

Surfacing Deeply Held Beliefs about Gender-and Race-Based Minoritization in Engineering: Emerging Insights After Two Years Focused on Data Collection

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Background and Project Overview

The mission of broadening participation in engineering is well-known and commonly accepted [1, 2]. Women and Peoples of Color in engineering continue to remain minoritized in undergraduate engineering, despite decades of diversity and inclusion initiatives [1, 2, 3, 4]. The purpose of our research project is to focus on engineering faculty, staff, and administrators (EFSAs) to explore 1) what they believe causes race- and gender-based inequity in engineering, 2) how they arrive at or justify these beliefs, and 3) the aspects of their lived experience that they understand as formative in their beliefs. Specifically, we are working to address the following research questions over the course of the five-year study (NSF #1943934):

1. What do engineering educators believe to be the dominant cause of gender- and race-based inequity in undergraduate engineering education?
2. How do they justify their beliefs?
3. What is the nature of the lived experiences they perceive as key in their evolution?

Participants include EFSAs with majority racial or gender identities (male and/or White) who have been endorsed by students and/or peers as being inclusive in their praxis. Our focus on the individual-level beliefs of this group of relative privilege and power complements other important work happening in the equity space that is focused on system-level inequity.

Our research design includes a series of four one-on-one interviews with each participant. The first two interview protocols are focused on surfacing their beliefs about the cause of gender- and race-based inequity, respectively, and are framed theoretically by Thinking as Argument (TaA) [5]. The third interview will explore their personal narrative, and the fourth interview (or some type of interaction) will be designed based on how the project evolves and what we learn between now and then. As of the 2021-2022 academic year, we are in Year 2 of the study, and this paper describes our emerging insights based on completing data collection for the first two interviews, consistent reflection and discussion within the research team, and some preliminary analysis.

Methods

Recruitment and Selection

We recruited the participants for this study primarily using a crowd sourcing approach. We sent an email to the listservs for campus affinity groups with concentrations of students with identities that are minoritized in engineering (e.g., SWE, NSBE, SHPE, WiE, MEP, etc.) This email invited students from minoritized gender/racial/ethnic groups to offer names of engineering educators that they perceived to be inclusive, and we invited those whose names were given by students to participate in the study. Additionally, we emailed engineering educators who were recipients of awards focused on diversity and inclusion initiatives and invited them to participate. Finally, we used snowball sampling with individuals identified by the first two strategies,

inviting them to provide names from their networks to access more extended and nationwide networks in our recruitment. Our recruitment methods were designed to fulfil our sampling needs. To answer our research questions, we sought a sample of at least 20 EFSAAs who had been identified within the community as inclusive, particularly those identified by folks with a non-majority racial or gender identity. We wanted a stratified sample across racial and gender-identities. Specifically, our goal was to obtain at least five White women, ten White men and five men of Color. We also wanted diversity across professional roles including faculty, staff, and administrators because the responsibilities and purposes of these roles differ in the context of broadening participation in engineering. Finally, we wanted half the participants to come from our institution and the other half from other universities within the United States to enable participant confidentiality while also strengthening our local network for future change efforts. Our recruitment efforts yielded 32 total potential participants. We chose to start the study with a larger sample than necessary to maintain diversity within the sample and prepare for attrition, so we invited everyone who was referred to us to take part in the study, which resulted in a sample of 29 participants.

Data Collection

For the first two interviews, we collected data using semi-structured interview protocols informed, in part, by TaA [5]. Our use of TaA as a framework enabled the collection of data to answer our first two research questions (participants' beliefs about the dominant cause of inequity and how they arrived at that belief). Further details about our use of this framework (and the additional questions we added) can be found in a previous publication [6]. We matched the racial and gender-identities of the member of the research team conducting the interviews with those of the participants (e.g., as a White woman, PI Dringenberg interviewed the participants who identified as White women). In accordance with IRB approved procedures, we piloted the gender beliefs interview protocol in Spring 2021 with three participants. Each pilot participant was recruited and selected through convenience sampling within the networks of each interviewer. The research team then refined the protocol and interviewing techniques to generate the final gender protocol, which we have included in Appendix I. We completed the gender-beliefs interviews with 29 participants during the Autumn 2021 academic semester, and we completed the race-beliefs interviews with 27 of those 29 participants during the Spring 2022 academic semester. The protocol for the race-beliefs interviews was refined after we completed the gender-beliefs interviews, and the final version is included in Appendix II.

Data Analysis

We remain preliminary in our data analysis in terms of the life of the project. To date, we have completed one round of data condensation on the transcripts generated during the gender beliefs interviews. Two members of our team compiled summary sheets detailing the main concepts conveyed by the participants for each section of our gender beliefs interview protocol. For example, we condensed their descriptions of beliefs about the dominant cause of gender-based inequities in engineering into a single, succinct causal theory, and we condensed and listed the ways in which they described arriving at or being convinced of that causal theory (e.g., types of evidence they offered as informing their beliefs). We also condensed their responses to questions about needed change in engineering, to the scenarios presented, and to our inquiry about what a hero for gender equity looks like to them. Here, we present our emerging insights that stem from our collective work on this project over the past two years. Specifically, the insights reported

here are the result of 1) our data collection, 2) our preliminary data analysis, which includes having audio recordings of the interviews professionally transcribed then reviewing, cleaning, and de-identifying those interview transcripts, 3) holding weekly meeting discussions with our research team to discuss our reactions to the ongoing efforts and ideas for future analysis, and 4) engaging in individual and collaborative reflection to deepen our understanding of this work and what our community can learn from it.

Emerging Insights

We currently synthesize the insights we are gaining from doing this work into two primary ideas. First, we are recognizing the role of diverse ways of knowing when it comes to how people form their beliefs about what causes minoritization in engineering. Second, we are seeing a tension, or a paradox, in the way we think about expectations for individuals to be change agents or ways of holding each other accountable as inclusive engineering educators while remaining sensitive to the ubiquitous role of power structures and context.

Our first emerging insight at this stage of the project is that participants draw on different ways of knowing (i.e., types of evidence) as they describe how they arrived at their causal theory about the dominant cause of race- and gender-based inequities in engineering. For example, our preliminary analysis has revealed that participants draw on some combination of the following when they justify their causal beliefs: their own lived experiences, empathic understanding of the lived experiences of others, systematic research, sociohistorical understanding, observations within their personal or professional contexts. This emergent finding is not surprising in and of itself—we know that beliefs about complex social phenomena develop gradually, implicitly, and over time through an individual's lived experiences and as a function of socialization. Instead, this emergent finding has helped us realize that in our research context of higher education, we approached this project with a tendency to privilege systematic research as a way of knowing or type of evidence. For example, we recognize that we are likely to judge participants as “knowing” or “robust in their beliefs” when they can cite academic research. However, our analysis has helped us realize the equal (or sometimes even greater) value of other ways of knowing when making sense of complex social phenomena (such as our interest in minoritization). As a result, we have come to see all these diverse ways of knowing emerging from our data as important pieces of the “pie” that the participants describe using as sources of evidence for forming their beliefs. Furthermore, we see some evidence that it is powerful when folks can draw on different ways of knowing and synthesize them together to support their causal theory. Just the completion of the interview and the ability of TaA to reveal the diverse ways in which participants think about inequity [6] seems to be important in their development as change agents. For example, consider this quote from one of our participants, Ellen, as she describes how the process of completing the interview helps her feel more secure in her ability to speaking knowledgably and convincingly about why minoritization happens in engineering education:

I think it's been helpful to see that I know more about it than I always feel confident talking about. So, I feel like it's nice to have that reinforced because it is part of my job and I really care about it. - Ellen

Moving forward, this insight is shifting our motivation for the project. Initially, we had an idea of surfacing deeply-held beliefs to change them to align with findings of systematic research. We

are still interested in surfacing deeply-held beliefs as a key mechanism for disrupting inequity, but we are now hypothesizing that making explicit the need for different ways of knowing or types of evidence is important for enabling critical reflection on one's deeply-held beliefs. Because racism and sexism are dynamic, we believe that supporting EFSA's process for surfacing their beliefs and the ways they use evidence to arrive at or justify those beliefs explicit in a way that enables reflective synthesis across ways of knowing or types of evidence is needed. This is particularly important for those with privileged identities (the focus of our study) as their ability to articulate justification for their beliefs leveraging on diverse ways of knowing and types of evidence can enable them to increase their impact as change agents.

Our second insight is that we have begun to feel a tension between established frameworks for promoting equity and our desire to honor the positionality and varied development and contexts of our participants (and all engineering educators interested in becoming more inclusive in their praxis). As scholars, we rely on theoretical frameworks for how educators can behave in increasingly inclusive ways. For example, Haynes and Patton [7] emphasize the need for White educators to behave in ways that increasingly assume risk rather than avoid risk. Such a framework can be used to place participants on a continuum associated with judgement (e.g., those assuming more risk are "better" than those assuming less risk), which we realized we were doing in our work. For example, consider the following two quotes from two different participants when asked about what they do to promote gender equity or how they describe their "ideal" for promoting gender equity in engineering education:

Certainly, by my very presence, I am a role model...I frame things in the classroom, trying to bring out women's contributions, women's take on these things. [...] Anyway, so role modeling.
- Freya

[My hero] is an utter go getter, not afraid to call it like it is, provides support to individuals, but also questions the system, the entire system is not afraid to call out the system. Has gotten to the place where she is completely using her voice to forge a better path for people right in your face, as far as not tiptoeing around anyone, just very thoughtful, very well thought out. Arguments, national thinker works with... certainly works with people inside engineering, but boundary spans work across, works with other disciplines. – Rachel

Initially, we would have viewed the latter quote as demonstrating "more advanced" ways of thinking about the change that is needed to promote equity in engineering education. However, our engagement with participants and their willingness to vulnerably share their beliefs has made us reluctant to place any judgement on participants relative to one another. We have become more aware of the fact that what is considered "risk" is different for every participant because it is inherently linked to their own positionality, development, context, and lived experiences. As such, while frameworks for developmental and accountability are needed as ideals, they can simultaneously be problematic when used as a source of decontextualized judgement. Therefore, we are now more interested in developing data analysis techniques that can untangle the complexities that exist in and around the role of participants' positionalities, contexts, lived experiences, and development. To us, that means that there is a paradox—there is truth in the need to hold people accountable and promote development as informed by theory, but there is also truth in the need to meet people where they are and acknowledge where they are and how

they exist in larger power structures as we make any judgement or recommendations for how they can improve or advance as inclusive educators.

Future Work

As we continue work on this project considering the insights presented here, we are excited to conduct continued analysis to finalize codes and categories for the ways of thinking or types of evidence that are emerging inductively from our data set. We believe these results will have exciting potential for our efforts to design professional development opportunities that help engineering educators, regardless of the content of their beliefs, to formalize a process by which they can surface their beliefs and the ways in which they arrive in them, as well as a process for integrating new information, especially via diverse ways of knowing, as their beliefs evolve over time. Additionally, we have a goal of designing data collection and analysis approaches that allow us to navigate the paradox of both holding individuals accountable for developing as change agents and of honoring participants and interpreting their beliefs or reported actions *within* the context of their individual positionality in sociohistorical power structures. Both aspects of future work will be addressed, in part, with the next interview we will conduct, where we will use a much less structured, narrative approach for data collection to explore the contextualized lived experiences that participants understand as formative in their development as engineering educators.

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Appendices

Appendix I. Gender Protocol

BACKGROUND INFORMATION

Our goal today is to explore your beliefs about the causes of gender-based inequities in engineering. As you know, this project is investigating beliefs about both gender- and race-based inequities, but today we will focus on gender. Gender inequity can be a tough topic to talk about openly, so we may fumble at times, and that's okay. I want to assure you that the goal of this project is NOT to pass any judgement on our participants or to determine if you are 'sexist.' In fact, the members of our research team adhere to the modern understanding that an individual is never really 'sexist' or 'not sexist.' Instead, we are focused on the fact that we are all socialized in a society that is fundamentally organized around gender. Furthermore, there is no 'correct' belief or set of beliefs for what we will be discussing, so I hope you won't worry about saying the 'right thing.'

Our goal is to understand the way that engineering faculty, staff, and administrators THINK about the cause or causes of gender-based inequities. We are doing this work because we want to learn from you and eventually design meaningful ways for other engineering educators to contribute to broadening participation in engineering. Also, please remember that we have selected you to participate in this study because you have already been endorsed as an inclusive engineering educator by [a student, colleague, award]. While we know that everyone has room to learn and develop in their ability to act inclusively, we do want to learn from you specifically as someone who has been identified as an exemplar. So, I encourage you to be as honest as possible, and of course feel free to elaborate or ask questions at any time during this interview. Any questions so far?

Ok, so just a bit of background before we begin the interview. For this project, we are defining 'gender-based inequities' broadly as anything that results in the inequitable participation of individuals who self-identifies as non-male. As a collective group, individuals who identify as non-male obviously possesses a great deal of diversity, including differences in racial-identity, nation of origin, sexual orientation, gender expression, and so on. Just want to note that we do use the men/women dichotomy as a way to talk about these things for the sake of discussion. As you are likely aware, in the U.S., women remain underrepresented in engineering compared to their presence in the population. Furthermore, research is largely conclusive that when women do participate in engineering, they face gender-based inequities. With that said, you have already consented to participating in this research project. Do you have any questions before we begin the interview?

[researcher START RECORDING]

ORIENTATION

1. Before we dive into our discussion of what you believe to be the cause of gender-based inequities in engineering, please tell me a little about yourself.
 - a. Background, social identities
 - b. Current role

ARGUMENTATION AS THINKING

[Researcher remember to explore/clarify throughout:

- *What do you mean by that?*
- *Why do you say that?*
- *What would this show?*
- *What would you expect to find out?]*

Causal Belief with Justification

2. What causes gender-based inequities in engineering?
 - a. *(Probe when subject completes initial response)* Anything else?
 - b. *(If multiple causes mentioned)* Which of these would you say is the dominant cause of gender-based inequities in engineering?
3. How do you know that this is the cause?
 - a. *(Probe, if necessary)* Just to be sure I understand, can you explain exactly how this shows that this is the cause?
4. If you were trying to convince someone else that your view (that this is the cause) is right, what evidence would you give to try to show this?
 - a. *(Probe, if necessary)* Can you be very specific, and tell me some particular facts you could mention to try to convince the person?
 - b. Is there anything further you could say to help show that what you've said is correct?
- c. Is there anything someone could say or do to prove that this is what causes gender-based inequities in engineering?
5. Can you remember when you began to hold this view?
 - a. *(If no)* Have you believed it for as long as you can remember?
 - b. *(If yes)* Can you remember what it was that led you to believe that this is the cause?

Alternative Belief with Justification and Rebuttal

6. Suppose now that someone disagreed with your view that this is the cause. What might they say to show that you were wrong?
7. What evidence might this person give to try to show that you were wrong?
 - a. *(Probe, if necessary)* Just to be sure that I understand, can you explain exactly how this would show that you were wrong?
 - b. *(If not already indicated)* Is there any fact or evidence which, if it were true, would show your view to be wrong?
- c. Could someone prove that you were wrong?
8. *(Omit if alternative theory already generated)* A person like we've been talking about whose view is very different from yours—what might they say is the major cause?
9. *(Include if no alternative theory generated)* Suppose that someone disagreed with you and said that [interviewer provide alternative theory] was the cause. What could you say to show that this other person was wrong?
 - a. *(Probe, if necessary)* Just to be sure I understand, can you explain how this would show the person was wrong?

Rebuttal

10. Would you be able to prove this person wrong?
11. *(If not already indicated)* What could you say to show that your own view is the correct one?

Instrumental Reasoning

12. Is there any one important thing which, if it could be done, would reduce gender-based inequities in engineering?
 - a. Why would it improve it?
13. Is there any one important thing which, if it could be done at your institution, would reduce gender-based inequities in engineering?
 - a. Why would it improve it?
14. Is there any one important thing that you could do to reduce gender-based inequities in engineering?
 - a. Why would it improve it?
15. So, you are mentioning things mostly aimed at _____. I'd like to open it up to ideas you have about how to reduce gender-based inequities that are focused on [*Interviewer offer follow ups below if not a part of answer to 12-14*]:
 - a. Engineering Students? (male or female)
 - b. Engineering faculty? Staff? Administrators? (male or female)
 - c. Engineering education systems (e.g., policies or processes)?
 - d. Societal-level systems (e.g., policies or processes)?
16. Ultimately, what role do you perceive you have as an engineering faculty, staff or administrator in addressing gender inequities in engineering? Can you provide an analogy for the role?

CHECK IN

Awesome, thank you so much. That is the end of the section of the interview to explore your beliefs and reasoning about why gender-inequities remain a part of engineering. The next part is a little different. I have two “cases” that I’d like to share with you with some follow-up questions about each and then a final question about the idea of “heroes” before we wrap up. It will probably take at least another 30 minutes or so. Are you alright to continue? If so, could you use a break?

EVALUATION OF EVIDENCE: UNDERDETERMINED

17. Alright, now I’m going to offer you a “case” and then ask your take on it. Here’s the case [*interviewer share text so participant can follow along*]:

Ella Haris first grew interested in engineering as a young child after her 3rd grade class room participated in a local science fair. At that fair, Ella heard one of her classmate’s parents talk about how engineers make the world a better place, and that sounded like something she thought she would be good at. Ella maintained her interest in becoming an engineer through middle school and high school, but math and science weren’t her strongest subjects. Ella picked up that engineering does require math and science skills, so she worked hard in these classes, earning mostly B’s. Ella heard her teachers encourage the ‘A’ students to consider engineering as a career path, but no one ever provided her with such encouragement. Ella completed all the high school classes required for an engineering pathway, and she noticed along the way that she was often among only a handful of girls in those spaces. By the time she began applying to colleges, she knew she didn’t have the GPA necessary to be admitted to her desired engineering major at her target school, so she decided to pursue a degree in education instead. Since completing her degree, Ella says that she’s satisfied with her decision.

Okay, so I’d like to know:

- a. What do you think is the cause of Ella’s exit from an engineering pathway?

- b. Why do you think this is the cause?
- c. How sure are you that this is the cause of Ella's exit from an engineering pathway?
 - a. (if sure) What makes you sure?
 - b. (if not sure) What makes you unsure?
- d. Are there any other possibilities?
 - a. (if yes) Is it possible to choose among these different possibilities to say what caused Ella to exit from an engineering pathway?
 - b. (if yes) Is it possible to choose based on the information we have here? Why? Why not?

EVALUATION OF EVIDENCE: OVERDETERMINED

18. Now, we'll take a look at a different case followed by a few questions. Here's the case
[interviewer share text so participant can follow along]:

A multi-part study was conducted by three different researchers to understand the experiences of 25 women who had, at that time, decided to exit undergraduate engineering programs:

- A social science researcher conducted one-on-one interviews with the women, which revealed that many of them, especially the ones who had children, reported that unsupportive environments and systemic barriers contributed most to their decision to change their major. Within the same group, married women and those with the highest academic performance were likely to cite a lack of motivation when asked about their decision to leave. Finally, the interviews also revealed that many of the women felt at risk of conforming to gender-based stereotypes so much that it affected their performance.
- A different researcher conducted extended ethnographic observations of the participants within their school settings and concluded that they were all subject to different forms of gender-based inequities. Some women experienced gender-based microaggressions; others outright sexism.
- A final researcher investigated the women's academic performance and concluded that they performed roughly the same as the men.
 - a. What does this study suggest about the cause of gender-based inequities in engineering?
 - b. Does this study prove that this is the cause?
- c. Does this study suggest anything else about the cause of gender-based inequity in engineering?
- d. Does anything from this study influence your own thinking about what causes gender-based inequities in engineering?
- e. Do you have any doubts about what this study suggests?

HERO

- 19. I want you to imagine a person who works in engineering education (could be faculty, staff or administrator) and is a 'hero' for gender equity. This person is your *ideal* example for what it looks like to contribute to gender equity in engineering. With that person in mind (fictional or real), tell me...
 - a. What are they like?
 - b. What matters most to them?
 - c. What motivates them?
 - d. How do they spend their time?
 - e. How do they behave on a day-to-day basis?

- f. What sorts of things have they accomplished over time?
- g. What is it about them and their life that makes them a hero?

CLOSING

- 20. Now that we've been through this interview...I just want to open it up to any closing thoughts you might have.
 - a. How would you summarize what we've discussed?
 - b. Have you gained any insights through this process?
 - c. Additional thoughts or ideas? Things we left out?
- 21. How would you like your interview to be identified? We can use your name, or we can provide you with a pseudonym starting with the letter [*interviewer provide next letter in alphabet*].
 - 1. At this point, we've completed the portion of this study with a focus on gender-based inequity. Thank you so much for sharing your time and perspective with us. I'd just like to confirm that it is alright for us to reach out to you if we have any questions about this interview as well as to schedule the next interview about race-based inequities sometime in the next semester or two. Is [*interviewer list email we have on file as contact*] still the best way to reach you?
 - 2. As a small token of our appreciation for your time, we will be providing you with a \$50 Amazon Gift Card claim code through email within the next week or so. If you do not receive it for some reason, please reach out to a member of our research team and let us know!

[*researcher STOP RECORDING*]

Appendix II. Race Protocol

BACKGROUND INFORMATION

Our goal today is to explore your beliefs about the cause of race-based inequities in engineering. Depending on the person and setting, talking about race can range from being seen as taboo, as necessary, or even as enjoyable. As a result, I want to acknowledge that this conversation between you and I today is just one discourse, and I thank you in advance for your willingness to do this regardless of your level of comfort. I want to assure you that we are NOT trying to determine if participants are ‘racist’ or not. In fact, those of us working on this research project do not believe that an individual is either ‘racist’ or ‘not racist.’ Instead, we recognize that we are all socialized in a society organized around race, which influences our deeply-held beliefs, even when we don’t realize it. Furthermore, there is no ‘correct’ belief for what we will be discussing, so I hope you won’t worry about saying the ‘right thing.’ The goal here is to understand the way that engineering faculty/staff/admin THINK about the cause of race-based inequities so we can design effective ways to SURFACE and reflect on our deeply-held beliefs, which we know is important to develop as inclusive educators. So, I encourage you to be as honest as possible. Feel free to ask questions along the way, of course.

For this project, we are defining “peoples of color” as any individual who identifies as Black, Latinx, Native, Asian, or Asian-American (i.e., non-White). As you are likely aware, peoples of color remain underrepresented in engineering compared to their presence in the U.S. population. It is important to note that while Asian and Asian-American individuals may not always be underrepresented in engineering, research has shown that they still face stereotyping and discrimination based on race. Furthermore, research is largely conclusive that the peoples of color who do participate in engineering have at least *some* negative experiences in undergraduate engineering programs due to their race.

Because the term “peoples of color” includes many groups with different historical and societal contexts, I’d like to focus on a more specific group of your choice throughout this interview. When I say “peoples of color,” who comes to mind for you? Would you like to refer to this group specifically during this interview, or is there another group you feel more comfortable using for our discussion?

[researcher note here the “participant-identified group”]:

[researcher START RECORDING]

ORIENTATION

1. Before we dive into our discussion of what you believe to be the cause of race-based inequities in engineering, please tell me a little about yourself—any updates you’d like to share or things you’d like to add since last time we spoke [*have participant summary sheet to reference*]?
 - a. Background, social identities
 - b. Current role

ARGUMENTATION AS THINKING

[Researcher remember to explore/clarify throughout:

- *What do you mean by that?*
- *Why do you say that?*
- *What would this show?*
- *What would you expect to find out?]*

Causal Belief with Justification

2. What causes race-based inequities for *[participant-identified group]* in engineering?
 - a. *(Probe when subject completes initial response)* Anything else?
 - b. *(If multiple causes mentioned)* Which of these would you say is the dominant cause of race-based inequities for *[participant-identified group]* in engineering?
3. How do you know that this is the cause?
 - a. *(Probe, if necessary)* Just to be sure I understand, can you explain exactly how this shows that this is the cause?
4. If you were trying to convince someone else that your view (that this is the cause) is right, what evidence would you give to try to show this?
 - a. *(Probe, if necessary)* Can you be very specific, and tell me some particular facts you could mention to try to convince the person?
 - b. Is there anything further you could say to help show that what you've said is correct?
- c. Is there anything someone could say or do to prove that this is what causes race-based inequities for *[participant-identified group]* in engineering?
5. Can you remember when you began to hold this view?
 - a. *(If no)* Have you believed it for as long as you can remember?
 - b. *(If yes)* Can you remember what it was that led you to believe that this is the cause?

Alternative Belief with Justification and Rebuttal

6. Suppose now that someone disagreed with your view that this is the cause of race-based inequities for *[participant-identified group]*. What might they say to show that you were wrong?
7. What evidence might this person give to try to show that you were wrong?
 - a. *(Probe, if necessary)* Just to be sure that I understand, can you explain exactly how this would show that you were wrong?
 - b. *(If not already indicated)* Is there any fact or evidence which, if it were true, would show your view to be wrong?
- c. Could someone prove that you were wrong?
8. *(Omit if alternative theory already generated)* A person like we've been talking about whose view is very different from yours—what might they say is the major cause of race-based inequities for *[participant-identified group]*?
9. *(Include if no alternative theory generated)* Suppose that someone disagreed with you and said that *[interviewer provide alternative theory]* was the cause. What could you say to show that this other person was wrong?
 - a. *(Probe, if necessary)* Just to be sure I understand, can you explain how this would show the person was wrong?

Rebuttal

10. Would you be able to prove this person wrong?
11. *(If not already indicated)* What could you say to show that your own view is the correct one?

Theory in Context of Related Systems of Race-based Oppression

12. For the sake of clarity, we've focused on [*participant-identified group*] so far today. Of course, that is not the only racial/ethnic group that faces inequities in engineering. I'd like to open it up a bit: how do the causes of inequities of other groups (e.g., Latinx, Black or African American, Asian American, Native American) relate to what you've described so far? Similarities? Differences?

Instrumental Reasoning

13. Is there any one important thing which, if it could be done, would reduce race-based inequities in engineering?
- a. Why would it improve it?
14. Is there any one important thing which, if it could be done at your institution, would reduce race-based inequities in engineering?
- a. Why would it improve it?
15. Is there any one important thing that you could do to reduce race-based inequities in engineering?
- a. Why would it improve it?
16. So, you are mentioning things mostly aimed at _____. I'd like to open it up to ideas you have about how to reduce race-based inequities that are focused on [*Interviewer offer follow ups below if not a part of answer to 13-15*]:
- a. Engineering Students? (e.g., white or non-white)
- b. Engineering faculty? Staff? Administrators? (e.g., white or non-white)
- c. Engineering education systems (e.g., policies or processes)?
- d. Societal-level systems (e.g., policies or processes)?
17. Ultimately, what role do you perceive you have as an engineering faculty, staff or administrator in addressing race-based inequities in engineering? Can you provide an analogy for the role?

CHECK IN

Awesome, thank you so much. That is the end of the section of the interview to explore your beliefs and reasoning about what causes race-based inequities in engineering. The next part is a little different. Like last time, we have a set of questions about heroes. In addition, we have a set of questions that brings the ideas of race and gender together as well as a few questions about popular discourse before we wrap up. It will probably take at least another 45 minutes or so. Are you alright to continue? If so, could you use a break?

HERO

17. I want you to imagine a person who works in engineering education (could be faculty, staff or administrator) and is a 'hero' for racial equity. This person is your *ideal* example for what it looks like to contribute to racial equity in engineering. With that person in mind (fictional or real), tell me...
- a. What are they like?
- b. What matters most to them?
- c. What motivates them?
- d. How do they spend their time?
- e. How do they behave on a day-to-day basis?
- f. What sorts of things have they accomplished over time?

- g. What is it about them and their life that makes them a hero?

INTERSECTIONALITY

- 18. So, we talked during our first interview about the cause of gender-based inequities, and today we've gone through the cause of race-based inequities.
 - a. How are the causes of race-based and gender-based inequities in engineering related? Similar? Different? *[offer their causal theories for each back to them if needed]*
 - b. In this research project, we've asked you to talk about race and gender separately, but I'd also like to open up a discussion about the cause of inequities faced by women of color *[use participant-identified group]*.
 - c. Beyond race and gender, what do you think causes inequities for individuals with other non-dominant social identities? *[offer examples if needed: e.g., ethnicity, sexual orientation, varied ability, gender-identity, country of origin, etc.]* Similarities? Differences?
 - d. We've spoken about inequities, which includes this idea of privilege. Talk to me about privilege and how it fits into what we've been discussing.
 - i. Male privilege?
 - ii. White privilege?
 - iii. Your own privilege?
 - e. How do these ideas around inequities and privilege matter in engineering classrooms?

CONNECTION TO POPULAR DISCOURSE

- 19. In some communities, there has been a recent increase in popular discourse related to gender- and race-based equity.
 - a. Is there a current event or social movement related to gender and/or race that you are familiar with? *[offer examples if needed: e.g., Black Lives Matter, SayHerName, StopAsianHate, the MeToo movement; if multiple offered, ask them to focus on one they are most familiar with]*
 - b. How have you learned about this current event?
 - c. What do you think needs to be done?
 - d. How does this matter in your role as an engineering [faculty/staff/admin] member?
 - e. How do you think this relates to engineering education? Undergraduate engineering students? Engineering faculty?

CLOSING

- 20. Now that we've been through this interview...I just want to open it up to any closing thoughts you might have.
 - a. How would you summarize what we've discussed?
 - b. Have you gained any insights through this process?
 - c. Additional thoughts or ideas? Things we left out?
- 21. As a reminder, we will be using [participant pseudonym] to identify your transcripts. Is this pseudonym still good for you? Also, we will send you a copy of your transcript before the next interview.
- 22. At this point, we've completed the portion of this study with a focus on race-based inequity. Thank you so much for sharing your time and perspective with us. I'd just like to confirm that it is alright for us to reach out to you if we have any questions about this

interview as well as to schedule the narrative interview sometime in the next year or so. Is *[interviewer list email we have on file as contact]* still the best way to reach you?

23. As a small token of our appreciation for your time, we will be providing you with a \$50 Amazon Gift Card claim code through email within the next week or so. If you do not receive it for some reason, please reach out to a member of our research team and let us know!

[researcher STOP RECORDING]