

Ethical Practices and Tips for Improving Engineering Faculty-Student Research Relationships

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Abstract—Ethical mentoring is a relatively new term in engineering that describes the dual relationship that both an advisor and an advisee should have for each other during an intersectional time in their engineering education or profession. Ethical mentoring has several principles—beneficence, nonmaleficence, autonomy, fidelity, fairness, and privacy—principles to ensure that research relationships are effective and mutually beneficial. In a prior qualitative study, led by the author, a group of graduate student mentees and faculty mentors in science and engineering were interviewed around the six ethical mentoring principles. Out of this analysis, three key themes emerged: (a) power; (b) awareness; and (c) communication around implicit expectations within the research culture. While some recommendations around ethical mentoring were provided from that study, no comparisons were made to ethical practices of engineers (i.e., NSPE). This research-to-practice paper expands upon prior findings on ethical mentoring and compares them against NSPE. From this comparison, practices in the form of recommendations, tips, and resources were derived. While not comprehensive, the practices included aims to improve engineering mentoring relationships to support mentees towards their transition to the workforce.

Keywords—ethics, mentoring, engineering, power, communication, awareness

I. INTRODUCTION

According to Smith [1], “underrepresented students have limited knowledge about how to play and win the higher education game” and consequently, “it is crucial [...] that we create mentoring programs that help students navigate their school’s academic cultural environment” (p. 3). In higher education, mentoring is normally classified as either *informal* or *formal* [1]. Informal mentoring is considered ‘authentic’ in that the interaction between the mentor and mentee occurs spontaneously, naturally, and without the intervention of an external party or group [1], [2]; peer mentoring typically falls under this category [3]. Formal mentoring is considered less authentic in that individuals are assigned mentors through an academic program [1], [4], [5] and the relationship, in many ways, is ‘forced’. Studies have suggested that informal mentoring is the type of relationship that contributes most to the success of mentees in academic environments [5]. However, the reality is that many academic programs cannot guarantee this

type of natural, non-forced connection among STEM students and mentors within their programs. Also, many times, new students in STEM may have a lack of awareness on who could be a good mentor to them.

When students and faculty are unaware of what traits of a mentoring relationship leads to positive outcomes [6], dysfunction happens [7]. A dysfunctional mentoring relationship becomes “unproductive or characterized primarily by conflict” [7, p. 45]. While not fully understood, studies from the author and colleagues [8], [9] have suggested that power, communication, and awareness are important components to consider when overcoming dysfunctional relationships.

What is less known is how these mentoring relationships connect with ethics and more specifically within the context of the engineering profession. In engineering, there are many ethical guidelines and policies to abide to but perhaps the most known and taught in engineering classrooms is the National Society of Professional Engineers’ (NSPE) code of ethics. Understanding how mentoring and ethics relate to each other, particularly in the context of professional preparation of engineering students is important as it can help equip mentors to better prepare their mentees to the engineering workforce. This research-to-practice paper expands upon prior work [8], [9] to present tips and tools to power dynamics, awareness, and communication in faculty-student academic relationships in engineering. This work will be presented from the perspective of an ethical mentoring framework.

II. RESEARCH QUESTION

For this research-to-practice paper, the research question is: *From the perspective of ethical mentoring, what practices could serve to improve faculty-student academic relationships, in terms of power, awareness, and communication? Are there inferences that can be made from existing professional ethical documents (i.e., NSPE) that can be included when considering these ethical mentoring principles?*

To answer the research questions, the theoretical framework of ethical mentoring, applied to engineering, will be used. More specifically, the NSPE Code of Ethics will be considered as an additional framework and guide for the analysis.

III. THEORETICAL FRAMEWORK

A. Ethical Mentoring

Ethical mentoring, developed originally by Johnson and colleagues [6], [10] states that a mentoring relationship must be *intentional* to guarantee that psychosocial support and well-

being is safeguarded. It is this intentionality that allows authentic relationships between a mentor and a mentee to occur. Ethical mentoring in its early iterations of the framework consisted of six principles: Beneficence, Nonmaleficence, Autonomy, Fidelity, Fairness, and Privacy. *Beneficence* involves the mentor's/mentee's obligation to promote best professional interests. *Nonmaleficence* results in an avoidance of using mentor's/mentee's role for harm. *Autonomy* considers how mentors/mentees intentionally promote pathways for independence. *Fidelity* takes into consideration a mentor's/mentee's sense of loyalty to each other. *Fairness* ensures that equal treatment between a mentor and mentee is kept. *Privacy* takes care to avoid revealing sensitive material without consent. Today, Johnson and colleagues have added and changed some principles to include considerations of justice, transparency, and competence [11]. However, the latter principles will not be the focal point of this work since this paper is premised on findings deriving from the earlier versions of Johnson's framework [4], [6], [7].

B. Ethical Mentoring in Engineering

In engineering, very little work has been conducted around the idea of ethical mentoring. To the best of our knowledge, only the author and colleagues have worked on studying mentoring relationships among faculty and students in science and engineering [8], [9], [12], [13]. In that work, it was found that amongst graduate students and faculty who are part of an academic mentoring relationship, three themes are important in overcoming mentoring dysfunctions: power, awareness, and communication.

Power, according to Johnson, should be shared by mentors to mentees to ensure that excellence in mentoring occurs [7]. A power dynamic that is equitable consists of "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)" [9, p. 123]. In recent work by the author and colleagues [13], a group of underrepresented minority women mentors and mentees in science and engineering were asked to comment on the ethics of their research mentoring relationships in academia. When comparing both respondent roles using qualitative thematic analysis, both participants recognized that power imbalances existed between the faculty mentor and student mentee. All participants acknowledged that not everyone is conscious about sharing this power in a mentoring relationship and suggested a need to develop tips and strategies to equip mentors and mentees to recognize and share power more equitably.

Awareness was described by the author and collaborators previously as "an ethical obligation of both mentors and mentee" [8, p.13]. It was suggested that a high level of awareness must be tied to an understanding of how a mentor/mentee's actions compromise the other parties emotionally. Furthermore, it requires an introspection of the relative positions of power in the relationship [8], [9] as well as a recognition of the value that resources (campus-wide offices, programs, etc.) have in helping a mentee or mentor advocate for an issue [9].

Communication is essential to an effective mentoring relationship [9] because it is through communication that individuals are held accountable in upholding their ethical obligations. Open, honest, and objective information ensures that the power differentials between a mentor and mentee are balanced [9]. It also facilitates processes where accountability is central to the mentoring relationship. For example, if a mentor has information that can directly influence a mentee's success, withholding that information can potentially harm the mentee. At the same time, if the mentor shares information without communicating their expectations on how this information can help the mentee, the rationale for sharing this information, or the consequences to using the information, there is a risk that the actions of the mentee are misinterpreted and misled. Second, purposeful sharing of information and resources/points of contact can benefit both parties in the mentoring relationship if there is a mutual understanding that time may be needed to process the provided information and resources [9]. Thus, it is crucial that both the mentor and mentee realize that they may not have all the information and tools needed to properly communicate. In these circumstances, a mentor must be prepared to point the mentee to other individuals better positioned to attend to the mentee's need.

An additional point to consider in ethical mentoring comes from Gelles et al.'s [9] study of women graduate students and faculty in science and engineering. In their study, they showed that underrepresented women participants in STEM were most aware of the ethical mentoring principles of beneficence (e.g., promoting best professional interests) and fidelity (e.g., sense of loyalty) but were least aware of the principle of fairness (e.g., safeguarding equal treatment). It was believed that this "finding may be because ensuring equitable treatment and access to mentors and 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" [9, p. 125]. As such, taken together, power, communication, and awareness are intertwined to support a mentor and mentee. At least in the context of engineering, the author, and colleagues [8], [9], [12], [13] have suggested its importance in technical disciplines like engineering as subjectivity without proper objective and truthful balances within the mentoring relationship can lead to misuse and misrepresentation of important professional guidelines such as those found in the fundamental canons of engineers [14].

C. NSPE Code of Ethics for Engineers

The National Society of Professional Engineers (NSPE) Code of Ethics is a document that highlights the standards by which professional engineers should conduct themselves in the profession [14]. The NSPE Code of Ethics outlines six fundamental canons along with nine professional obligations to guide engineers in the way that they should conduct themselves professionally. To minimize repetition of the canons and professional obligations of NSPE, these will be outlined in the results section of this work. However, additional information can also be found in their website [14].

One area that is yet to be explored is a more in-depth

look into how the NSPE canons may inform principles of ethical mentoring and how these collected ideas can be applied toward engineering relationships and practices. While the author acknowledges that there are other ethical documents that could be used in this topic, NSPE was used because in the United States, the country in which the context of ethical mentoring was conceived, NSPE is the gold standard document to professional engineers and is the primary document taught in engineering classrooms. As such, this research-to-practice paper is not meant to be comprehensive but rather a first step toward a better understanding on how professional ethics can be transferred into mentoring in academic circles where many students are trained prior to entering the workplace.

IV. METHODS

To collect ethical practices for mentoring in engineering, based on the notion of power dynamics, awareness, and communication, the author was interested to find out if there were additional published works in ethical mentoring and engineering that can be compared to the NSPE Code of Ethics. A cursory search using Google Scholar, ERIC, EBSCO, Compendex, INSPEC, and other similar databases. Words like “ethics”, “ethical”, “mentor”, “mentoring”, “advising”, “coaching”, and “engineering” was conducted. This yielded 155 articles although upon closer inspection, none of them specifically attended to ethical mentoring in engineering except for the author’s own papers [8], [9], [11], [12]. As such, only the author’s papers were used to compare against the NSPE Code of Ethics and its canons. It is the hope of the author that this research-to-practice paper will support future scholarship tying these important topics and documents together.

Using the author’s papers, a secondary analysis of the findings was conducted. A naturalistic first cycle of *a priori* and thematic coding was conducted on elements that included “power”, “awareness”, and “communication” from the identified publications. Then, the themes identified were compared against the NSPE Code of Ethics and an additional cycle of axial and magnitude coding was conducted by comparing the papers’ themes and the six NSPE canons and nine professional obligations side-by-side. From these comparisons, tips and strategies were synthesized and re-verified against existing publications of the authors to ensure that the original intent of the proposed work was maintained. The suggestions were custom developed to attend to both the previous paper findings and NSPE.

V. RESULTS

From the publications, power, awareness, and communication were revisited with a consideration toward ethical mentoring and professional practices in engineering. While some of recommendations provided below may apply to other science, technology, engineering, and math (STEM) disciplines, we argue that in lieu of the NSPE Code of Ethics [14], much of the information provided below has been tailored to the engineering profession. Also, it is important to note that while there are existing resources and tools to tackle ethical topics such as case studies and instructional materials, these are typically conducted for professional scenarios [i.e., 14] and not necessarily for mentoring related to ethics. Resources in the

literature that are suggested for mentoring tend to occur in general forms and are not contextualized to engineering, let alone ethical mentoring. As such, the results presented here are tied to ethical mentoring principles of power, awareness, and communication in lieu of NSPE and is meant as a starting point for future work and iterations of practices and tips.

A. Power

While multiple NSPE canons may be impacted by power, from the standpoint of an ethical mentoring relationship in engineering, NSPE Canon 1, Canon 4 and Professional Obligations 1, 8, and 9 are applicable. These are listed as bullets below:

- *NSPE Canon 1:* Hold paramount the safety, health, and welfare of the public
- *NSPE Canon 4:* Engineers shall act for each employer or client as faithful agents or trustees
- *NSPE Professional Obligation 1:* Engineers shall be guided in all their relations by the highest standards of honesty and integrity
- *NSPE Professional Obligation 8:* Engineers shall accept personal responsibility for their professional activities, provided, however, that engineers may seek indemnification for services arising out of their practice for other than gross negligence, where the engineer’s interests cannot otherwise be protected
- *NSPE Professional Obligation 9:* Engineers shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others

Safety, health, and welfare from a mentoring standpoint require a consideration of the boundaries that mentors and mentees find themselves in. Boundary pushing is one of the most important principles in ethical mentoring [7], [15]. Boundaries that cross personal and professional goals, well-being, and attention are important considerations for ethical mentoring [7], [15] and in particular, to engineering research and practice. For example, professional goals in engineering can involve the development of innovative techniques and approaches and in some occasions, lead to a patent and/or publication. However, if boundaries are crossed in ways where a mentor pulls their ‘power muscles’ and takes credit for the ideas and programs that they did not help with, a power boundary has been crossed. In the same way, not protecting mentees or engaging in directed personal or professional attacks can greatly affect the career of an engineer as their welfare may be put at risk. Perhaps the highest risk within this canon is health, particularly mental and/or emotional health. Engineers are often expected to juggle multiple deadlines and projects at the detriment of their health. If a mentor or mentee is not cognizant of the time that is being used toward professional matters without work-life balance, the risk for burnout is great.

Professional obligations stated under this theme, involve professional honesty and integrity, personal accountability or negligence, and crediting work properly. Honesty and integrity in the context of engineering is primarily viewed from the standpoint of data handling and interpretation.

In the context of ethical mentoring, it is imperative that engineering mentors take the time to help train a mentee to review raw data, go through the research motions with the mentee, and apprentice a mentor to analyze, represent, and interpret data. In doing this, “not only have mentors not ensured that the mentee understands how to protect the integrity of data, but they have also taken advantage of their power over mentees by putting the workload of two on one individual” [15, p. 183]. On the same train of thought, personal accountability or negligence, typically found among mentors or mentees that do not dedicate time to the mentoring relationship [9], either because the individual is engaged in excuse making [15] or because they are overcommitted, can risk negative motives behind the mentoring relationship, ultimately leading to dysfunction [8]. Finally, not crediting work properly can risk functional aspects of the mentoring relationship leading to professional distrust and hindering of project goals [15].

A summary of practices and tips around the theme of power in the context of ethical mentoring in engineering is summarized in Table I. Please note that a mentoring relationship, particularly between students and faculty, takes time because time is ethical [9]. Much of what has been uncovered as practical tips are meant for smaller groups and one-on-one mentoring scenarios, although they could be adapted to larger groups, if needed. The latter is outside of the scope of this work and will not be discussed in the paper. One additional consideration to mention is that Table I is meant to be suggestions or starting points but not all of these may be applicable to or can be adapted to all mentoring scenarios.

TABLE I. PRACTICAL TIPS TO IMPROVE POWER DYNAMICS IN ENGINEERING MENTORING RELATIONSHIPS

Tip	Description
1.Create an ethical agenda	For the onset and duration of a mentoring relationship, create an ethical agenda where mentees and mentors discuss ethical dimensions of the work about to take place. Revisit these principles over time. Continual revisiting will ensure that ethical issues are addressed and managed in a timely fashion rather than risking an ethical issue to arise.
2.Develop an mentor-mentee expectations document	Information is power in the making. Many times, a lack of clearly delineated expectations, drafted and discussed by both the mentor and mentee risks professional mistrust and limited understanding of the motivations behind the mentor and mentee.
3.Share or document effort	Mentors and mentees are busy. However, there are limited opportunities for either party to understand how much time is being put on a task, let alone multiple tasks. Occasionally, share an overview (not detailed) outline of a calendar and/or create an effort document that is mutually shared and updated. Understanding how to not overwhelm either party and prevent outcomes like burnout [15] is the responsibility of both parties.
4.Conduct a ‘numerical privilege’ assessment	Quantify the relative position of power in your mentoring relationship. The author and colleagues developed a numerical privilege assessment for engineering [12] that helps parties reflect upon their privilege and power. Reflecting individually about these positions of power may support mentors or mentees to ensure more equity of power throughout their mentoring relationships.

5.Invite a ‘power auditor’	Consider occasionally bringing a neutral-third party, to evaluate mentoring conversations from an ethical mentoring standpoint. The author and colleagues developed a procedure for including such a neutral party in mentoring conversations [9]. If needed, create a short document or contract delineating the roles of the ‘power auditor’ as well as the mentors and mentees in this process.
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B. Awareness

While multiple NSPE canons may be impacted by a gain in awareness, from the standpoint of an ethical mentoring relationship, NSPE Canon 2 and 5 and NSPE Professional Obligation 2, 3, and 4. These are listed below:

- *NSPE Canon 2*: Engineers shall perform services only in the areas of their competence
- *NSPE Canon 5*: Avoid deceptive acts
- *NSPE Professional Obligation 2*: Engineers shall at all times strive to serve the public interest
- *NSPE Professional Obligation 3*: Engineers shall avoid all conduct or practice that deceives the public
- *NSPE Professional Obligation 4*: Engineers shall not disclose, without consent, confidential information concerning the business affairs or technical processes of any present or former client or employer, or public body on which they serve

Awareness, from an engineering standpoint, may include an agreement of what is considered acceptable and ethical between the mentor and mentee. Awareness, from an ethical mentoring standpoint, may involve an in-depth introspection and reflection of each role in the mentoring relationship and within the context of the profession. Furthermore, it may require an attunement to the cultural, personal, and behavioral sensitivities of each person. The second NSPE canon was included within this theme because performance of a service in several areas requires an awareness of the nature of the problem, their role in solving a given problem, and the required skills or expertise needed to fulfill the goals of the problem. This level of awareness requires continual communication between the mentor and mentee to ensure that all require components of a project or product goal can be met. If the mentee or mentee recognizes a lack of competency in an area, resource finding, and allocation will be needed to ensure a required area of competence is being attended to. It is imperative that engineers avoid all conduct or practices that deceive the public. For this to occur, there must be an awareness of how facts or data are accurately represented to the public and clearly detail how decisions are made about presenting a source of data or information. Helping the public understand the challenges, decisions, iterations, and actions taken in each project and the individual behind the decisions ensures trust from the public and allows for buy-in and participation of all parties.

In the same vein, as the mentor and mentee engage in a mentoring relationship, it is important that any confidential information, whether personal or professional, are not disclosed without the explicit consent of the affected parties. For mentors and mentees to gain this level of awareness, both parties must

agree on what is considered acceptable and unacceptable forms of disclosure.

Finally, awareness involves an understanding of how conflicting interests can be intertwined within the professional duties of a mentee and mentor. For that awareness to happen, there needs to be an honest and open conversation of the responsibilities and expectations of each mentor and mentee. It also signifies an intentional understanding of the needs of the public to identify ways to meaningfully serve the public.

While the list is not comprehensive, the following tips may serve to ignite awareness between engineering mentors and mentees as they consider ethical mentoring principles (Table II).

TABLE II. PRACTICAL TIPS TO IMPROVE AWARENESS IN ENGINEERING MENTORING RELATIONSHIPS

Tip	Description
1.Co-develop a disclosure decision flowchart or concept map	Outline what areas of a project (information, data, details) can be shared and not shared to the public. Include reasons for opting its disclosure or not (e.g., patent, legal, non-disclosure agreement, etc.). Practice communicating information-sharing in research safe spaces (e.g., one-on-one lab or group meetings). Explicitly convey the importance of understanding what areas may infringe ethical principles when sharing or not sharing information.
2.List transferable, learnable, or outsourced competencies	Among creating and identifying competencies for a project, mentor and mentees should discuss first if the skills that the individuals carry are transferrable, learnable, or outsourced. This is important in that it helps situate important deadlines of a project, the effort expended by the mentor and mentee to gain a given competency and the potential time, cost or work involved in outsourcing the required skillset. Aspects of this tip involve equipping the mentee to design and manage projects in the future.
3.Fact-finding trustworthy sources	Consider inviting a speaker, expert, or professional with demonstrated knowledge about fact-finding to provide resources to mentors and mentees about best practices on identifying trustworthy sources. These individuals do not necessarily need to be external to the institution or home department of the mentor or mentee and can serve as a source of support to the mentee as they navigate their data collection, analysis, and interpretation process. The important matter is to ensure that key elements of proper steps for fact-finding are discussed and re-enforced.
4.Role-playing	As part of discussion expectations for the mentor and mentee, it is equally important to gain an awareness of each other's roles and responsibilities. As such, having open, out-of-classroom or out-of-lab conversations about what the mentor's job entails and an honest conversation about the current requirements of mentees will ensure that both parties are up to date on current policies, programs, and requirements as they fulfill their roles. Have these conversations periodically and always ensure that a proper balance of personal and professional conversations is monitored and safeguarded [15].
5.Mentoring needs or resolution mapping	Engineers must not only be aware of the needs of the public but also understand the time it will take to properly mentor or be mentored. It takes time to understand the other person's standpoint of a mentoring relationship. Similar to empathy mapping approaches to human-centered design [16], take a few minutes to complete a map of what each other sees, thinks, feels, and does for a given issue. This

	may help both the mentor and mentee to see each other's viewpoints and needs when an issue arises.
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C. Communication

While multiple NSPE canons may be impacted by again in awareness, from the standpoint of an ethical mentoring relationship, NSPE Canon 3 and Professional Obligation 5, 6, and 7 are applicable. These are listed below:

- *NSPE Canon 3*: Engineers shall issue public statements only in an objective and truthful manner
- *NSPE Professional Obligation 5*: Engineers shall not be influenced in their professional duties by conflicting interests
- *NSPE Professional Obligation 6*: Engineers shall not attempt to obtain employment or advancement or professional engagements by untruthfully criticizing other engineers, or by other improper or questionable methods
- *NSPE Professional Obligation 7*: Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action

Communication, from an ethical mentoring standpoint, represents the explicit and implicit, direct, and indirect, intentional and unintentional, reciprocal or hierarchical, accusatory or elevating forms of expression and behaviors between mentors and mentees. Since much of the communication within the NSPE canons in this category may involve issues in where professional reputations or legal reporting may be at play, this category is perhaps one of the hardest to elucidate. Communication, from a mentoring standpoint, may require that motives [15] are clarified before an action or decision is taken. This may not always be easy because what is documented may not always be the reality behind closed doors and professional 'red tape'. Even if in paper, communication may appear to be clear and without ill intent, peoples' behaviors and actions may be contradictory to what is written. That is why, for mentors and mentees in this category, it is important that there is a level of trust-building that takes place prior to understanding the motives behind a mentoring relationship.

According to Kelly and colleagues [15], there are three motives behind a mentoring relationship: relational, functional, and participatory. A mentor/mentee that engages in communication with the purpose to relate may be seeking a deeper personal connection for the short and long term [15]. Functional forms of communication aim to help the mentor/mentee to navigate their professional structures and seek to learn about policies, expectations, and processes [15]. Participatory forms of communication involve a time-long commitment to updating a mentor/mentee about their progress with the intent to gain a positive and favorable view of each other over time. In the context of engineering, mentees and mentors' communications should convey a sense of trustworthiness and morale in their conduct, their actions, and their communicated or uncommunicated messages.

In engineering, mentoring relationships that aim to communicate a given hidden curriculum of their learning or working environments [16] aim to address relational, functional, and participatory elements of communication. From an ethical standpoint, it means that mentors and mentees whose communication is intentional and focused on helping each other relate, navigate through, and sustain a relationship should be sincere, transparent, and without ill intent. It means that there is a focus on a collective growth and gain rather than a one-sided approach toward success. As suggested in Table III, communication for ethical mentoring in engineering must transcend superficial views of relationship-building.

TABLE III. PRACTICAL TIPS TO IMPROVE COMMUNICATION IN ENGINEERING MENTORING RELATIONSHIPS

Tip	Description
1. Positionality discussions or statements	All mentees and mentors have a unique story to share. Being open about their journey to their career, fears, desires, how they overcame challenges, and future interests can help communicate the intent behind a sought mentoring relationship. Consider including positionality discussions or statements as part of the rationale for given research projects, either through formal venues (e.g., journal articles, grants) or informal venues (e.g., social media, op eds, blogs). Opening opportunities for positionality discussions or statements can set the stage for a long-lasting and productive mentoring relationships in the future.
2. Translate the norm	All mentees and mentors may be in different stages of life, have differing experiences, cultural contexts, and/or may be seeking to learn more about the setting they find themselves in, especially if they are new to the learning or working environment. During onboarding and important key events of a mentoring relationship in engineering, take some time to discuss and interpret/gain clarification on existing policies, expectations, and processes. If by any chance, there is an opportunity to add clarification to any document as it pertains to the mentor and mentee (e.g., student manual, lab manual, etc.), include or verbalize clarifying notes to the mentee to help them translate the norm. Learning about how each mentor and mentee interprets these norms may uncover blurred lines of expectations and responsibilities.
3. Journey map the mentoring relationship	Typically, in the context of engineering, project or product timelines dictate the length of a mentoring relationship. However, long-standing mentoring relationships can create new and exciting venues for participation and innovation. Consider creating a journey map that outlines either by drawing or mapping tools on how the mentee or mentor views the growth of their relationship over time. If you identify common areas of interest, it may be a good opportunity to pre-identify them, discuss them, and strategically plan for future projects and collaborations!
4. Plan before spreading gossip	When a mentee or a mentor does not realize the potential harm that can transpire from reputation-damaging behaviors, consider including discussions in your mentoring groups about the harm that subjective and false testimonies can have to an individual. Create some ‘fake news’ articles or private (not public) mediated channels (e.g., social media, email, text message, chat) about a person, with a common understanding that this is to be

	shared internally with the aim to view each other’s perspective. Discuss how it made you feel when you saw lies said about your person and character. Create a plan to minimize any communications that can be interpreted by the individual as harmful to the other party. Remember that a damaged reputation cannot just harm the individual but also the entire engineering team collaborating with them too. Aim for peaceful environments at all costs.
5. Follow-up on objective evidence	If a mentee or a mentor is indeed performing an unethical act, and there is substantial evidence to support the claim, it will be important to report it to the proper authorities. As a mentor or a mentee, it may be important to know and learn about the policies, expectations, and processes to report an individual in an ethical manner. If possible, include these guidelines as part of an onboarding document or webpage policy.

D. A note about the intersection of power, awareness, and communication in engineering for ethical mentoring

While the prior focus on power, awareness, and communication as individual themes behind ethical mentoring in engineering, these concepts are also intertwined. As such, the tables shared with the reader do not have to be exclusive and can be combined as needed. At the same time, these tables are not comprehensive but meant to be a conversation-started to ignite strategies to support a healthy and productive mentoring relationship in engineering and more specifically as they are guided towards professional practices of engineering. The important aspect to consider is that both the mentor and the mentee have a responsibility to respond to and make meaning of the messages sent by both parties.

It also signifies that at the intersections of power, awareness, and communication, ethical mentoring in engineering includes duality in responsibilities as well as considerations of each other’s contexts, needs, and intentions. Furthermore, it may indicate a mutual and honest assessment of what mentor or mentee qualifications are the most desired for the relationship [15] and which ones would have to be addressed from the onset.

Finally, with any mentoring relationship, ongoing self-reflection is key. As you navigate the mentoring relationship, ask yourself the following types of questions to ensure that you are also keeping yourself ethically accountable in the process (Table IV).

TABLE IV. SELF-REFLECTIVE QUESTIONS TO MAINTAIN ETHICAL ACCOUNTABILITY IN MENTORING RELATIONSHIPS

Mentors	1. Am I assuming my experience and stage of life is the same as my mentee? 2. Am I trying to impart my own values to the mentee or am I trying to understand the context and unique experiences of the mentee? 3. Am I checking my biases as I provide advice to the mentee?
Mentees	1. Am I understanding where the peer mentor’s advice is coming from? 2. Is the advice relevant to my unique situation and context?

	3. Do I understand enough about the landscape of my school or workplace to know how to act upon the mentor's advice?
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VI. IMPLICATION FOR PRACTICE

Regardless of the approach taken, ethical mentoring affects us all but especially in high stakes, socially driven disciplines like engineering. Ethical mentoring should be a centerpiece of the professional roles of engineers as it sets the stage for training of ethical practices, behaviors, and informs even designs and products.

The implication of this work for the practice of engineering is to fundamentally challenge and encourage further reflection on the role that ethics and mentoring plays in the professionalization of engineers. In this work, ethical mentoring was presented as being intertwined and not disconnected from the realities of the mentor and mentee. This generated a set of practices and tips that can be used holistically or individually to support a mentoring relationship in engineering. At the same time, ethics is a difficult conversation to have in a mentoring relationship. In a final implication and tip for this work, some ice-breaker questions or topics that can be used or modified to start these activities are shared in Table V. Without starting on the right 'ethical foot', many mentoring relationships will wither away, leaving an ongoing gap in how engineers are trained and sustained throughout their educations and careers.

TABLE V. ICE-BREAKER QUESTIONS TO START ETHICAL MENTORING DISCUSSIONS

Guiding ice-breaker questions to broach ethical mentoring topics
1. Can you tell me what attracted you to this degree/work/experience? 2. What is your goal in obtaining this degree/work/experience? 3. How do you want to use this degree/work/experience in the future? 4. Do you think that this degree/work/experience is a good match with you as a person? As a student/faculty? Why or why not? 5. What would you say are your greatest strengths you bring in pursuing this degree/work/experience? 6. Right now, what do you think you could use more help with in this degree/work/experience? 7. In the future, what do you envision you may need help with for this degree/work/experience? 8. What resources have you used as far as a student/faculty/professional? How have these resources helped you navigate this degree/work/experience? Which resources have you not used and why? 9. From what you have seen so far, if a less experienced person or newcomer asked you how things ran in this degree/work/experience, what would you tell them? 10. Let's talk a bit about what you expect from a mentor/mentee. Answer the following: • What are you expecting is the role of a mentor/mentee? • Do you expect that you may need more than one mentor/mentee to navigate your degree/work/experience? Why or why not? • If our mentoring relationship is not attending fully to your needs, do you know where or how to find other mentors/mentees? If not, what do you think you need to do to find them? • Have you thought about if and how this mentoring relationship is ethical? Let's discuss this more.

VII. CONCLUSIONS

This research-to-practice paper aimed to generate ethical practices for engineers to improve mentoring relationships between faculty mentors and student mentees. The offered practices and tips centered around the themes of power, awareness, and communication. While the list of suggestions is not comprehensive, this work aimed to provide a starting point by which individuals can reflect upon and have meaningful conversations toward more positive and effective mentoring relationships in their education and careers.

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REFERENCES

- [1] B. Smith, "Mentoring at-risk students through the hidden curriculum of higher education" Lexington Books, Plymouth, United Kingdom, 2014.
- [2] L.T. Eby, J.E. Rhodes, & T.D. Allen, "Definition and evolution of mentoring" in *The Blackwell handbook of mentoring: A multiple perspectives approach*, 2007, pp. 7-20.
- [3] R. Spencer, "Naturally occurring mentoring relationships involving youth" in *The Blackwell handbook of mentoring: A multiple perspectives approach*, 2007, pp. 99-117.
- [4] W.B. Johnson and C.R. Ridley, *The elements of mentoring*. New York: Palgrave MacMillan, 2004.
- [5] C.A. Mullen, "The WIT cohort: A case study of informal doctoral mentoring," *Journal of Further and Higher Education*, vol. 27, 2003, pp. 411-426.
- [6] W.B. Johnson, *On Being a Mentor, A Guide for Higher Education Faculty* (2nd ed.). New York, NY: Routledge, Taylor and Francis Group, 2016.
- [7] W.B. Johnson, and J.M. Huwe, "Toward a typology of mentorship dysfunction in graduate school," *Psychotherapy: Theory, Research, Practice, Training*, vol. 39, pp. 44- 55, 2002.
- [8] L. Gelles, I. Villanueva, & M. Di Stefano, "Perceptions of ethical behavior in ethical mentoring relationships between women graduate students and faculty in science and engineering," *Proceedings of the American Society of Engineering Education Annual Conference & Exposition, Engineering Ethics Division*, June 24-27, 2018, Salt Lake City, UT, Paper ID # 21889, p. 1-20, 2018.
- [9] L. Gelles, I. Villanueva, and M. Di Stefano, M, " "Mentoring is ethical, right?": Women graduate students and faculty in science and engineering speak out," *International Journal of Gender, Science and Technology*, vol. 11, 2019, pp. 108-133.
- [10] L.Z. Schlosser, H.Z. Lyons, R.M. Talleyrand, B.S. Kim, and W.B. Johnson, "Advisor-advisee relationships in graduate training programs," *Journal of Career Development*, vol. 38, 2011, pp. 3-18.
- [11] C. Palmer, "How to mentor ethically," *Monitor on Psychology*, vol. 50, 2019.
- [12] I. Villanueva, L. Gelles, and M. Di Stefano, "Chapter 14: Understanding ethical peer mentoring," in *Navigating the Peer Mentoring Relationship: A Handbook for Women and other Underrepresented Populations in STEM*; Amanda Rockinson-Szapkiw, Jillian Wendt, and Katie Wade-James (eds.). Kendall Hunt Publishing, 2020.
- [13] I. Villanueva, M. Di Stefano, L. Gelles, P. Vicioso, and S. Benson, "A race re-imaged, intersectional approach to academic mentoring: Exploring the perspectives and responses of womxn in science and engineering research," *Contemporary Educational Psychology*, 59 (101786), 2019.

- [14] National Society of Professional Engineers, “NSPE Code of Ethics for Engineers” [Code of Ethics | National Society of Professional Engineers \(nspe.org\)](https://www.nspe.org/code-of-ethics); accessed 4/21/2022.
- [15] S. Kelly, J.A. Morrow, and G. Skolits, “Effective Mentorship, Effective Communication,” In Contemporary Issues surrounding ethical research methods and practice. IGI Global, Hershey, PA, 2015.
- [16] S. Gibbons, “Empathy mapping: the first steps,” [Empathy Mapping: The First Steps - Human-Centered Design - HCQIS Confluence \(cms.gov\)](https://www.cms.gov/hcqis/confluence/empathy-mapping-the-first-steps-human-centered-design); accessed 4/23/2022.
- [17] I. Villanueva, M. Di Stefano, L. Gelles, K. Youmans, and A. Hunt, “Development and Assessment of a Vignette Survey Instrument to Identify Responses due to Hidden Curriculum among Engineering Students and Faculty,” International Journal of Engineering Education, vol. 36, 2020, pp. 1549–1569.