SD = 1.32 N= 45 | 0.649 | Mean = 3.79 SD = 0.68 N= 29 | Mean = 3.76 SD = 0.89 N= 21 | 0.038 |

*** $p < .01$, ** $p < .05$, * $p < .10$ for one-tailed parametric *t*-test

††† $p < .01$, †† $p < .05$, † $p < .10$ for one-tailed non-parametric rank-sum test

¹Includes a purified scale of measures, combined into a weighted factor score and rescaled to the original Likert scale units

²Includes a purified scale of measures combined into a summative scale (i.e., no. of 'yes' responses)

Cohen's *d* = standardized mean difference (# of standard deviations apart)

0 to .20 = small effect size

.20 to .50 = medium effect size

> .50 = large effect size

Of particular interest is why there were differential impacts of *Dialogues*. We are especially interested in why *Dialogues* had its particular impacts on Engineering. Research has indicated that when working on ill-structured problems, such as the ones presented during *Dialogues*, engineers engage in different aspects of the engineering design process such as identifying constraints, brainstorming, generating different solutions, and communicating solutions.³³ Ill-structured problems include multiple perspectives, interpretations, holistic approaches to solutions, and they are dynamic and the constraints can be both engineering and non-engineering related.³⁴ In the end of session assessments, the engineering faculty involved in the *Dialogues* expressed engaging in similar activities (e.g., brainstorming, identifying constraints, and generating solutions) when discussing the department's ability to improve the working environment for female faculty. Thus, in the context of *Dialogues*, engineering faculty assumed and portrayed the same technical, methodological, and logical nature of engineering. Faculty members, indirectly and through their responses, emphasized, collectively, their perception that engineering habits of mind and dispositions are required for success in solving "ill-structured problems" not only in engineering, but also to move toward success as an academic unit.

Engineering involves not only strictly cognitive activities, but also learning how to talk, act, think, and share common beliefs, values, and ways of knowing and doing.³⁵ In this sense, engineering can be described as a microculture that encompasses human phenomena related to learned behavior patterns distinctive of a culture such as the norms, beliefs, expectations, or conventional actions. According to Godfrey and Parker, in order to move toward a cultural change, we must look into the collective "values, beliefs and assumptions which underpin the culture of engineering education at the disciplinary, departmental, or institutional level" (p.18).³⁶ We believe that *Dialogues* was successful with engineering faculty because the process mirrored the engineering design process and was similar to providing solutions to "ill-structured problems".^{34,37,38} These "challenge-based" environments motivate people to solve problems, because they are embedded in familiar and meaningful activities – activities that are also emphasized in the classroom. *Dialogues* was more successful in engineering contexts, indicating that designing change processes that reflect the approach of "ill-structured problems" has enormous potential to improve gender equity in engineering.

When comparing natural science and math to engineering, it is important to note that in the case of Collective Efficacy, engineering shifted to be closer to science and math's original perception; thus, *Dialogues* appears to have helped engineering reach a value already attained by natural science and math. This is not true of Conflict, where engineering started out as equivalent to natural science and math and decreased to below natural science and math in the post-test results. The results for Vicarious Experience appear credible, in that more natural science and math departments have successfully recruited, retained and promoted women, whereas, this is not the case for engineering, where success has been less.

Finally, the trend in social and behavioral sciences is notable, given that this area has the most success in gender equity, with some disciplines having majority female faculty. In terms of dual agenda efforts, the results in social and behavioral science add most to Joan Acker's points about the importance and difficulty of changing gendered institutions. Perhaps because there are more women, these disciplines are perceived as feminized and less prestigious, therefore faculty within them actually must adhere most closely to gendered norms that privilege masculine behaviors.

Perhaps, prior to *Dialogues*, these faculty members perceived their dynamic as positive because of the large numbers of women, but when they had conversations around departmental practices like promotion and tenure expectations, workload and work life balance they realized they were in an untenable situation. Further, some faculty in these sessions resisted gender equity goals of the larger ADVANCE project by arguing that they needed to recruit more male faculty and that their disciplines were becoming too female skewed. The departments did not identify racial equity as a goal although many racial/ethnic groups are underrepresented in these fields. Thus, some of the results could also have been due to push back around gender equity initiatives from the larger ADVANCE project that they perceive as irrelevant.

In contrast to our expectations, there were no significant changes in Affective State, Optimism and Interdependence. The lack of impact to Affective State could reflect the design of the survey. Take, for example, the statement, "Changing the way we do things, in our department, is a good idea." Faculty might be satisfied with the way they currently do business. We did not measure Affective State in natural science and math because the variables did not meet the criteria for a scale. The lack of effect to Optimism could reflect the fact that *Dialogues* was, in the scheme of attaining gender equity, a short term intervention. Faculty could have a 'wait and see' attitude. The lack of impact to Interdependence could be for a similar reason. Perhaps, the perception of positive groups dynamics while working together will come after faculty have had the opportunity to work together to attain goals, rather than to plan for change.

Overall, our work is significant because it demonstrates an effective strategy for addressing gendered group processes. Thus, it answers the call from Acker and dual agenda proponents and from within engineering education to conceive of institutional processes, practices and cultures as gendered and to address this gendering. Further, *Dialogues* appears to be an effective strategy to use with majority male environments to help develop cultures that will be inclusive for underrepresented faculty when they are recruited. The need for approaches to create and support such climates is clear. One way to accomplish this goal is to provide discussion formats in which participation "by faculty from every race/ethnic and gender group may show faculty members how they can structure effective research and teaching agendas. Such a strategy may also strengthen the bonds of collegiality and foster opportunities for more productive activity" (p. 182).³⁹ This is especially critical in engineering where "[r]eputations and rankings matter for the survival of academic careers and schools, so activities that seem to loosen standards (for incoming students, or for faculty research attainments) present intolerable risks. We need to change that situation by systematically rewarding those activities that support demographic change" (p. 211).⁴⁰

In our future research, we plan a mixed method analysis to include qualitative data, both faculty participant feedback and the products (e.g. Ideal Department) produced as part of the work, to provide a deeper understanding of why impacts of *Dialogues* differed across the groups.

Limitations

Dialogues examined faculty perceptions rather than action to attain gender equity. The follow up was also limited in time so we don't know if the changed attitudes will persist. The intervention occurred at one institution; further testing is needed to see how it translates to other contexts.

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Appendix A: Survey items measuring psycho-emotional development constructs

| Construct | Survey Items | Part of Composite Scale for... | | |
|-------------------------------------|---|--------------------------------|--------------|-------------|
| | | SBS | Science/Math | Engineering |
| <i>Dependence</i> ^a | • Faculty Members go along with what the Chair wants with little or no debate. | | X | |
| | • Faculty members don't know each other well. | X | X | X |
| | • Most faculty members interact through the Chair. | X | | |
| | • Only a few faculty members talk much at meetings. | X | | X |
| | • The Chair makes most of the decisions. | | X | X |
| | <i>Cronbach's α</i> | | .70 | .57 |
| <i>Conflict</i> ^a | • Faculty members seem to have different views about how things should be done. | | X | |
| | • Faculty members are often critical of the decisions from the leadership. | X | | X |
| | • Faculty members avoid each other at times. | X | X | X |
| | • There are subgroups in our faculty who exclude others. | X | X | X |
| | • Our faculty discussions are combative. | X | X | X |
| | <i>Cronbach's α</i> | | .84 | .82 |
| <i>Interdependence</i> ^a | • Faculty members encourage high performance from each other. | X | X | X |
| | • Faculty members rely on each other to accomplish departmental goals. | X | X | X |
| | • There is a general spirit | X | X | X |

| | | | | |
|---|--|-----|-----|-----|
| | of cooperation among faculty. | | | |
| | • The workload is distributed fairly in our department. | X | X | |
| | • Faculty members give each other useful feedback on effectiveness and productivity. | X | X | |
| | • The goals and objectives of our department are clear to everyone. | X | X | |
| | <i>Cronbach's α</i> | .90 | .87 | .79 |
| <i>Affective States</i> ^b | • Changing the way we do things, in our department, is a good idea. | X | X | X |
| | • Our faculty should be more diverse. | | | |
| | • Advancing women in STEM fields is a good idea. | | | |
| | • I am frustrated by the current efforts to change our department. | X | | X |
| | • I am concerned the efforts to create changes in STEM departments will fail. | X | | X |
| | <i>Cronbach's α</i> | .75 | -- | .69 |
| <i>Collective Efficacy</i> ^b | WORKING TOGETHER, we are able to CREATE CONDITIONS, in our department to... | | | |
| | • ...advance qualified women faculty into leadership positions. | X | X | X |
| | • ...promote qualified women to Full Professor. | X | X | X |
| | • ...hire qualified women for faculty positions. | X | X | X |
| | <i>Cronbach's α</i> | .94 | .92 | .88 |
| <i>Optimism</i> ^c | I am OPTIMISTIC that my department will... | | | |

| | | | | |
|--|--|-----|-----|-----|
| | • ...become more diverse in the future | X | | X |
| | • ...attract qualified women. | X | X | X |
| | • ...improve faculty retention rates. | X | X | X |
| | • ...promote qualified women to leadership positions. | X | X | X |
| | <i>Cronbach's α</i> | .81 | .78 | .69 |
| <i>Vicarious Experience</i> ^c | I am aware of OTHER ACADEMIC DEPARTMENTS, like mine, that have been successful in... | | | |
| | • ...advancing qualified women into leadership positions. | X | X | X |
| | • ...promoting qualified women to Full Professor | X | X | X |
| | • ...retaining qualified women. | X | X | X |
| | • ...hiring qualified women. | X | X | X |
| | <i>Cronbach's α</i> | .96 | .93 | .88 |

^a Measured on a 1-8 Likert Scale (1=Very strongly disagree, 8=Very Strongly Agree)

^b Measured on a 1-5 Likert Scale (1=Strongly disagree, 5=Strongly agree)

^c Binary response item (Yes/No)