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"Mentoring is Ethical, Right?": Women Graduate Students and Faculty in Science and Engineering Speak Out

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ABSTRACT
The relationship between graduate students and their research advisors within academia is pivotal to the development and success of the research enterprise. Graduate students rely on their faculty advisor to be a source of information, a departmental negotiator, and a role model to guide their professional and ethical behavior. However, if an advisor does not fully recognize a student's best interest or they are unaware of how to be an "ethical mentor", they may overlook the unique social capital of the graduate student (e.g., background, culture) and jeopardize the research relationship. This work aims to explore how women graduate students and faculties in science and engineering understand ethical mentoring within research relationships. Particularly, we are interested in understanding the six ethical mentoring principles suggested by Johnson (2016)—beneficence, nonmaleficence, autonomy, fidelity, fairness, and privacy—all of which require an in-depth understanding for a productive research relationship. Qualitative analysis revealed that participants emphasized the principles of beneficence and fidelity, while principles of privacy and fairness were mentioned the least. Three key themes emerged from this analysis: (a) communication; (b) relative power between mentor and mentee; and (c) awareness (or a lack thereof) around implicit expectations within the research culture.

KEYWORDS
Women; intersectionality; science; engineering; ethical mentoring

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INTRODUCTION

The purpose of this exploratory case study research was to understand the perspectives of ethical mentoring around research relationships for women graduate students and faculties in science and engineering.[1] The relationship between a faculty advisor and a graduate student is one of the most important factors in persistence and retention in academia (Barnes, 2010; Devos et al., 2017; Travaglianti, Babic, & Hansez, 2018; de Valero, 2001). Advisors act as an information source, departmental negotiator, advocate, role model, and gatekeeper to success (Grady, La Touche, Oslawski-Lopez, Powers, & Simacek, 2014; Johnson, 2016; Polson, 2003). Advisors can help graduate students navigate the explicit and implicit intellectual, methodological, and ethical norms of their discipline and department (Acker, 2001; Gardner, 2009; King, 2003; Lovitts, 2007).

As a specific type of advisor-advisee relationship, mentoring is typically a positive relationship in which an advisor goes beyond providing mere technical and programmatic guidance to the student and offers intentional career development and psychosocial support (Johnson, 2002; Schlosser, Lyons, Talleyrand, Kim, & Johnson, 2011). A good mentoring relationship with an advisor—one that is dynamic, emotionally connected, and reciprocal—has been associated with greater emotional well-being and higher degree completion rates in graduate students (Hyun, Quinn, Madon, & Lustig, 2006; Sowell, 2008; de Valero, 2001). In fields in which women are underrepresented (e.g., science and engineering), a lack of mentoring can limit professional development and become a barrier to success (Johnson, Rose, & Schlosser, 2007; Rosser, 2004).

Within a given mentoring relationship, the specific background and needs of the graduate student concerned require additional consideration (Johnson, 2016; Schlosser et al., 2011). For example, women graduate students have reported issues of greater isolation and stress, lower self-confidence, and conflict between their personal and professional roles than their male peers (Benshoff, Cashwell, & Rowell, 2015; Hyun et al., 2006; Oswalt & Riddock, 2007). Furthermore, women graduate students do not represent a monolithic group, and their unique experiences may result in differential needs (Johnson, 2016) and ethical expectations (Rose, 2005). For example, in a study of international womengraduate students in engineering, Dutta (2015) reported that participants experienced differential treatment, tokenism, and communication barriers stemming from the intersection of their gender, race, class, etc.

In the same vein, faculties cannot be viewed as a uniform group either. Research has shown that an advisor's role and personal experience may influence their expectations of their mentees (Lechuga, 2011) and influence their perception of a mentee's needs and the type of support they provide (Carpenter, Makhadmeh, & Jean-Thorton, 2015; Johnson, 2016; Schlosser et al., 2011). Any lack of awareness of their own or another's intersecting identities may risk a misinterpretation of

mentoring expectations and needs, which have been shown to lead to attrition among graduate students (Gardner, 2009; Golde, 2005; Lovitts, 2008).

This study aims to explore participants' perceptions of how their approach to mentoring in research may or may not consider the unique intersectional needs of mentors and mentees in science and engineering. For this work, we focused solely on women in science and engineering, as within these fields women are underrepresented (National Center for Science and Engineering Statistics [NCSES], 2018) and because their unique experiences may allow for an understanding of their multiple yet distinct social realities and overlapping experiences (Crenshaw, 1989). To this end, the research questions for this exploratory case study, which took place at a public research university in the Western United States, are: (1) In what ways did women in science and engineering perceive the ethics of mentoring in their own research relationships? (2) In what ways did women in science and engineering express unique experiences and perspectives in these mentoring relationships related to the intersection of gender, race, role, etc.?

By exploring these questions, we hope to make explicit women's unique experiences with the aim to contribute to the development of an intersectional approach to ethical mentoring.

LITERATURE REVIEW

Theoretical Framework

The conceptual lens that guided this study is based on the framework of ethical mentoring (Johnson, 2016), which was used to explore the intersectional nature of the issues facing the participants. Ethical mentoring centers around the "special relationship in which one person accepts the trust and confidence of another to act in the latter's best interest" (Plaut, 1993, p. 213; see also Johnson, 2002). In particular, we draw upon Johnson's (2016) six guiding principles of ethical mentoring in order to help identify areas of misconception and risks that may harm a mentoring research relationship: (a) beneficence (mentor's/mentee's obligation to promote best professional interests); (b) nonmaleficence (avoidance of using mentor's/mentee's role for harm); (c) autonomy (mentor's/mentee's avoidance of dependency and intentionally promoting independence); (d) fidelity (mentor's/mentee's sense of loyalty); (e) fairness (mentor's/mentee's safeguarding of equal treatment); and (f) privacy (mentor's/mentee's avoidance to reveal sensitive material without consent).

Intersectionality

One element of specific interest was how these mentoring theories applied in the context of intersectionality. Intersectionality can help scholars understand how women negotiate multiple identities (Samuels & Ross-Sheriff, 2008), each in the context of their own particular systems of oppression (Crenshaw, 1989). The intersection of multiple identities—gender, race, ethnicity, migration status, history, social class, sexuality, disability—can cause cultural alienation and anxiety, especially in those who find themselves under pressure to represent an entire demographic (Armstrong & Jovanovic, 2015; Mondisa, 2015; Samuels & Ross-

Sheriff, 2008). Therefore, in order to understand women's experiences, we must consider how other intersectional characteristics influence one's experience as a woman—in this case, particularly those centered around systems of mentorship in research.

In science, technology, engineering, and mathematics (STEM), intersectionality has been used to explore the variation in professional occupations for Latina and Black women (Smedley, 2014),[2] as well as to analyze the process of science identity development in students from underrepresented racial minorities enrolled in STEM degree programs (Tran, 2011). The double-bind of intersectionality related to race and gender has been shown to influence women's mentoring experiences in STEM (Irby, Boswell, Hewitt, Lynch, & Abdelrahman, 2017; Mondisa, 2015; Reddick, 2011).

This work aims to blend two frameworks, namely ethical mentoring and intersectionality, applied to women graduate students and faculties in which they study. We believe that understanding the experiences of women who face various intersecting forces in both their studies and lives (e.g., race, culture, background) can enable us to understand mentoring dynamics and the systems that pervade and influence individual views of what should be considered ethical (or not) within their research relationships.

METHODS

Researchers' Positionalities

All of the contributing authors to this work are underrepresented women whose voices at some point in their mentoring research relationships became compromised. As they have met and interacted with each other, they have all become keenly motivated to act on the importance of dual, ethical, equitable, and trustworthy research relationships. The first and second authors have experience in science and engineering research and are underrepresented women in their areas of research expertise (engineering, science, and education). The third author has experienced ethical issues during her doctoral studies in the field of education (curriculum and instruction). All three authors adhere to the principles stated in the theoretical framework and aim to elevate the voices of women mentors and mentees across science and engineering disciplines, both of which are traditionally male-dominated and technically and scientifically demanding (Corbett & Hill, 2015).

Research Design

We selected a qualitative case study design as the most appropriate enquiry strategy with which explore the subject of ethical mentoring in science and engineering. With such an approach, we sought to: (a) look in depth at the often problematic relationship between mentors and mentees; (b) understand the specific ethical mentoring principles that are nurtured among women in science and engineering; and (c) generate new hypotheses and research questions in order to advance more ethical mentoring parameters for graduate students and faculties in science and engineering (Flyvbjerg, 2011).

Context of the study
This study was conducted at a land- and space-grant university located in a rural region of the Western United States, the population of which is primarily White. While similarities exist in content and delivery of science and engineering graduate programs both within and outside of the United States, findings from this study are not generalizable to all research institutions. However, women are underrepresented in science and engineering—both academically and professionally—not only across the United States (NCSES, 2019), but also internationally (United Nations Educational Scientific and Cultural Organization [UNESCO], 2017). Thus, by studying the experiences of these graduate students and faculty members, our findings could be transferable to other research contexts in which women are underrepresented.

Selection of case studies as vignettes
We selected vignettes or "case studies" from Johnson's (2016) mentoring guide for higher education faculties, which was "designed to be an ideal tool for faculty workshops, discussion groups, and training sessions on mentoring in higher education" (Johnson, 2016, p. 6). The qualitative vignette technique was selected in order to explore the attitudes towards, and the perceptions, beliefs, and norms (Finch, 1987) surrounding, hypothetical scenarios on "difficult topics of enquiry" among participants (Hughes & Huby, 2002, p. 384). It also allowed participants to explore potentially sensitive topics in a less threatening way while still offering them an option to talk about their personal experiences (Barter & Renold, 1999).

Johnson (2016) included these case studies to highlight both exemplary and dysfunctional mentoring relationships in higher education. For this study, a dysfunctional mentoring relationship is defined as one that is "unproductive or characterized primarily by conflict"—a mentoring relationship in which the needs of both mentor and mentee are not being met, the long-term costs of maintaining the relationship outweigh the long-term benefits, and the mentor and/or mentee are distressed or harmed (Johnson & Huwe, 2002, p. 45). Six cases were selected from Johnson's book to correspond to the six "ethical mentoring" principles (beneficence, nonmaleficence, autonomy, fidelity, fairness, and privacy) created to help "mentors consider their ethical obligations to mentees" (Johnson, 2016, p. 123).

Each case study selected either exemplified or violated one of the six ethical mentoring principles. Two of the six case studies or vignettes depicted a more explicitly positive scenario (beneficence and privacy), while the remaining four demonstrated problematic aspects (nonmaleficence, autonomy, fidelity, and fairness). Each case study presented a potential ethical issue depending on the various points of view of the participants and the different levels of awareness that mentees and mentors exhibited regarding ethical mentoring principles (Table 1). To minimize bias in case study selection, the case studies were discussed at length by the research team, whose insider perspectives could be leveraged to identify the most relevant case studies for both graduate students and the faculty.

Table 1: Summary of ethical mentoring principles and case studies (adapted from Gelles, Villanueva, & Di Stefano, 2018).

Ethical Mentoring Principle	Definition	Case Study Summary
Beneficence Case 5.8 (Johnson, 2016, p. 82)	Mentor's/Mentee's obligation to promote best professional interests	An assistant professor at a highly selective undergraduate technical university, Frank, offered energetic coaching and sincere personal support to his engineering student mentees. Frank pushed and challenged his students to develop confidence, face their anxieties, take risks, and rise to the level of excellence he expected. Frank provided encouragement and rarely asked a student to do more than they could handle. As a result, Frank's students were often better prepared upon graduation compared to other students in the program.
Nonmaleficence Case 14.3 (Johnson, 2016, p. 213)	Avoidance of using mentor's/mentee's role for harm	A biology major student, Mary, selected a famous scholar, Dr. Scathe, as her major advisor because she was impressed with his lectures and publications. Mary began to regret this decision when confronted with Dr. Scathe's poor communication skills, emotional tirades, demeaning comments on her work and intelligence, and complete unawareness of the corrosive effect of his behavior.
Autonomy Case 14.11 (Johnson, 2016, p. 221)	Mentor's/Mentee's avoidance of promoting dependency vs. independence	One of the few full female history professors, Dr. Copie, encouraged a Ph.D. student, Sandra, to join her research group. Over three years, Sandra began to feel that the more Dr. Copie invested in their relationship, the more pressure she felt to research only in Dr. Copie's area of interest, to pursue a similar career, and to forego a family until completion of her doctorate. While Dr. Copie was unaware of this, Sandra was certain that Dr. Copie's approval and interest hinged directly on Sandra's willingness to follow Dr. Copie's career path.
Fidelity Case 14.4 (Johnson, 2016, p. 213)	Mentor's/Mentee's sense of loyalty	A new research fellow, Todd, hoped to receive career guidance and support from his supervisor, Dr. Scarce. However, Dr. Scarce was rarely available and missed the appointments that Todd scheduled. Dr. Scarce did not return Todd's phone calls, only had time to talk between meetings and his lab work, and seldom had time to help Todd with questions about grants, or to read drafts. When searching for a job, Todd asked other faculty members for letters of recommendation because he was worried that his supervisor hardly knew him.
Fairness Case 8.16 (Johnson, 2016, p. 131)	Mentor's/Mentee's safeguarding of equal treatment	A minority second-year doctoral student complained to the department chair that he was discriminated against in securing the faculty mentor of his choice. He had evidence that he had better grades, higher GRE scores, and similar research interests and publications in a senior female professor's area of research. He had requested to be advised by this professor, Dr. Select, but was told there were no openings. However, two months later, Dr. Select accepted a White male advisee with no publications or experience in her area of research. The student believed the decision was based on his race/ethnicity, attractiveness, or both.
Privacy Case 5.15 (Johnson, 2016, pp. 94–95)	Mentor's/Mentee's avoidance to reveal sensitive material without consent	An associate professor, Dr. Allen, developed strong mentorships with the students in his department because of his genuine concern for students. Students felt comfortable disclosing personal difficulties, conflicts, and anxieties, to which Professor Allen listened carefully and reassured the students. Occasionally, a student's emotional difficulties appeared so severe he urged them to seek assistance at the university counseling center. He made sure to have up to date counseling resources, helped schedule appointments, and made sure his mentoring was not mistaken for a professional counseling relationship.

Participants for the study
The participants were purposefully selected (Glesne, 2006) based on their gender, discipline, and time within a research relationship. To be eligible for the study, participants had to: (a) self-identify as women; (b) be a current tenure-track faculty or graduate student in science and engineering at the selected higher education institution; and (c) be working with a current advisor/advisee in a science and engineering research project for six months or longer. Four faculty members and five graduate students responded to the call for participants and were selected for the study. Three additional graduate students were selected through snowball sampling (Creswell, 2013). We included women mentors with male mentees, and women mentees with male mentors as participants because the intention was to highlight the experiences of women faculty and graduate students who are typically underrepresented in science and engineering (Corbett & Hill, 2015; Landivar, 2013). The 12 participants were from a public university in the Western United States.

In this study, we replaced the term Hispanic, commonly used in census data, with Latina in order to better represent the women participants from Latin-American backgrounds (Salinas & Lozano, 2017). The mentees were predominantly doctoral students with time in a research relationship ranging from 0.5 to 7.0 years. Faculty members ranging from assistant to full professors had research experiences ranging from 10 to 30 years. A more detailed table of information about the participants is presented in Table 2.

All participant names used in this manuscript are pseudonyms. Pseudonyms were assigned to the 12 participants for their interviews. We recognize that "allocating pseudonyms to confer anonymity is not merely a technical procedure, but renaming has psychological meaning to both the participants and the content and process of the research" (Allen & Wiles, 2016, p. 149). We chose to use pseudonyms because of our commitment to the privacy and confidentiality of our participants, who we intended to "safeguard against unwanted exposure" (Christians, 2005, p. 145). We also tried to the best of our ability to use pseudonyms and disguised locations so that insiders to the study may not be able to recognize the participants (Christians, 2005).

Interview procedure
We collected data in the form of two structured interviews, two structured discussion boards, researchers' journals, and a member-checking session encompassing questions from the two interviews. Participants were required to attend two structured interview sessions in which they were asked to read the six case studies. Participants were video-recorded, audio-recorded, and visually observed. In each interview, participants read the case studies individually and answered a series of questions about each case study. A voluntary online follow-up member-checking session was provided to the participants in which they were asked to respond to two discussion boards on the general themes of this study's analysis. The findings presented in this work include the first structured interview and the discussion board, researchers' journal notes, and member-checking questions relevant to the first interview.

Table 2: Summary of participant demographics.

Role	Avg. time in research relationship (years)	Avg. # of research advising mentors/ mentees	Avg. # of female mentors/ mentees	Mentor/ mentee outside institution	Marital status	Children	Citizenship	Self-identified Race/ Ethnicity	First generation
Ph.D. Student	3.9	2.4	1.2	3 Yes 2 No	1 Married 4 Single	1 Yes 4 No	1 Domestic 3 International 1 Dual	2 White 1 Latina 1 Black/Latina 1 Asian	1 Yes 4 No
M.S. Student	3.5	1.5	1	1 Yes 1 No	1 Married 1 Single	2 No	2 Domestic	1 White 1 White/Korean	1 Yes 1 No
M.S./Ph.D. Student	0.5	2	0	No	Single	No	Domestic	1 White	No
Assistant Professor	10	9	3	No	Married	Yes	Domestic	1 White	Yes
Associate Professor	19	26	19	No	Married	Yes	Domestic	1 White	No
Full Professor	28	32.5	11	Yes	2 Married	1 Yes 1 No	1 Domestic 1 Dual	2 White	2 No

Discussion boards
As part of a voluntary member-checking process, several weeks after the interviews we provided participants with the opportunity to participate in two anonymous discussion boards. In the first discussion, we presented the preliminary results of the qualitative analysis that compared graduate student and faculty themes. We asked participants to comment on the results and provide an ethical mentoring strategy that they would apply to their own research relationships. The second discussion board contained links to the university's graduate student handbook and the faculty's standards of conduct. We asked participants to comment on these policies with a focus on ethical research relationships. Also, these discussion boards were used to identify any institution-specific policy actions or strategies that might inform readers of potentially transferrable implications from this work.

Ethics in Data Collection and Analysis
This study explored potential ethical issues between women graduate students and faculty members who serve as advisors. As researchers in such advisory relationships ourselves, we felt it was important to conduct ourselves in a way that minimized the potential for ethical infractions, not only from the perspective of research ethics, but also in our own research relationships. Firstly, to minimize issues of interviewee-interviewer power imbalance, graduate students were interviewed by the student researcher (first author). Both faculty members and doctoral students were assisted by the third author, who was a postdoctoral fellow during the member-checking session. As suggested by our institution's Internal Review Board (IRB), data collection and preliminary analysis of faculty and graduate student participants were kept separate. In this way, we did not have access to, nor did we discuss, the case studies or our interviewees' responses to the cases until at least two observer meetings mediated by a neutral third party were completed. This was done to minimize coercion between the authors of this work. The neutral third-party observer's presence ensured that the research team did not use their positions to coerce each other or otherwise bias interpretation of the data.

Data Coding Procedures
We determined that multiple coding methods were needed in order "to capture the complex processes or phenomena" in our data (Saldaña, 2009, p. 75). Therefore, we chose to combine holistic coding (first cycle) with inductive/deductive thematic analysis, which included *a priori* coding of the ethical mentoring principles (second cycle) in order to ensure a rigorous and substantive data analysis.

Holistic coding
In the first cycle of coding, we used holistic coding as an exploratory and preparatory approach (Saldaña, 2009) in order to determine preliminary themes for the study. We investigated portions of the interviews and the research journals. For example, we analyzed how participants provided demographic information, and how they answered questions about ethical mentoring and the six case studies. This first cycle of coding was essential, because it allowed us to challenge our framework and verify that the conceptual lens adopted was suitable for the design and procedures of this specific study.

Thematic analysis
In the second cycle of coding, we used deductive and inductive thematic analysis to further explore the interviews and researchers' journals, and to analyze the discussion board entries and member-checking sessions. We used thematic analysis as a "way of systematically observing a person, an interaction, a group, a situation, an organization, or a culture" (Boyatzis, 1998, p. 5), which in this case we identified as the specific disciplinary and research cultures that these women were in. Beginning with deductive thematic analysis, we looked at the development of common patterns and themes among the graduate students and the faculty participants, proceeding from our main research questions and theoretical framework. The six ethical mentoring principles were chosen as *a priori* codes (Saldaña, 2009, p. 71). However, we did not limit our analysis to these codes and conducted inductive thematic analysis to ensure a rigorous data analysis process.

While each case study was specifically chosen to represent a single ethical mentoring principle, our analysis allowed participants to describe other ethical mentoring principles throughout the interviews and voluntary member-checking boards if they so wished. For example, participants were asked what was important in a research advising relationship before being presented with any case studies. This was done in order to understand their initial perceptions without introducing any other frame of reference.

Data was analyzed using MAXQDA-12 (MAXQDA, 2018), a mixed-method analysis software that allows for computer-assisted qualitative data analysis. Regular member-checking sessions helped establish a communal code system to ensure trustworthiness and internal validity, and to avoid errors of interpretation (Lincoln & Guba, 1985). We conducted an intercoder agreement check on representative faculty and graduate student interviews as an external check on the coding process (Creswell, 2013). The interview was independently coded and discussed with a 96% agreement of codes.

RESULTS

Themes Identified
Thematic analysis of the case studies considering the ethical mentoring principles yielded three recurrent themes among the participants: (a) communication; (b) power; and (c) awareness.

Communication
A synthesis of the interviews revealed that the participants considered productive or "effective" communication between mentees and mentors in a research advising context to be a two-way communication in which each party is responsible for open, honest, and direct exchanges (i.e., verbal, textual, nonverbal). They also indicated that such communication involves frequent and timely exchanges that are respectful, professional, and meant to reveal and clarify expectations, perceptions, and goals. It was suggested by the participants that both mentors and mentees must be approachable and trustworthy—demonstrated by listening to each other in a supportive and sympathetic manner.

Among the graduate students interviewed, communication was a central issue within the autonomy case study, which described a fictitious situation in which a student (Sandra) perceived that her advisor (Dr. Copie) wanted her graduate student to research exclusively in her area of research and forego a family. When asked about what ethical behaviors she would expect of her mentor in this situation, Lindsay (graduate student) replied:

> I think, to some extent, some frank discussion about intended trajectory just so that some of the subliminal pressures are out in the open. Um, and so that there's not some potentially unethical but unknown sort of currents going on. But yeah, a more clear discussion about the expectations that both Dr. Copie and Sandra have for Sandra's path forward. (Lindsay, Graduate Student, Interview #1, Line 339)

The graduate students frequently identified the importance of clarifying expectations as an effective communication strategy. Along with clarifying expectations, the students noted the importance of their mentors clarifying decision-making as a way to avoid negative interpretations. One notable finding was that some international students expressed a concern that revealing personal information about their unique situations (especially centered around issues of mental or physical health) gave the mentor more power over them.

The faculty members brought up effective communication as important in productive research relationships, most notably through the nonmaleficence case study, which related to a faculty member (Dr. Scathe) directing demeaning criticism to his students. Valerie (faculty) stated:

> We have demands as mentors that come from where we are and where our status and position is. And from what I'm reading here I would say, well, we can't forget that our mentees are not where we are at. And secondly, not everybody is armed to get the criticism that you would give to a colleague, for example, or a person who's at your same level. (Valerie, Faculty, Interview #1, Line 172)

Overall, faculty members also reported two particular communication responsibilities of mentees, namely: (a) articulating when a mentor has demanded too much of them either professionally or personally; and (b) in instances of conflict, attempting communication with their mentor before seeking help from anyone of higher authority.

Power

All participants were aware of the power imbalance that exists between a mentor and a mentee. Both faculty and graduate students were most sensitive to the relationship of power in the beneficence case study, in which a mentor was pushing and challenging his mentees; and in the fidelity case study, in which a mentor did not have time to help a mentee.

In the beneficence case study, graduate student participants encouraged mentors to challenge mentees, yet expected that mentors would intrinsically know how far

to push mentees relative to their ability. Faculty participants were particularly cognizant of the difference of power between them and their mentees, and expressed this in the importance they attributed to maintaining boundaries. The issue of time as an example of power imbalance was brought up by all participants, particularly in relation to the fidelity case study. Students in particular expressed the lack of power they felt over how much time their advisor gave them. For example, when responding to the fidelity case study, Kate (graduate student) described her current situation in this way:

> I feel like now that my advisor is on sabbatical and when he went through the tenure process he became more scarce, more like Dr. Scarce. So, he's on sabbatical currently and it is harder to get him to respond to things and he has too many students right now. He's got like 15. So, yeah it's negatively affecting me but I don't necessarily know what I'm doing about it. (Kate, Graduate Student, Interview #1, Line 552)

Students and faculty members alike expressed that mentees are owed time by their mentors. However, faculty members were more forgiving of situations in which an advisor did not have enough time for their students due to the demands of their profession. Faculty members mentioned the importance of not taking on too many students if they are overburdened. For example, when discussing the fidelity case study, one faculty member stated:

> Yeah, there is a point where you don't have enough time to give, to be an effective mentor. And so on my end, it's important for me to know when I've crossed that line where I don't have time to take on more students. (Kendra, Faculty, Interview #1, Line 187)

In contrast, graduate students expressed how important it is that an advisor gives them time, both in terms of progress towards degree completion, and professional success (i.e., letters of recommendation). They described time in terms of both a commitment to, and investment in, them as a person and future colleague. For example, when asked what advice they would give to the individuals involved in the fidelity case study, Bridgette (graduate student) stated:

> I would have advised Todd that it is important to have a mentor who is a brilliant scholar, but if you cannot access his brilliance—if you can't access his experience, his knowledge, there's no use having such a mentor. It's better to have a mentor who's ready to grow with me, who's ready to invest time in me—invest his experience, his knowledge in me. (Bridgette, Graduate Student, Interview #1, Line 432)

The graduate students in this study elaborated that when faculty advisors did not give them time, they believed it was a reflection of their worth and that it negatively affected their self-confidence. Additionally, several students felt hesitant to ask their advisors for more time, one expressing that she did not want to inconvenience her advisor.

Awareness

The need to establish awareness emerged as a prevalent theme in the analysis of the interviews and was confirmed in the other data sources. Awareness was described as mentors or mentees possessing self-awareness and being aware of the effects their actions had on each other, being aware of professional and personal boundaries, and using peers as a baseline to determine what was typical in a research relationship. Faculty members expressed awareness of their relative position of power to their mentees. When asked if the autonomy case study contained ethical issues, Barbara (faculty) responded:

> I think they all do to some extent, and it has to do with the power imbalance between a mentor and a mentee. And it's important to always, as the mentor, be aware of that so that power is not abused. (Barbara, Faculty, Interview #1, Line 112)

While the graduate students were aware of the power imbalance in a research relationship, they did not emphasize it as strongly as the faculty participants did. Instead, the graduate students focused on the strategy of using their peers to elucidate unclear situations or suspect relational interactions with mentors. When asked who they might approach for advice or help if placed in the situation of the case studies, graduate student participants across all disciplines, both U.S. and international, mentioned going to their fellow and more seasoned graduate students to determine what was "normal" in mentoring interactions.

The boundary between a professional and personal relationship was a common concern of all participants. For both faculty members and students, this theme was most prevalent in the privacy case study, in which a professor, Dr. Allen, listened to the personal struggles of students and offered support, making sure to advise them to go to a counselor if needed. Both participant groups expressed the importance of keeping those professional-personal boundaries, but for different reasons. Faculty members established it was important to be open to their mentees, but were uncomfortable with a counseling role and being overburdened with a mentee's emotional problems. When asked how she would respond if placed in the same situation as the case study, Kendra (faculty) responded:

> I would provide support for students but I try not to get too deeply involved with their personal lives because it just doesn't seem appropriate . . . , you know, it's kind of a gray area but I'm involved but not too involved. And so I would be very cautious about getting overly involved with students, such that it might impact the professional relationship. (Kendra, Faculty, Interview #1, Line 229)

When responding to the same (privacy) case study, many graduate students expressed appreciation for the sympathy and sincere personal support of an advisor like Dr. Allen, appreciating that he was aware of when (or if) to suggest counseling. They felt they also had some responsibility in maintaining the professional and personal boundary of mentor-mentee relationships. While some used this professional distance as a way to protect themselves, others saw how a lack of

professional distance could negatively impact a productive research relationship.

Intersectional Findings Among the Case Studies

A priori coding for the six ethical mentoring principles revealed that the graduate students and faculty members were most aware of the ethical mentoring principles of beneficence and fidelity—to help individuals achieve their career goals and their sense of loyalty (via dedicated time) to each other, respectively. However, participants also noted that they did not recognize ethical principles related to privacy and fairness in comparison to the other principles.

Among the privacy findings, concerns were raised regarding how much personal information mentees needed to reveal to their mentors, and the mentors' responsibility to maintain the confidentiality of that information. Faculty members were concerned about how this personal information affected their ability to maintain boundaries in their relationship. Conversely, students focused more on the disclosure of personal information. This concern was most salient for international students. All of the international students mentioned that they would not reveal overly personal information unless absolutely necessary. For example, Carrie (a Latina international graduate student) stated:

> Well, I don't...I have to be honest. I don't in general…I don't…I just try not to tell my personal difficulties to my professors. I don't do that. (Carrie, Graduate Student, Interview #1, Line 342)

In the fairness case study, involving a second-year doctoral student complaining to the department Chair about possible discrimination due to his race/ethnicity, participants rarely mentioned the issue of equal access to mentorship. Most participants were willing to give both faculty and administration the benefit of the doubt and attributed the selection of a less qualified White student in the scenario to other (albeit unexplained) factors. However, the international students predominantly focused on the issue of fairness and discrimination in the selection of students. One Latina international graduate student, Beatrice, mentioned how language can also be used as a means of discrimination:

> I didn't feel discriminated by the color of my skin. The only time it's happened to me is when my major professor discriminated against me because of my English. (Beatrice, Graduate Student, Interview #1, Line 569, translation ours)

Faculty participants expressed the importance of carefully documenting the rationale behind their hiring decisions and hinted at how students should speak to them first before making accusations of discrimination. For example, Hailee (faculty) stated:

> I would expect that if a student really felt like they were being discriminated against that they would raise the issue, but as a mentor I would appreciate [it] more if they actually asked me about it because it would give me an

> opportunity to kind of defend my choices and maybe I would learn something. (Hailee, Faculty, Interview #1, Line 267)

Regarding the autonomy and nonmaleficence case studies, graduate students and faculty participants had differing opinions. For example, when considering the autonomy case study, most U.S. graduate students indicated it was normal for students to feel pressure to pursue similar research and career interests as their faculty advisors, even when not explicitly stated, and they seemed to ignore or deflect the issue of pursuing a similar personal life (i.e., not having children until after completion of a doctorate). Conversely, international graduate students had highly variable opinions on the matter. For example, one international graduate student, Carrie, believed that it was natural to want to mimic faculty advisors out of admiration and could logically take that respect further into mimicking their personal life. Another international graduate student, Bridgette, focused on the detrimental effect that researching in the same area as one's faculty advisor might have and elaborated that pursuing a differing field between mentee and mentor offers a much greater opportunity to network and grow beyond the boundaries of their discipline. Beatrice, an international graduate student with children, reacted strongly to the personal aspects of the case study and its implications regarding family life. When asked if the case study contained ethical issues, she responded by stating:

> Yes, because it influences her family matters and professional and both. Yeah, that's the ethical thing to highlight. (Beatrice, Graduate Student, Interview #1, Line 481, translation ours)

Regarding nonmaleficence, faculty members focused on how the power dynamics between mentor and mentee could have detrimental effects on their students, especially with regard to criticism and feedback. However, some graduate students could not determine if the level of criticism was acceptable until consulting with their peers. Beatrice described her experience as follows:

> Having a person next to you that is treating you wrong or that makes ugly faces at you in front of others . . . , and when I believe it's maybe me or that I'm being overly sensitive that I feel that I'm just not used to being with these people. My gringo colleagues they tell me that rumors have been spreading that my advisor treats me really badly in front of other people and so now… now I know that it's not just what I thought or that it was just me. Now everyone else is seeing it. (Beatrice, Graduate Student, Interview #1, Line 392, translation ours)

Graduate students facing intersecting issues of race, gender, class, role, etc., also focused on the toll—both emotional and stress-related—of harsh feedback and an advisor's ability to withhold vital information or impede degree progress. For example, when asked what the most negative attributes of a research mentoring relationship were, Bailey, an Asian-American graduate student, responded:

> When you're like scared of being yelled at, that's kind of... I don't know, that was the scariest thing for me. So yeah… it's okay to make mistakes, but

> when it's not okay that mistakes are going to happen that's stressful. (Bailey, Graduate Student, Interview #1, Line 118)

Some students saw criticism as necessary to improving their work. However, they stated that a mentor had to be aware of the difference between criticizing a student's work and a personal attack related to their abilities and intelligence. This was particularly noted by the international students, who struggled with both language and cultural barriers. They further stated that mentors must also take steps to communicate to their mentees that their criticism was not meant to be taken personally and show an appreciation for the mentee's hard work.

DISCUSSION

Themes: Communication, Power, and Awareness

Communication

Although communication was found to be an integral component of ethical mentoring relationships for both the faculty and graduate students, participant responses often raised issues of power. Communication was said to be bounded by the power relationship between the faculty and graduate student—one in which information is usually provided from the top-down (Lin & Hsu, 2013). Considering the relative power imbalance between graduate students and faculty members in those relationships, it is unsurprising that these graduate students focused on "effective" communication strategies. Aligning and elucidating expectations in the beginning and throughout the relationship is a well-established communication strategy in the mentoring of graduate students (Fleming et al., 2013; Huskins et al., 2011; Kalbfleish, 2002). It is important to note the reciprocity of expectations within the research relationship because both the faculty and the graduate students not only have explicit or implicit expectations of the other (Klomparens & Beck, 2004; Lovitts, 2007), but also different cultural reciprocity rules (Shore, Toyokawa, & Anderson, 2008). For example, in Rose's (2005) study of 537 Ph.D. students at a Midwestern university, she reported that international students had different expectations of their personal relationship with their advisor compared to domestic students.

Power

While participants expressed that communication can be used to mitigate potential research relationship dysfunction, it was expressed that mentors can also take steps to equalize the power imbalances in their relationship. Defining mentoring excellence in graduate education, Johnson (2002) describes excellent mentors as those who share power with their mentees. This can be achieved by establishing, communicating, and respecting boundaries, giving time to the other, and sharing informational power and social capital via the revealing of unwritten rules and expectations (i.e., hidden curriculum) at institutions of higher education (Acker, 2001; Smith, 2014). Mentors can also be seen as providing access to resources, such as insider information on departmental norms, and influential people within their field (Yob & Crawford, 2012). In a study of science and engineering graduate students, 69% of participants agreed that being a successful scientist depends on establishing connections within the field (Anderson & Swazey, 1998).

Awareness

As was suggested in the preliminary work, students lack an awareness of what should, or should not, be considered acceptable behavior compared to faculty members who do (Gelles et al., 2018). Our results suggest that, in order to ameliorate this, students look to their peers in order to determine what is normal in research relationships. However, this strategy fails to adequately determine whether their research relationship is ethical or reciprocal, or if it accounts for the intersectional experiences and the systems of power acting upon the concerned parties. Instead of relying exclusively on the experiences of their peers, students and faculty members should develop and communicate a strong self-awareness of their intra-group differences and interpersonal skills (such as communication), as well as their individual strengths, limitations, and competencies.

Participants in this study expressed that unintentional harm in mentoring research relationships often stems from a lack of awareness on the part of the mentor or mentee. Literature suggests that mentors should not only be self-aware, but should also be aware of the unique talents, backgrounds, experiences, professional and personal needs of their students (Brown & Krager, 1985; Johnson, 2002). For example, women graduate students (especially when underrepresented) may lack support and understanding within their department or at home due to conflicting demands of their study as well as culturally-imposed gender roles (Carter, Blumenstein, & Cook, 2013), their ethnic backgrounds, and other intersectional considerations (Johnson, 2002). Additionally, in a study of faculty advisors of Latin American descent and their graduate students in science and engineering, Lechuga (2011) found that possessing cultural sensitivity contributed to a successful mentoring partnership. Literature suggests that students should also be more cognizant of the needs and demands of faculty members (Johnson & Huwe, 2002), not least because of the reciprocal nature of the relationship between the faculty and the student (Johnson, 2016).

There appears to be an expectation that those with greater power in the relationship should be more self-aware and aware of the specific needs of the power-disadvantaged individual. This was especially true in the case of boundary violations. Boundary violation is a common ethical issue found in the literature pertaining to the mentoring of graduate students (Brown & Krager, 1985; Clark, Harden, & Johnson, 2000; Johnson, 2008; Johnson & Huwe, 2002; Löfström & Pyhältö, 2017). The faculty-student relationship inherently contains several overlapping roles, such as advisor, research supervisor, employer, and evaluator (Johnson, 2016). With the inclusion of the psychosocial and professional functions of mentoring, this exacerbates the potential for boundary violations and exploitation (Johnson, 2002). With the balance of power favoring the faculty, there is an assumption that setting and enforcing boundaries is primarily their responsibility. Despite this, faculty participants in this study expressed that graduate students also have a shared responsibility to maintain these boundaries (Gelles et al., 2018). From this finding, it is evident that there is a need to explore the role that the power that mentees also possess, plays in these types of relationships. Future work will expand upon these areas.

Intersectional Perspectives of Ethical Mentoring

Participants' opinions of what was considered an ethical issue in research relationships varied both by status, and within disciplines. Often, these perspectives were colored by the unique intersectional lens and experiences that they brought to the mentoring relationship. This was most evident in the reactions of participants to the ethical issues presented in the autonomy case study, in which both advisor and advisee perceived different expectations of each other while following a specified research and personal path. Preliminary analysis of this finding revealed that all faculty participants were able to recognize and articulate whether an ethical issue was present in the autonomy case study, while most graduate students had highly variable responses as to whether there was an ethical issue present and what that issue actually was (Gelles et al., 2018). However, as our results show, for international women of color, ethical boundaries may have been crossed when personal considerations came into play over an intended career path—as was evident by an international graduate student's (Beatrice) reaction to this case study. Additional work is needed to uncover the ways in which personal perspectives intersect with intended career paths among women of color in science and engineering.

For our study, faculty and graduate student participants were most aware of the ethical mentoring principles of beneficence (the obligation to promote best professional interests) and fidelity (a sense of loyalty), but rarely acknowledged the principle of fairness (safeguarding of equal treatment). The authors of this study believe that this finding may be because ensuring equitable treatment and access to mentors or mentees requires both a fundamental reflection upon, and communication of, the individual differences that characterize each individual within the relationship, and a dual responsiveness to such intersections. As Crenshaw (1991) states, "strategies based solely on the experiences of women who do not share the same class or race backgrounds will be limited for those whose lives are shaped by a different set of obstacles" (p. 1246). In other words, if both the mentor and the mentee are not willing to engage in meaningful discussions around equity, strategies for their success are, at best, limited.

Implications

There is a lack of formal mechanisms that elucidate what is ethical in a research relationship beyond federal definitions of research misconduct. Instead, determining what is ethical in a research relationship is often left to the individual's discretion (King, 2003). One of the intentions of this work was not simply to identify the core themes in this study (e.g., communication, power, awareness), but to include potential strategies within these themes as identified by the participants themselves in the discussion boards. Also, we were conscious that as ethical mentors and mentees, it is important to empower not only the participants themselves, but also the voices and solutions they proposed, presenting them first before our own recommendations.

The participants' recommendations in the discussion boards highlighted the need to verbally communicate expectations between graduate students and the faculty at the beginning of a given relationship. Among others, this can include topics such as

intended career plans, ethical responsibilities, and workload. Furthermore, they emphasized the need to discuss these expectations periodically throughout a research relationship, and not only prior or subsequent to such a relationship.

Participants also underscored the importance of providing written and explicit guidance that clarifies expectations for navigating relationships of power as well as the professional and ethical conduct of such interactions. This written guidance should be included in graduate student handbooks and faculty codes of conduct along with procedures on how to report ethical infractions or behaviors if and when they surface. One interesting recommendation was that universities should communicate in writing the differences between classroom and interpersonal mentoring conduct. There was a recognition that faculty and student codes of conduct do not differentiate between these behaviors in these contexts. Finally, it was recommended that codes of conduct and other written materials be used as a template via which to train students and faculty members in the ethical behaviors involved in research mentoring.

Combining the participants' recommendations and the findings from this work, the authors would like to add that communication should also contain and reflect an awareness of the implicit cultural norms and expectations of researchers in science and engineering disciplines, and of the relationship of power between student and faculty. Awareness, on its own, is not enough. This awareness (i.e., informational power) must be shared through effective communication. Also, it was evident from our findings that faculties have greater knowledge and awareness of the unofficial expectations and unspoken cultural practices (i.e., the hidden curriculum; Acker, 2001; Bourdieu, 1986; Smith, 2014) and that, by sharing this knowledge through effective communication, power can be shared while at the same time engendering a culture of ethically conscious mentors and mentees.

Whenever a faculty member is considering introducing a new mentee into their research, open communication of expectations in an ethical mentoring relationship is recommended. Furthermore, a culture of ethical accountability should be encouraged by both the faculty and graduate students alike. In this ethical culture, the faculty and students would be entrusted to reduce unintentional and potential harms in the research relationship together. As suggested by the participants, including some of these expectations in formal documents (such as handbooks and codes of conduct) can aid individuals, providing a starting point for discussion via which power differentials can be equated and intentionally shared by both parties. Finally, as academic programs begin to consider issues of ethical mentoring, it will be important to include language in both training and admission programs that consider the ethical roles and responsibilities of everyone involved in a mentoring research relationship. These institution-wide initiatives have the potential to minimize the obstacles that prevent individuals from having healthier, more productive, and long-standing research relationships.

Limitations

This study was limited in that it was conducted on a narrow population in a predominantly White institution in the Western United States. Recruitment of

participants, while initially purposeful, became based on convenience throughout the institution. One interview was conducted with a bilingual participant who chose to express most of her responses in her native language. There could have been interpretation complications when analyzing this translated interview. Also, while the data were collected from limited data sources, we believe that sharing the data will add value to individuals seeking to learn more about this topic. The findings may also help readers to identify potential strategies that could be transferred to their own institutions, when applicable.

An additional limitation of this study was that participants may have assumed the function of mentoring is occurring between research advisors and students without that relationship meeting the professional and psychosocial requirements as defined within contemporary literature (Johnson et al., 2007). However, these definitions were provided in the member-checking session in order to allow participants to refine or modify their responses as they saw fit.

We also recognize that the findings from this study present a "snapshot in time" and may not represent the long-standing perspectives and experiences of the participants in this study. Finally, most participants indicated that they did not know what resources were available for them at the institution if they experienced mentorship dysfunction. While the authors of this work shared resources around ethical mentoring with the participants, including these resources in a centralized manner across institutions of higher education may be more beneficial.

CONCLUSION

The goal of this case study was to identify the perceptions graduate students and faculty members hold regarding research relationships. Its aim was to help reveal the perspectives, beliefs, norms, and other factors that can hinder inclusive, healthy, and productive research relationships among women graduate students and faculty in science and engineering. Qualitative analysis has revealed: (a) the importance of effective communication; (b) how power imbalances are reinforced between the research advisor and graduate student; and (c) how awareness of hidden norms and expectations within the research culture can shape research relationships. Collectively, these findings suggest that for many science and engineering disciplines, ethical mentoring issues are centered upon communication, power, and awareness of ethical mentoring principles.

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ENDNOTES

[1] We opted to include the term "woman" or "women" rather than "female," as the latter term limits participants' identities to their reproductive abilities rather than representing them as human beings.
[2] Latina was used in lieu of Hispanic to more inclusively represent the self-identified women participants from Latin-American backgrounds (Salinas & Lozano, 2017).

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