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CRITICAL PARTICIPATION



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### ABSTRACT

This paper draws on data from the National Science Foundation (NSF) ADVANCE-funded LATTICE program (Launching Academics on the Tenure-Track: an Intentional Community in Engineering) to examine how a diverse group of women worked across social and professional identities to support early-career women in academic engineering. We used ethnography to elucidate the social dynamics and power relations involved in forming a coherent group identity for the LATTICE leadership team, and the boundaries we negotiated in running the LATTICE program. We identify the processes and behaviors through which we made boundaries between members salient yet porous to build a coherent community across various dimensions of difference. We offer three actionable strategies that impact change agents' engagement and the group's coherence across multiple dimensions of difference: (1) intentionally creating a socio-emotional culture in our group, one that spans across group members' personal and professional identities; (2) validating other group members' perspectives, and (3) striving to build consensus using storytelling. These strategies of the LATTICE leadership team provide guidelines for others who work across intersecting dimensions of difference.

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Collaboration; engineering; broadening participation; intersectionality; ethnography; emotions

## Introduction

Increasing diversity, equity, and inclusion in engineering and computer science has long been a challenge in the United States. Despite moderate growth in other science, technology, engineering, and mathematics (STEM) disciplines, engineering, and computer science have had the smallest growth in representation of historically marginalized populations.<sup>1</sup> While there have been many studies on segregation within engineering and efforts to broaden participation in engineering,<sup>2</sup> with notable exceptions,<sup>3</sup> little has been written about how collaborative teams can work successfully across differences to advance such efforts.

This paper addresses this gap by examining a racially diverse team of women who led the national NSF ADVANCE-funded LATTICE program (Launching Academics on the Tenure-Track: an Intentional Community in Engineering). LATTICE is a collaborative effort among

three universities in the US to advance early-career women in academic engineering. The authors of this article comprised the interdisciplinary leadership team who adapted existing professional development models for early-career faculty from underrepresented groups. LATTICE collaborators organized two four-day in-person symposia followed by virtual peer mentoring circles, one in 2017 and another in 2019.

This ethnography focuses on the values, practices, relationships, and philosophies of the LATTICE leadership team as we ran the LATTICE program. In the first months of our collaboration, we came to a consensus on defining ourselves as a coherent group, similar to other ‘small, self-aware, mutually interacting groups of thinkers who have identified a social problem, analyzed its sources, ... devised a solution’ and overcome internal differences to lead scientific communities in transformative directions.<sup>4</sup> Our first goal in this article is to engage coherent group theory to explain the socio-emotional dynamics of our collaboration and to extend it with insights from intersectionality theory and participatory action methodology, highlighting the labor of negotiating differences among collaborators. Our second goal is to share how we tried to achieve and maintain coherence – both logistically and epistemically – as we resisted practices that unfairly privilege dominant groups in engineering.

We ask: How does the LATTICE leadership team remain attentive to and negotiate differences in social identities and disciplines to form a coherent group that contributes to the social movement to achieve institutional transformation in engineering? Social movements are a ‘collective effort to pursue research programs or projects for thought in the face of resistance from others in the scientific and intellectual community ... [they are] coherent programs for scientific and intellectual change or advance’.<sup>5</sup> To maximize the impact of LATTICE, we need to know more about how gender intersects with race and academic discipline in our collaboration to catalyze scientific change and mobilize that knowledge in the growing US social movement to desegregate engineering.

### **LATTICE: a coherent group of scientists from different backgrounds**

The LATTICE leadership team members worked together over five years to create effective interventions to retain women, especially women of color, in academic faculty ranks of engineering disciplines. We are a group of researchers from a range of backgrounds and identities who worked collectively toward common goals. We defined these goals in the following terms:

- Form an interdisciplinary group of scholars each with their own voice;
- Build rapport across multidimensional differences, including social and professional;
- Advance change in academia;
- Support the success of early-career female faculty in engineering, especially women of color.

The LATTICE team is comprised of eight scholars; two members identify as African American women and two members identify as Asian American (one Taiwanese American and one Korean American) women. Four members of the team identify as white American women, one of whom also identifies as Jewish American. Two members identify as queer. We come from industrial and systems engineering, electrical engineering, chemical engineering, biological sciences, sociology, anthropology, and education. We also represent

the full spectrum of academic career stages from a doctoral student to senior leaders in academia. LATTICE was a ‘polymorphous engagement’, meeting every other week for two hours over several years, interacting across different states, mostly virtually.<sup>6</sup>

The LATTICE team came together through connections between individual team members. While many members had long-standing relationships with subgroups of the LATTICE team, only one person, the principal investigator (PI) of the project and third author of this paper, knew all of the others prior to the formation of LATTICE. Multiple team members had roles in National Science Foundation (NSF)-funded ADVANCE projects to advance women faculty in science and engineering. These team members either worked together on those projects or encountered each other through the national ADVANCE community and PI meetings. These NSF ADVANCE connections date back to the mid-2000s. Some team members work together on a National Institutes of Health-funded project that was first funded in 2011. Two team members attended graduate school together in the 1990s and discussed adapting one of the aforementioned ADVANCE projects into a future collaboration. Subgroups of team members also have overlapping institutional affiliations. All team members were engaged in broadening participation in STEM efforts prior to coming together as the LATTICE team. Informal conversations among different collections of team members indicated that all members were curious about how to build on our prior experiences, had complementary areas of expertise, and were open to collaborating with each other. Thus, the LATTICE PI, who had relationships with all other LATTICE team members, brought everyone together to establish this coherent group.

LATTICE is designed to build upon our prior experiences in social movements in STEM. We integrated three national interventions for broadening participation in STEM fields in US higher education. The first is the WEBS (Women Evolving the Biological Sciences) program, a series of professional development symposia for early-career women in ecology and evolutionary biology.<sup>7</sup> Another is BRAINS (Broadening the Representation of Academic Investigators in NeuroScience), an adaptation of WEBS to a new discipline (neuroscience) that includes symposia as well as Mentoring Circles for early-career scientists who are racial/ethnic minorities and/or people with disabilities.<sup>8</sup> The third is the Peer Mentoring Summits for Women Engineering Faculty of Color. This was a series of professional development summits that convened women of color faculty members to offer mentoring and articulate strategies for persisting and advancing in academic engineering.<sup>9</sup> Thus, our LATTICE collaboration requires building trust and rapport not only across disciplines and social identities, but also blending and adapting three programmatic interventions in service of advancing groups underrepresented in STEM.

## **Theoretical framework**

### ***Emotion and coherence in science***

Scholars from a range of social sciences highlight the importance of emotions in knowledge production.<sup>10</sup> Patricia Hill Collins argues that ‘emotion indicates that a speaker believes in the validity of an argument’.<sup>11</sup> Scheper-Hughes and Lock suggest that paying attention to emotions in knowledge systems can bridge the micro, mezzo, and macro dimensions of life and deepen inquiries into human action.<sup>12</sup> Since science is often a collaborative effort, especially research that advances solutions to complex social problems, it is important to

understand, specifically, the emotional dynamics in the formation and care of coherent groups that advance new pathways in science.<sup>13</sup> Coherent groups are the intellectual arm of social movements, incubating theories, and testing their explanatory efficacy on the bench of collective action. Yet there is little scholarship on how they produce new scientific knowledge and cultural change in scientific institutions.<sup>14</sup> As a collaborative team working to foment institutional change in engineering, LATTICE offers an opportunity to address this gap using a critical race feminist approach that values emotions in the production of knowledge and social change.

Parker and Hackett explain, 'emotions spark creativity, tighten social bonds, and lower barriers to collaboration', generating coherence in a group, a state in which differences are mitigated, communication flows, and trust and rapport grows, thus stimulating the group's collective commitment to confronting dominant norms and values.<sup>15</sup> While emotions create bonds between scholars who trouble the status quo in science,<sup>16</sup> differences, across race and disciplines for example, can cause friction. Care is needed. For example, the LATTICE group was unyielding in our efforts to negotiate a range of emotional dynamics. Such laborious care helped us avoid pitfalls that would thwart our ability to contribute new, interdisciplinary knowledge to the social movement for transforming engineering culture.

How difficult emotions may be mitigated to preserve the coherence of groups working across both professional and social identities and against taken-for-granted conventions in science and engineering needs further study. To address this, we explore how our individual lived experiences navigating predominately white, male-dominated institutions influenced our collective experience of building and sustaining coherence to uplift other women and non-binary people in engineering. By paying attention to how social identities impacted emotional and intellectual processes in our collaborative scientific work, we also add to this scholarship a unique methodological approach to intersectional collaborations across not just across social identities such as race/ethnicity, gender, and sexual identity, but also across scientific disciplines as well. This paper highlights the possibilities and potential power of engineers working across disciplinary divides and collaborating on leadership teams with individuals outside of engineering. Further, we also blend science and technology studies (STS), engineering education, and critical race feminism to contribute to and extend extant scholarship and programmatic interventions to broaden participation in STEM.

## ***Intersectionality***

There is a critical need to better understand alliances between women of color and white women in academia and how these alliances can create institutional transformation.<sup>17</sup> In our quest to achieve coherence, our group negotiated individual boundaries forged by our personal experiences navigating multiple systems of privilege and oppression. These systems are not independent of one another, but rather, they coexist and intersect.<sup>18</sup>

Intersectionality studies how multiple systems of power intersect to create distinct experiences, constraints, and opportunities for individuals.<sup>19</sup> Different aspects of an individual's identity and lived experience are uniquely connected to systems of privilege, oppression, and exclusion<sup>20</sup> that dictate whose voices are more likely to be heard, whose ideas are moved forward, and which groups have access to scientific endeavors. Importantly, for the LATTICE group, intersectionality is both a conceptual framework and a methodological tool

for research. We drew upon it first to build a coalition across disparate group memberships and design our programmatic interventions, and second, as an interpretative resource in the knowledge-making aspect of LATTICE. As Metcalf et al. outline, intersectionality ‘allows us to make visible similarity across difference and difference across similarity’.<sup>21</sup> Intersectionality theory is informed by critical race feminism, in which ‘Black women have argued within the broader feminist movement: “the personal is the political”’.<sup>22</sup> It therefore is ideally suited to understanding the socio-emotional dynamics and power relations of a diverse group of women working together to advance other women.

Intersectionality is also a theory to explain oppression and subordination and to resist these forces.<sup>23</sup> Intersectionality holds critical analyses of power and applied practice in tension with one another, idealism and the prosaic respectively, and, in doing so, must remain flexible to incorporate the two and adaptable to change.<sup>24</sup> The LATTICE leadership team shared the goal of dismantling the reproduction of segregation in academia; yet, members of our coherent group hold complex identities that necessitated examination with an intersectional lens.<sup>25</sup>

By rooting our work in intersectionality, we build a flexible, methodological approach that privileges marginalized voices to share their experiences, and aligns with existing scholarship from women of color on creating self-definitions.<sup>26</sup> While intersectionality is increasingly used to understand the experiences of women in STEM,<sup>27</sup> it is underutilized in the social study of science.<sup>28</sup>

Intersectionality theory posits that one can have numerous social identities that have a multiplicative effect on how one navigates life. In this paper, we define social identity as a group membership recognized by an individual and perceived by others as such. When we refer to crossing boundaries between gender, race, institutions, and fields/disciplines, we are speaking from multiple perspectives – individualistically, organizationally, and institutionally.<sup>29</sup> These transgressions of boundaries are a manifestation of the critical praxis dimension of intersectionality that remains incipient in intersectionality theory as an analytical strategy.<sup>30</sup>

## Critical methodology and methods

### *Participatory action research*

Ethnography, a primary tool of anthropologists, is used to understand culture from the perspective of insiders. Ethnographic methods include participant observation, field memos, autoethnography, and individual and group interviews.<sup>31</sup> The methodology of this paper is rooted in critical ethnography, which ‘begins with an ethical responsibility to address processes of unfairness or injustice within a particular lived domain’.<sup>32</sup> We chose a particular kind of critical methodology called Participatory Action Research (PAR) because it is a collaborative approach to research aimed at ameliorating injustice. PAR can take many forms,<sup>33</sup> and uses both quantitative and qualitative approaches.<sup>34</sup> PAR allowed us to ensure that our research ‘participants’ (i.e. the LATTICE coherent group) were involved in research design and implementation. Meaningful involvement allowed us to reach consensus, working with the complexities of multiple identities, fields of study, and lived experiences. PAR explicitly emphasizes the construction of useful knowledge while simultaneously questioning traditional structures of power.<sup>35</sup> People from underrepresented

groups navigate institutions differently and thus, they have unique insights into how power operates interpersonally and institutionally.<sup>36</sup> For far too long, women of color have been silenced, appearing in texts as ‘an absent presence’ and talked about, spoken for, but denied a voice.<sup>37</sup> Conversely, here, we strive for all LATTICE coherent group members to have an *active presence* in this research and the opportunity to co-produce outputs.<sup>38</sup>

Knowledge production is always a political practice and researchers must be aware of their stances and agendas.<sup>39</sup> One way in which we worked to address our stance is through member-checking, which enables participants to contest or consent to the way in which they are represented in a research project. Through this process of collective examination, the ethnographic component of LATTICE generated knowledge while forging interpersonal bonds, as ‘disagreement, dissent and misperceptions are unearthed and, rather than being smoothed over in consensus, are often the sources of new directions and additional data for the project’.<sup>40</sup> Not only is this approach inherently participatory, it ‘nurtures the sense of community’ where community-building is a fundamental goal of the research itself.<sup>41</sup>

### **Data collection and analysis**

I, the first author, an anthropologist, led all phases of the ethnography from research design to dissemination.<sup>42</sup> I oscillate between my own analyses and the LATTICE research participants’, only using the plural first person when I am confident that the data supports a collective integration of our perspectives. In accordance with PAR, I made all data available to LATTICE team (my co-authors on this article) for reading, reviewing, and member-checking. Additionally, the first and second authors selected salient data points to discuss and unpack in depth collectively. PAR was particularly appropriate in this study because it excavated an *active presence*, thus addressing inequities in ethnographic research by reaching consensus on key decisions with the people in our study.<sup>43</sup>

We collected data in a variety of ways: semi-structured interviews, group interviews, participant observation field notes at bi-weekly group meetings, member-checking responses, and extensive dialogue and debriefing about the data set. This paper is informed by data from the first 18 months of the five-year project, including: nine individual interviews and three group interviews with the team members, and detailed field notes on over 40 observations of online meetings and 45 hours of in-person observations.

Data analysis included several distinct steps. Transcriptions from the interviews and meeting recordings were analyzed using open coding. The first and second authors noted emerging themes and developed a code book to systematize these themes. We paid careful attention to the social dynamics among team members to better understand how best to work across differences to create effective interventions. The interviews, field notes, and meeting minutes were then close-coded using Dedoose coding software. Within Dedoose, the data were analyzed for recurring themes and patterns.

Our PAR design motivated us to conduct member checks with LATTICE coherent group members, seeking their consent and validation of the data and emerging findings. Since the LATTICE members occupy a variety of high-pressure professional positions in different time zones, we needed a process that would allow for different schedules and work commitments. We created a data sharing and analysis system. Within this system, we shared individual pieces of data along with a document for memo-ing on these data, with all members having full editing access. The ethnographers asked our colleagues to review

transcripts, highlight salient moments in the data set, and interpret them. Members then memo-ed about the process of reviewing the data which allowed for new insights to build on existing themes and patterns. The memos, and the member-checking process more generally, served not only as an assurance of data quality, they also became additional data, which are included in the findings section.

### ***Trouble with anonymity***

Given the ‘small N’<sup>44</sup> of the LATTICE leadership team, we faced difficulties regarding anonymity in the dissemination of our work. We decided to experiment ethnographically, which was a unique challenge since we are conducting research with highly under-represented scholars who may face retaliation for challenging the status quo in their profession.<sup>45</sup> In this article, we decided to breach anonymity at times to honor a coherent group member’s voice and experiences. This stewardship aligns well with intersectionality theory as methodological practices but also carries risk of harm. Thus, this de-anonymizing tactic required glossing over some details and decontextualizing our findings so as to make us less vulnerable to retaliation.<sup>46</sup> Our struggle with anonymity is part of our methodological approach. Our reliance on PAR means we must continually negotiate the bounds of our individual and collective vulnerabilities, and the responsibility we have to one another. We approached this complicated question of balancing rigorous results with our privacy and safety as a matter of care,<sup>47</sup> and we came to consensus as a coherent group about what data to share in this article. This means breaching traditional protocols of ethnographic narrative by blending speaker identification and anonymity and leaving it up to the research participants, not the ethnographers, to decide how they will be represented in the text.

## **Findings**

### ***Socio-emotional research design: breaching the personal and professional***

From the beginning, the LATTICE coherent group took a methodological approach to intersectionality to grapple with how race, ethnicity, and gender intersect to form ‘interlocking oppressions’.<sup>48</sup> This required designing opportunities for LATTICE group members to better understand each other’s identity politics and document the discoveries. We devised processes to share and validate the particular experiences of each member as they related to both our individual identities and our group memberships. In this process, we resisted some normative categories. For example, in academic engineering, the boundary between the personal and professional is often rigid. We recognized how policing this boundary creates hostile environments for women of color and other subordinated members of academia and thus, from the moments of this project’s conception, we transgressed this binary. We did this work in both our coherent group and in the LATTICE symposia, combining techniques from LATTICE members’ prior experiences with critical ethnographic praxis and as change agents in engineering.

We engaged in three activities designed to blur boundaries between the personal and the professional dimensions of our lives. First, we held meetings every other week for two hours. Each began with ‘world’s checks’,<sup>49</sup> where each group member shared what was

going on in our 'world', either personal or professional. Second, we had a two-hour session early in our collaboration to engage in Identity Examination, in which almost everyone shared both professional and personal identities, even though that wasn't explicitly in the prompt. Finally, we came to consensus that we should have a group retreat in June 2016 in Seattle, three days of working and bonding together that began with a group interview with the question of 'How we can work best together to provide the most effective, inclusive space for women at our LATTICE symposia?' Below we portray how these three activities helped us breach the professional and the personal to cohere best practices for working across our differences.

*Team Meetings:* The LATTICE coherent group met for biweekly video conferences, each one beginning with 'worlds checks'. Some common topics of worlds checks were members' struggles with parents, children, finances, or health, or exciting news such as buying a home, planning a celebration, or taking a vacation. We shared both challenges and rewards in our personal and professional lives.<sup>50</sup> The worlds checks were essential to the establishment of 'coherence' in the group, as group members provided glimpses into their personal lives. Worlds checks were also essential in creating opportunities for us to be vulnerable and foster feelings of trust. At times, we realized that we were sharing things for the first time in our group. One reason for this candor was the agreement that conversations from worlds checks were inadmissible in the research data set. In other words, during worlds checks, I, the ethnographer, did not collect data. Privacy from the anthropologist's spyglass engendered friendships, evinced in activities that included congratulations, support, mentorship, care packages, laughter, and validation. Acts of friendship in LATTICE offer examples of how coherence was formed and sustained in service not just for our own career success, but toward collective efforts to transform engineering. Over the years, worlds checks, protected by group consensus from the scrutiny of traditional ethnographic protocols, did heighten my theoretical sensitivities in the induction, deduction and verification stages of this ethnography.

Intersectionality prompted us to design our team meetings to be led by one member at a time who gave a presentation explaining their work, epistemologies, theoretical lenses, or professional pathways. Group members were able to use these presentations to explain philosophical differences in our disciplines, to describe how our work in past symposia might impact the design of ours, or to tell a story about all of the life experiences that motivate us to broaden participation in engineering. These meetings were critical to explaining our perspectives.

*Identity Examination Activity:* In the first year of LATTICE, we led an Identity Examination activity that asked group members to write down five different aspects of their identities (e.g. race, ethnicity, sexuality, political affiliations, family roles) and then explain to the team why they chose them. We aimed to generate rapport and emotional intimacy amongst our team, and to displace white privilege, heteronormativity, classism, and other biases from the LATTICE organizing and the research outputs too. In doing so, we also breached boundaries between researcher and researched.

Another purpose of our Identity Examination was to understand which identities are most important to group members and to allow the researchers to interpret our data with knowledge of colleagues' group memberships and attendant emotions. This activity helped us connect with each other in a deeply personal way and build understanding across the group. Additionally, this Identity Examination activity helped team members

illuminate and reflect on aspects of our identity that motivate our work. All coherent group members expressed gratitude that we did this activity because we learned what is most important to each of us, which often facilitated smoother negotiations in our boundary work.

Furthermore, our professional activities to change our scientific institutions both shape and are shaped by our lived experiences. Putting intersectionality into practice meant challenging systems of power, but because of our individual standpoints, our emotions about challenging the status quo varied considerably. Thus, sharing our lived experiences helped us understand one another's emotional standpoints and the principles undergirding our worldviews, which motivated us to conduct and share the new knowledge we are creating to desegregate STEM.

*LATTICE Team Retreat:* While video conferencing enriches our coherence, the team agreed that an in-person retreat would allow us to enhance our emotional rapport. During this retreat, we participated in symposium logistics planning, including a site tour of the symposium location, and ethnographic research activities, including individual and group interviews. Conducting research and organizing in person helped build trust, and a greater understanding of each other's prior experiences in social movements (both within and outside academia) and intrinsic motivations. For example, Coleen began the group interview with the question: 'In regards to the intersecting "LATTICE" of our identities, how can we have hard conversations in order to facilitate an inclusive, lasting community?' The question sparked a conversation that addressed a range of topics, including (1) whether the design of our two symposia asks women of color engineers to choose between their race and discipline; (2) our lived experiences at past diversity-in-STEM forums; and (3) the challenge of balancing anonymity and the *active presence* of all members in the ethnographic research. The retreat culminated with a ferry ride in the Puget Sound where we shared heartfelt emotions regarding our collaboration and our time shared together in Seattle.

By breaching the personal and professional, and virtual and embodied presence, the LATTICE coherent group was able to better understand each other and our shared commitment to inclusion in engineering. This coherence allowed us to navigate challenges as they arose with care and trust.

### ***Analysis: engaging across difference***

In the process of organizing the symposia, the team negotiated boundaries between our social, political, professional, and cultural identities to build rapport and emotional energy so that we could communicate across various dimensions of difference. Next, we examine essential strategies in these negotiations, including: (1) explaining our perspectives; (2) validating each other's perspectives; and (3) semantically building consensus using storytelling. To dismantle oppressive practices in the LATTICE symposia, we had to do so in our collective organizing. Each of these three strategies reveal how we tried to interrupt the reproduction of oppression at micro and mezzo levels, with implications for eradicating racism and sexism in engineering more broadly. These strategies also illuminate the trickiness and efficacy of blurring normative boundaries of what constitutes primary research and activism in engineering and the tensions arising from striving for consensus on when to challenge the status quo and when to hew to it.

### *Explaining perspectives*

As much of our work was done virtually and many of us did not previously know each other, building meaningful relationships amongst all members of the group proved to be challenging. However, we quickly developed strategies to understand each other's perspectives and feel understood.

The following quote from Julie speaks to the importance of having a safe space to share identities. She also avoids making assumptions that any two experiences are similar, even with people who share a salient identity:

Julie: I think that there's a level of comfort sometimes when you're just talking to [women who look like you], and you just say the truth, or like how you really feel, and no one questions it. No one judges it. No one explains to you why their circumstance is the same as yours or worse. So there's a level of comfort that comes from that, and I think that we'll experience it in two ways and that all URM [underrepresented minorities] women are not the same. Our experiences are not the same.

Christine: I don't think we really explore those differences, and I think we need to talk about that and talk with each other. I think that makes for a rich conversation, like even just kind of considering that of course all underrepresented women's experiences are not the same, but let's celebrate and learn about each other.

This discussion highlighted a daunting challenge facing our group – creating space in the LATTICE program activities for women with many different intersecting identities without judgment, silencing, or comparison. Julie also suggested that safe space is damaged when white people question the lived experiences of people of color or try to compare their experiences with the experience a person of color has just described. In our planning, we were explicit about needing to figure out how to address these types of power dynamics to create an inclusive LATTICE program. For example, I, Coleen, responded to Julie's concern of dismissing the experiences of marginalized groups:

Coleen: I'd like to go back to something that Julie brought up early on in this conversation—and that's the first symposium potentially having white supremacy embedded in it and not being a safe space, potentially, for women of color. Is there anything that we can do now, early on?

Christine: Did you say white supremacy?

Coleen: I did say white supremacy.

Christine: I was gonna say that's the first I've heard that! [laughter] I was like, I must have missed something!

Coleen: I hear white women being resistant to listening to women of color's experience of racism and trying to erase racism from conversations about gender—I'm sorry, that's what I heard ... It's a learning moment for me too. When I paraphrased, maybe I should be a little more careful.

Christine & Julie [together]: No, you're fine. You're fine.

This exchange exemplifies our strategy to anticipate and preemptively prevent barriers to inclusivity at the first symposium, in this case white women's microaggressions towards Black women. Dismantling oppression in the symposia thus required that we call out language or terms someone is using in our organizing sessions, and ask the other person to explain, justify, or confirm what they meant.

It was important to our group formation that we explained past failures, e.g. when we were not inclusive. Knowing that we are willing to examine our weaknesses strengthened

our bonds because it allowed failure and errors to be part of the process. Failure and wanting to improve came up when we reflected on WEBS and the centrality of heterosexual lifestyles at these symposia.

Joyce: I was also thinking that there are times when we have been blind to different identities. WEBS was very heteronormative-centric and we got called out on it. Coleen and Julie are encouraging us to have these conversations early, so we can think about them and be more proactive, so we don't accidentally exclude people when we don't [want to.]

Julie: Often, with women and gender, it is common that we focus on children and family and work-life balance, and it has a very specific meaning in some people's heads and then other people get excluded.

Our strategy to facilitate explanatory conversations were in service of our coherence but also for creating an inclusive safe space in the LATTICE symposia. Joyce reflected on her experiences with facilitating the WEBS and BRAINS symposia:

When we've done this before, sometimes we would totally miss an important identity, and I think because we've done all of this work as a team and share different pieces from ourselves that I feel more confident in our ability to cover a lot of different angles and that's going to be highly valuable to the [LATTICE] space.

One way we supported each other in sharing our marginalized identities was to explicitly name parts of identities that were privileged, acknowledging dimensions of dominant group identities that often are overlooked. For example, one discussion included topics related to race and sexuality, and created a dialogical space in which one learned about oneself but not at the cost of others. The following exchange on social identities was born from Christine sharing a story about her surprise one afternoon at a conference when a speaker identified as "heterosexual." Claire reflected on Christine's story by comparing how white privilege operates similarly to that of heteronormativity.

Claire: Visible privilege is often unnoticed by people who don't notice their whiteness, because they're often—you're often—in a room, if you're white with lots of other white people. And if your skin is darker, you notice because it's different, right? The same thing is true for all identities.

Christine: Right, exactly.

Claire: You are most aware of the ones where you do not have privilege, right? So white women are talking about gender because it's white women, right? It's not 'I'm white!—and I'm a woman!' The whiteness doesn't do anything but give me privilege, again, and again. So I think the same is true across so many identities.

Christine's story of a conference speaker naming a *privileged* dimension of her social identity sparked a dialogue on how visibility, privilege, and naming are connected. These connections were evident in our Identity Examination exercise too. For example, only one person identified as cisgendered, an identity shared but not named by other coherent group members. In discussing this element of her identity, Cara said:

I was reading an article the other day about Michigan Womyn's festival, which has a long-standing issue around transgender identity, and I'm thinking through how easy it is for me to take for granted that I belong in spaces as a cis-gendered individual as I move through the world and not have to think about that.

Naming one's privilege encouraged discussion about the power and complications of intersectionality in action. In this way, LATTICE members would demonstrate the work required

to be an ally, someone who does not identify with a particular underrepresented group but supports that group's struggle for redistribution of access and resources, even when it is uncomfortable or dangerous. Further, naming privilege and opening up that privilege to discussion signaled it could be safe to share our intersecting identities with each other. One LATTICE member reflected that this rapport and trust allowed her greater expression in our coherent group space, saying: 'I feel like this gives me an opportunity to maybe bring different pieces of myself to the puzzle than I typically do on a given day'.

It also made our work in LATTICE rather complex, difficult even, because of the diversity of perspectives. We never took for granted our coherence, our priorities, or who is being served and for what purpose. Also, the significance of our identities fluctuated over time and space. For example, Claire shared at one point: 'I'm still trying to figure out what the really salient parts of myself are, and in different contexts'. This complicates talking across differences and explaining where we are at, both individually and as a coherent group. We tried to embrace these complications as an opportunity for growth as a coherent group and a means to deepen the impact of LATTICE. We had difficult conversations to develop a common language and learn to work together across the full spectrum of our intersectional group memberships.

### *Validating perspectives*

Another strategy that helped us successfully negotiate boundaries was to consistently validate the perspectives that were explained by an individual group member. These interactions always involved building on information presented and not on questioning the information itself. Validation served as a way to show respect for each other and was a critical component to establishing and maintaining coherence across differences in our group.

For example, in one instance while discussing the schedule of the symposium, one group member told a story about a symposium where a strong sense of community was present due to a shared racial identity amongst the participants. She used the story to point out the power of sharing lived experiences to foster a supportive culture, and wanted our team to build this explicitly into the symposium.

To validate her perspective, Joyce said,

I completely agree with everything you're saying ... It aligns really well with our vision of what the symposium looks like and what happens and makes it great. There are more thoughtful things that need to be done based on your ideas and things you're bringing up.

Joyce validated her team member's expertise as a leader, and acknowledged how our team benefits from her contributions. This validation occurs because the possibility of a 'collective experience' whereby those who share her particular racial identity may have similar experiences,<sup>51</sup> was something that we as a team needed to address at the LATTICE symposia. Through this process of validation, her story was easily translated into a productive conversation about the workshop's curriculum.

Validating perspectives can also take place in the process of storytelling. For example, participants would use stories to say, 'As a person from X identity, I experience this. Participants from this identity might also experience this'. For those listening to this story, it is important to not dismiss or diminish the person's experience by saying, 'You did not experience what you felt you experienced'. Rather, the listener could build on the first person's

experience by elaborating on how their own experiences might differ or be similar. This strategy expanded collective knowledge on issues important to our work.

### *Semantic consensus building*

In breaching the boundaries between our disciplinary and social identities, members did a great deal of ‘semantic consensus building’. This strategy required that we take care to explain our words, their specific definitions and meanings within our worldviews (e.g. ‘in my field, it means XYZ’), to build a shared understanding. It became clear that the type and tone of language used to discuss issues of marginalization were very distinct between the social sciences, field sciences, and lab sciences. Throughout our meetings, there were many conversations in which we analyzed the meaning of a term to build a shared vocabulary. Affirmations like ‘I see’ and ‘I understand what you’re saying’ were common in our efforts to build consensus. For example, I, Coleen said: ‘I’ve chosen not to have children and I’m very happy about that [laughter]. I want us to honor women who are child-free as well’. Eve responded to my semantic framing: ‘Child-free. I like that. Thanks for sharing’. Christine seconded this validation, saying: ‘Child-free. I like that’.

While semantic consensus building does not always succeed, the process encouraged us to strive for deeper understanding of our lived experiences and worldviews. For example, one conversation examined how the group’s work would be positioned and framed. Specifically, do we align our work of expanding diversity with an agenda to maximize talent in engineering, or do we align our work with a social justice agenda of redistributing access and opportunity? The resulting conversation surfaced a disciplinary difference in how ‘diversity work’ was framed and discussed. STEM literature often leaned towards the ‘maximizing talent’ narrative,<sup>52</sup> while the social scientists of the group were more familiar with social justice frameworks. However, one member noted that this boundary was not useful or necessary, and extremely ‘breachable’. She stated: ‘In terms of social justice versus maximizing talent, I don’t think they are mutually exclusive, and the focus will change based on the audience... It’s not one box or another, but how they are together’.

There were other times when those who shared similar disciplinary frameworks spoke to each other within our own disciplinary language as a way to make sense of what we are talking about. When describing the selection process for symposium attendees, Joyce said: ‘This is making me think of when, for both for WEBS and for BRAINS, we invite people and then we do an optimization, right Julie?’ Optimization is a concept from operations research, Julie and Joyce’s discipline, where you seek to find the best solution given constraints. In this example, the goal was to create the most effective panel of senior speakers given constraints such as including speakers from different types of institutions, with different types of expertise, in different career stages. There also emerged a pattern when team members tested out using the language of other disciplines, especially the non-social scientists using social science language. For example, in a conversation about selecting applicants, Claire framed it in social science terms:

Claire: We learned about retrospective pre-analysis where you ask participants...

Joyce: Social scientist language: Incoming! Incoming! [laughter] ... Retrospective pre-test!

Claire: Right! We did it in the second WEBS.

Sometimes we would explicitly talk about learning language from each other. Joyce reflected:

They called it heterosexism at that [workshop]—they didn't call it heteronormativity. I said heteronormativity and he didn't write that down- [laughter] I learned that term from you [points at Coleen]! I was so proud of my word—that's very post-positivist! We're just trying to be like you! [laughter] And you [points at Saejin]! And you [points at Cara]!

This exchange represents Joyce's validation of the value of having social scientists on the team, and how theories from these fields help us to understand systematic patterns of inequities. This validation is significant given the epistemic hierarchy between technical and social knowledge production in engineering education which can impede effective collaborations.<sup>53</sup>

Semantic consensus building was more than our team building a common language. We spent many hours discussing key concepts: what they mean to us personally, in our work, and in the work of other scholars. Building a common language allowed us to first, examine what it means to be inclusive in our team work and of LATTICE symposia participants; second, to decide our boundaries of inclusion and exclusion for the program; and third, to attract those whom we are seeking to support in LATTICE. Terms for which we did not reach consensus served as opportunities to understand each other across intersectional axes of difference. For example, not all of us identify as feminists. One of the women of color on our team identified as a feminist, but she did so reluctantly. Saejin stated:

I have always found it difficult to connect to women from dominant groups but the term "feminist" to me has grown more useful within the past few years because it indicates an oppositional identity to systems of power, privilege, and oppression, but... if I had to choose, my racial/ethnic identity would come first.

This questioning and emotional engagement demonstrate how much we wrestle with these complexities in search of clarity in our purpose, communication, and outreach.

### *Storytelling*

Another strategy used by our group was storytelling. Stories play a critical role in professional decision-making.<sup>54</sup> For us, stories were important in forging coherence by allowing group members to disagree while also working to address tensions that arose. Storytelling allowed members to contextualize their concerns within their own personal experiences and worldviews. Thus, we used personal stories to build a boundary around our perspectives to communicate and provide insight to those who did not share such experiences.

For example, team members often used storytelling to bring up concerns they had on how our decisions might impact the experiences of underrepresented LATTICE participants. These concerns were brought up by using their own lived experiences in other workshops where they felt unsafe. Storytelling was an essential strategy of identifying issues from past experiences to ensure that LATTICE would not reproduce oppression in our program. In this way, stories were used to build commitment to a more inclusive culture at our symposia.

Storytelling also operated as a way to heal and problem-solve. In one meeting, Christine asked us if we had ever wanted 'to tell a story but don't know how because you're still living in the place where it happened and want to step away from the story and heal?' Julie responded:

I have this vision of having a book where different people tell their story of how they overcame. When you hear people's stories it can be so invigorating but also validating. So you can see what people went through to get to where they are. How it's possible to get through that adversity to excel despite it.

Claire responded affirmatively, saying: 'Julie! You should be a panelist at LATTICE!' The conversation continued as Christine explicitly outlined why storytelling is so powerful for women navigating engineering:

the most helpful thing is not just the story, but themes between them, ... so by the time you finish [listening], you have your own tools and approaches. If you identify with their problem, you can hopefully identify with their solutions. Your solutions will be a composite [of others].

Joyce then noted that what Julie and Christine are describing is the role of the senior panelists at the LATTICE symposia, saying: 'That's exactly what we do in 3-D form!' Christine responded: 'This is cool. Julie and I came up with this idea just by talking and it's exactly what we're doing. This is an aha moment!'

In this exchange, members made themselves emotionally vulnerable, shared vision, affirmed one another, and connected aspirations to the foundations of our work together. Together, we realized the critical role storytelling plays in desegregating engineering and that we have already embedded it into our programmatic intervention, whereby senior women faculty tell their stories to junior women faculty to affirm and support them. Senior women can also find healing in telling their stories of resilience and overcoming adversity.

Eve used storytelling to contextualize what her Jewish identity means to her, saying:

'There were [Holocaust] survivors in the town [where I grew up] ... I have many friends who were my age whose parents were survivors and the relationships they have with their parents—the [people] my age become caretakers even at young ages.'

In this instance, Eve used a story to situate herself in relation to the identities of others with whom she grew up and who share an identity and background that still play an important role in her life. In this way, storytelling served as a means of claiming membership in a particular marginalized group. Eve brought her story to our larger conversation about how caretaking duties impact equity in engineering and broadened our understanding of who does this labor and why.

Another function of storytelling was to advocate for groups that were not represented on our team. Cara, for example, used storytelling to advocate for people who identified in between the identity categories appointed by our symposium (e.g. non-binary gender identities). After telling a story of ruminating on her cisgendered privilege, she asked the rest of us to consider: 'how do we define our work for LATTICE with women while recognizing that we are operating in a non-binary world? Are we constrained by the [norms of academia] and more broadly, by the societal norms of gender?'

In this way, storytelling was not only used for personal advocacy, but also as a way to act as allies and advocate for perspectives that were absent from our team. For example, Christine framed a story of a woman of color coming out as queer to a group of other women of color as: 'She invited us in. She told us about herself ... And so I thought: 'Wow, you really do care about what we think. You do want to invite me in' ... My thinking has shifted'. Christine's story of another woman's act of courage and vulnerability is a story of interpellation on multiple levels – in which calling others to witness one's authenticity is

a moment of consciousness-raising and an invitation for greater communion with other women navigating engineering.

## Discussion

While the trust generated within the LATTICE leadership team is not automatically afforded to spaces beyond the group, we aim to provide guidance to other change agents on how to build coherence across difference. We are now in the process of disseminating our findings and must build consensus on several critical elements of the LATTICE team's coherence, including: authorship, data sharing, informed consent, and anonymity.

Another challenge ahead is in regard to adaptability. Our evaluation data show that LATTICE was a successful adaptation of WEBS, BRAINS, and Peer Mentoring Summits for Women Engineering Faculty of Color. Adapting the primary research aspect of the project, furthering knowledge on the social and emotional dynamics of coherent groups working across differences to dismantle racism and sexism in engineering requires much labor and thus, long-term funding. Engineers who collaborate with social scientists in such groups must also divest themselves of the popular sentiment that technical sciences are superior to social sciences and learn core theoretical frameworks from social studies of science.<sup>55</sup> Future efforts by change agents committed to desegregating engineering may consider designing research protocols in accordance with PAR, so that people leading transformative work can also be co-producers of innovative knowledge. This co-production of knowledge facilitated by PAR is a way to bridge the aforementioned divide between the social and technical sciences. The success of such methodological adaptation may be constrained by a discordance between the values of PAR researchers and the evaluation standards of the academy. In other words, the time- and energy-consuming effort and interdisciplinary expertise needed to engender trust, negotiate boundaries across fields and identities, and build consensus at every stage of the research process needs to be recognized and *valued* by funding agencies and promotion and tenure committees. PAR methodological approaches must also be welcomed by journals and conferences in each change agents' field.

Finally, even with our success negotiating boundaries and engaging across differences, there were still challenges. For example, we have had some difficult conversations related to boundaries of inclusion and exclusion regarding gender and sexuality. Those conversations remain unresolved. Practicing intersectionality along vectors of race, gender, *and* sexuality while broadening participation in engineering is important work still to be done.

## Conclusion

Intersectionality has become an increasingly poignant topic in engineering education research. Being able to authentically engage with and respect people from different cultures has often been positioned as a fundamental dream of change agents in the social movement to desegregate STEM, but this vision of inclusivity remains nascent. This paper contributes to research on inclusivity in engineering by interpreting the ways in which a coherent group took care with emotions to work across differences in social identities, disciplinary expertise and our personal and professional lives. Combining STS, engineering education and critical race feminism, we excavated coherent practices and strategies that foster

interdisciplinary collaboration that work across, with, and through various dimensions of difference in scientific and social identities. LATTICE as a knowledge project was made possible by co-mingling these theories. As guiding principles in our social transformational work to resist the status quo in engineering, this theoretical grounding kept us adaptable to the fluid, evolving contexts of systemic oppressions both inside and outside of engineering settings.

Moreover, PAR amplified our efforts to use intersectionality theory methodologically in the context of power relations in engineering fields. These frameworks yielded three actionable strategies to build group coherence across multiple dimensions of difference: (1) intentionally creating a socio-emotional culture in the group that spans across personal and professional identities; (2) validating group members' perspectives; and (3) building consensus using storytelling. These strategies provided a coherence required not only for harmonious relations in efforts to serve groups minoritized in engineering, but also to challenge traditional epistemic assumptions in engineering, for example objectivity, validation and the binary between the researcher and the researched.

Our coherent group negotiated boundaries of difference between our personal and professional identities to contribute to the social movement to end racism and sexism in engineering. This paper provides a snapshot into the lives of women in academia from different backgrounds, who came together for mutual support to achieve career success and collective action to advance inclusion in engineering. This work also demonstrates that interdisciplinary collaborations between social scientists and engineers are not just instruments of reform in engineering but, rather, a science in and of themselves. Studying how renegade members of the academy work simultaneously within and against scientific institutions and long held, cherished traditions can identify barriers to transforming who gets to do science and what counts as science.

## Notes

1. Corbett and Hill, *Solving the Equation*; and Ong, Smith, and Ko, "Counterspaces for Women of Color in STEM Higher Education."
2. Tao and Leggon, "African American Women in Engineering"; Ong, Jaumot-Pascual, and Ko, "Research Literature on Women of Color"; Blackburn, "Status of Women in STEM in Higher Education"; and Faulkner, "Doing Gender in Engineering."
3. Borrego, "Discipline-Based Views of Collaboration"; Isler et al., "Defining the Flow"; and Kellam et al., "The POWER Special Session."
4. Parker and Hackett, "Hot Spots and Hot Moments in Scientific Collaboration," 22.
5. Frickel and Gross, "A General Theory of Scientific/Intellectual Movements," 206.
6. Gusterson, "Studying Up Revisited," 116; Hannerz, "Being There ... and There ..."
7. Horner-Devine et al., "Beyond Traditional Scientific Training."
8. Margherio et al., "Connecting Counterspaces"; Margherio et al., "Learning to Thrive"; and Yen et al., "Diversity and Inclusion Begin with Trust."
9. Grant, Decuir-Gunby, and Smith, "Advance Peer Mentoring Summits."
10. Scheper-Hughes and Lock, "The Mindful Body"; Parker and Hackett, "Hot Spots and Hot Moments in Scientific Collaboration"; and Barker, Garvin-Doxas, and Roberts, "What Can Computer Science Learn."
11. Collins, *Black Feminist Thought*, 263.
12. Scheper-Hughes and Lock, "The Mindful Body."
13. Parker and Hackett, "Hot Spots and Hot Moments in Scientific Collaboration"; Frickel and Gross, "A General Theory of Scientific/Intellectual Movements," 206; Mansilla, Lamont, and Sato, "Shared

- Cognitive–Emotional–Intellectual Platforms”; Kuhn and Wolpe, *Feminism and Materialism*; Denzin, *Interpretive Ethnography*.
14. Parker and Hackett, “Hot Spots and Hot Moments in Scientific Collaboration.”
  15. Ibid., 24.
  16. Ibid.
  17. Dace, *Unlikely Allies in the Academy*.
  18. Moradi and Grzanka, “Using Intersectionality Responsibly.”
  19. Cho, Crenshaw, and McCall, “Toward a Field of Intersectionality Studies”; Crenshaw, “Mapping the Margins”; and Metcalf, Russell, and Hill, “Broadening the Science of Broadening Participation.”
  20. Metcalf, Russell, and Hill, “Broadening the Science of Broadening Participation.”
  21. Ibid., 582.
  22. Taylor, *From #Blacklivesmatter to Black Liberation*.
  23. Ong, Smith, and Ko, “Counterspaces for Women of Color in STEM Higher Education.”
  24. Collins, *Intersectionality as Critical Social Theory*.
  25. Collins, *Black Feminist Thought*.
  26. Ibid.
  27. Metcalf, Russell, and Hill, “Broadening the Science of Broadening Participation”; Ong, Smith, and Ko, “Counterspaces for Women of Color in STEM Higher Education”; Corneille et al., “Barriers to the Advancement of Women of Color Faculty in STEM.”
  28. Grzanka, “Intersectionality: Foundations and Frontiers.”
  29. Britton and Logan, “Gendered Organizations.”
  30. Collins, “Intersectionality’s Definitional Dilemmas.”
  31. Spradley, *The Ethnographic Interview*; and Spradley, *Participant Observation*.
  32. Madison, *Critical Ethnography*.
  33. Billies et al., “Participatory Action Research.”
  34. Denzin, *Interpretive Ethnography*.
  35. Denzin, *Interpretive Ethnography*; and Brown and Strega, *Research as Resistance*.
  36. Cho, Crenshaw, and McCall, “Toward a Field of Intersectionality Studies”; Ong, Smith, and Ko, “Counterspaces for Women of Color in STEM Higher Education.”
  37. McClaurin, *Black Feminist Anthropology*.
  38. Grande, “Red Pedagogy”; and McClaurin, *Black Feminist Anthropology*.
  39. Denzin, *Interpretive Ethnography*.
  40. Billies et al., “Participatory Action Research,” 280.
  41. Toyosaki et al., “Community Autoethnography,” 58.
  42. Maxwell, *Qualitative Research Design*; Merriam, *Qualitative Research*.
  43. Merriam, *Qualitative Research*; Mohan, “Not So Distant, Not So Strange.”
  44. Pawley, “Learning from Small Numbers”; Slaton and Pawley, “The Power and Politics of Engineering Education Research Design.”
  45. Bickford and Nisker, “Tensions between Anonymity and Thick Description”; and Pawley, “Learning from Small Numbers.”
  46. Bickford and Nisker, “Tensions between Anonymity and Thick Description.”
  47. Puig de la Bellacasa, “Matters of Care in Technoscience.”
  48. Combahee River Collective, “The Combahee River Collective Statement.”
  49. Loving, *Loving Leadership*.
  50. Daniell, *Every other Thursday*.
  51. Collins, *Black Feminist Thought*.
  52. Ong et al., “Inside the Double Bind.”
  53. Carrigan and Bardini, “Majorism”; Cech, “Ideological Wage Inequalities.”
  54. Mattingly, “Acted Narratives.”
  55. Carrigan and Bardini, “Majorism”; Yen et al., “Diversity and Inclusion Begin with Trust.”

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