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Resistance to advocacy around hidden curriculum in engineering

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Resistance to advocacy around hidden curriculum in engineering

Introduction

We analyzed participants' experiences with hidden curriculum (HC) in engineering, or the unacknowledged, unwritten, and often unintended, lessons, attitudes, and beliefs that individuals experience as part of their engineering education [1]–[7]. HC manifests from historical, structural issues, such as sexism and racism, to institutional and interpersonal messages within engineering [8], [9]. For example, racist policies like segregation excluded African American or Black people from higher education [10], and they remain marginalized as only 4.5% of 2020 US engineering bachelor's degree earners were African American or Black [11]. Researchers have contributed significant scholarship on the experiences of historically marginalized people in engineering [12]–[16]. However, given the stagnation of inclusion of historically marginalized people in engineering, it is necessary to examine the resistance to advocacy efforts, which hinders increased representation, participation, and belonging in engineering.

We did not initially plan to explain why individuals resist advocacy efforts, yet our ongoing research into self-efficacy and self-advocacy around HC messages in engineering positioned us to examine individuals' resistance to advocacy. Our previous HC research has focused on women [9], undergraduate and graduate students [7], and faculty members [17] in engineering who utilize their self-efficacy to understand and cope with negative HC messages. Since this past research focused on individuals' strategies, we have not considered the experiences of individuals who are resistant to self-advocacy, or advocacy for others, to challenge the status quo in engineering. In this research thread, we used an explanatory case study-inspired approach to analyze qualitative responses from a mixed-methods survey to explain why a small group of engineering students were resistant to advocacy elements of the survey and other advocacy within engineering. We hope to use insights from this case for future research on HC in engineering and expand on current literature about resistance to advocacy initiatives. This work-in-progress paper is an exploration of individuals' feelings and beliefs and does not include many recommendations or future implications, given the small sample size and the potential for future work. We hope to invite others to use this paper as a lens to then observe, ponder, consider their own experiences and specific knowledges, and share their recommendations with the broader community.

Literature review

Hidden curriculum

Early scholarship around the hidden curriculum (HC) occurred within K-12 educational settings. Giroux [18] noted: "there is a failure to recognize the complex, intimate relationship between the institution of the school and the nation's economic and political institutions [18, p. 21]. Thus, HC includes "unstated norms, values, and beliefs that are transmitted to students in both the formal content, as well as the social relations of school and classroom life" [18, p. 22]. HC does not only occur in K-12 educational settings and has also been studied in other fields within higher education such as medicine [19] and business [20]. Previous researchers have

described HC in STEM education, such as physics research community culture [21] and gendered lessons in STEM course syllabi [22].

Engineering status quo

The status quo in engineering is a result of unchallenged, unacknowledged, or unaddressed HC and negative impacts those who has been traditionally excluded from the discipline. Engineering has long fostered gendered values of objectivity, autonomy, and separation that all genders display, uphold, and practice [22]. This objectivity feeds the perception that engineering is colorblind, class-blind, and gender-blind, and relies on a system of meritocracy as the basis for success [23]. Thus, meritocracy, or the hardest worker will receive the greatest reward [24], creates a competitive and individualistic environment [25]. Stevens and others similarly noted a "meritocracy of difficulty" [26, p. 10], in which working hard denotes the worth of an engineer. These researchers have also noted that the reward for working hard in engineering is to be able to have a financially secure lifestyle after graduation [26].

Yet, the idea of meritocracy, particularly in engineering, does not consider marginalization or inequities in treatment and access to information or resources and assumes everyone who works hard has the same opportunity to pursue financial security with an engineering degree. For example, engineering is still predominantly White (59% of all races or ethnicities) and comprised mostly of men (77% of all genders) [11], which we can partially explain because of practices like racial segregation [27] and gender-based discrimination prior to the passage of Title IX [28]. Additionally, only 23% of four-year public colleges were affordable for students who received a Pell Grant [29], thus making it more difficult for individuals who cannot afford an engineering degree to pursue one. Further, structural issues like racism, sexism, and classism, manifest as interpersonal HC in the form of microaggressions [12]–[15], or brief indignities that communicate derogatory or negative slights toward individuals in engineering [30]. Thus, the status quo of the engineering meritocracy only functions if an individual is not aware of it or is not harmed by it [31].

Hidden curriculum research in engineering

HC engineering research has surged as Villanueva and colleagues [1], [4]–[7], [9], [17], [32]–[37] have developed a four-factor HC pathway model, which considers an individual's awareness, emotions, self-efficacy, and self-advocacy around HC experiences. The four-factor model describes how individuals must first become aware of HC in engineering and then internalize the experience with their emotions [7]. Individuals then utilize their self-efficacy to regulate and act on their emotions [7]. Within the model, action taken due to HC is self-advocacy [7].

Authors 1 and 3 have previously described how women utilize various levels of self-efficacy to enact strategies that allow them to navigate HC [9]. Authors 1 and 3 [9] found that in response to HC, women: 1) choose to change their environments, such as addressing communicators of HC directly or seeking others for support, 2) negotiate themselves, like working harder or developing individual skills, or 3) take minimal action, such as avoiding a situation with HC completely. These strategies are closely related to previous research on coping

self-efficacy, where individuals engage their self-efficacy to enact strategies to cope with stressful situations [38], as well as social and cultural capital, where individuals utilize access to network resources and cultural knowledge to navigate challenges [16], [39], [40]. Individuals who change their environments for themselves or others engage in self-advocacy, or "a person's willingness to take action and speak up" [7, p. 1553] to challenge the status quo in engineering.

Engineering self-advocacy and advocacy (self-/advocacy)

To challenge the status quo in engineering, we must characterize self-advocacy by individuals and institutional advocacy that challenges the status quo in engineering. We have previously found that individuals challenge the status quo and address issues directly, seek others or resources for support, lead in ways that increases representation for others, and mediate tense group situations [9]. We also argue that institutional advocacy involves providing financial support, such as Pell Grants, other forms of financial aid, and scholarships for members of marginalized groups (e.g., National Society of Black Engineers scholarships). Institutional advocacy also includes curriculum transformation, such as utilizing culturally relevant pedagogies in engineering [41] and adding liberal arts to engineering curriculum [42].

However, resistance to individual, as well as institutional forms of advocacy, have been previously noted in engineering. Lee and others [43] described participants who thought that learning about diversity in engineering courses would detract from learning about technical topics. Burack and Franks [44] described how members of the racial, ethnic and gender group in engineering (White men) may see diversity initiatives as a threat, especially if members of marginalized groups receive separate or special consideration. However, Burack and Franks [44] cautioned against ignoring anxiety, defensiveness, and hostility from majority members of engineering because it limits our understanding of why they do not want to welcome historically marginalized people. As a result of our ongoing research in self-/advocacy, we are uniquely positioned to understand the experiences of individuals who are resistant to self-/advocacy. Thus, we ask the following research question: Why are some individuals in engineering resistant to self-/advocacy around HC in engineering?

Methods

Data collection

The research team collected responses (N = 984) to a mixed-methods survey, Uncovering Previously Hidden Engineering Messages for Empowerment, or UPHEME, from 58 engineering colleges at higher education institutions across the U.S. and Puerto Rico [7]. The survey contains 43 quantitative and 7 qualitative items, including qualitative items about their perceptions of engineering and HC before and after a video vignette, a personal obstacle related to HC and their emotions and how they have overcome the obstacle. The video vignette featured dramatizations of a Latina professor and Latino student who discuss the contributions of a Puerto Rican civil engineer (Oscar Marty) to the field yet are dismissed by fellow professors and peers because the connection does not seem relevant to the technical-centric nature of engineering. The research team has previously described the video vignette in detail in Villanueva and others [36]. Even though the dramatization in the video vignette is fictitious, it contains covert layers of hidden

curriculum such as racism, sexism, professionalism, perceived success, and first-generation student status. The survey did not necessarily emphasize one HC issue or population, and the participant likely interpreted the video vignette based on issues that were salient to them. A description of quantitative and qualitative items in the UPHEME survey are in Table 1.

Table 1: Description and order of the UPHEME mixed-methods survey instrument, adapted from Villanueva and colleagues [7].

Survey Section	Description	Type of Questions
(1) Raw Engineering Perceptions	Participants were asked their perceptions of engineering and who belongs in engineering before definitions of HC were provided to them.	Qualitative (QUAL)
(2) Hidden curriculum awareness	Participants were given a written definition of HC followed by six HC statements. Participants were asked whether they agreed with the HC provided in the context of engineering	Quantitative (QUAN) & QUAL
(3) Video vignette	Participants watched a 7.5-minute video, which highlighted several examples of HC involving a marginalized Latino student and faculty member. Participants then defined HC in their own words and provided personal examples of engineering HC.	QUAL
(4) Emotions	Participants selected an emotion they felt corresponded to six HC statements and whether their emotion was positive or negative. They also recalled a personal experience with HC and the emotions they experienced in that situation.	QUAN & QUAL
(7) Self-efficacy	Participants selected their perceived level of self-efficacy in succeeding in engineering if they experienced HC in their education. They also described an obstacle they have had to overcome in engineering.	QUAN & QUAL
(8) Self-advocacy	Participants were given a definition of self-advocacy and identified their willingness to ignite an action on behalf of themselves and others around issues of HC. They provided a personal example highlighting what they have self-advocated for in engineering.	QUAN & QUAL
(9) Wrap-Up	These questions inquired about the major lessons learned about HC through this survey and asked participants to reflect on their major	QUAL

	passions for pursuing a degree in engineering.	
(10) Demographics	Participants were asked to enter information about their axes of inequity, such as age, role (student versus faculty), university of study or employment, race, gender, ethnicity, and first-generation status.	QUAL

Data analysis

We initially focused on individuals' responses to the self-advocacy item: "Briefly explain how you have advocated for yourself in engineering around a hidden curriculum. What factors influenced your self-advocacy?" Participants' responses ranged in length from a sentence to multiple paragraphs. Author 1 initially performed descriptive coding on all responses ($N = 984$) to the self-advocacy item. During descriptive coding, she highlighted participants' responses ($n = 30$) that indicated they may have conceptions of HC that may prevent or misguide their advocacy or influence them to consider HC advocacy to be harmful. Author 1 noted the overall negative sentiment toward either self-advocacy or the survey in the participants' responses. To investigate the perceptions more closely, we utilized an explanatory case study-inspired approach [45] to examine participants ($n = 7$) who described their own self-advocacy limitations or why others should not self-/advocate around HC in engineering. We feel an explanatory case study-inspired approach is appropriate given the nature of the data (i.e., open-ended responses to structured questions).

Author 1 added each participant's survey responses to a separate page in Microsoft OneNote and summarized: 1) their perceptions the central focus of engineering is and their passions for becoming an engineer, 2) their initial and post-hoc definitions of HC, 3) their previous experiences with HC and related emotions and actions, 4) how they have advocated for themselves around HC, and 5) their emotions and actions around the survey and other advocacy efforts in engineering. Author 1 then performed a within-case comparison to identify the similarities in the participants' experiences, such as their opinions and experiences with self-/advocacy, and organized the responses from least to most limits in accepting advocacy for others. Authors 1 and 3 discussed the findings to develop the within-case comparison.

Demographics

Participants in this sample ($n = 7$) are either undergraduates who are in their third year or greater or are in graduate school, and 6 of 7 participants are 18-29 years of age (Table 2). The participants attended universities in various regions of the United States, but they most attended universities in the US Southwest ($n = 3$). The participants represent different engineering majors, with civil engineering being the most common ($n = 3$). Participants identified as male ($n = 6$) and White ($n = 5$). Most participants were not first-generation students ($n = 5$), and more than half were non-traditional students ($n = 4$). We note that as we selected participants for this sample, we did not consider their racial/ethnic or gender identities. We acknowledge that participants are

listed out of numerical order in Table 2, but this is how we have chosen to present their experiences in the Results section.

Table 2: Participant (n = 7) demographics.

Participant ID	Role	University location in U.S.	Major	Age Group	Gender	First-Generation Student	Non-Traditional Student	Racial group
384	Undergraduate student- 3rd year or greater	University in Southeast	Electrical Engineering	18-29 years of age	Male	Yes	No	Hispanic, Latina/o, Chicana/o
622	Undergraduate student- 3rd year or greater	University in Northeast	Mechanical Engineering	30-39 years of age	Male	No	Yes	White
490	Undergraduate student- 3rd year or greater	University in Southwest	Hydraulic Engineering	18-29 years of age	Male	Yes	Yes	White
497	Graduate Student	University in Mid-Atlantic	Civil Engineering	18-29 years of age	Male	No	No	White
65	Graduate Student	University in Southwest	Civil Engineering	18-29 years of age	Male	No	Yes	White
20	Graduate Student	University not listed	Manufacturing Engineering	18-29 years of age	Prefer not to say	No	No	Other-Kekistani
449	Undergraduate student- 3rd year or greater	University in Southwest	Civil Engineering	18-29 years of age	Male	No	Yes	White

Positionality

Authors 1, 2, and 3 are all first-generation college graduates. The lead author is a White, cisgender woman, who brings geoscience, as well as geoscience and engineering education, experience. She focuses on identifying how structural issues manifest interpersonally for marginalized individuals in engineering. The second author is a biracial cisgender man who has a doctoral degree in Language, Literacy, and Culture in education, and focuses on critical qualitative inquiry with a discerning eye towards humanizing and culturally sustaining pedagogies. The third author is a cisgender Latina woman who brings chemical and biological engineering, as well as engineering education experience. The authors have transformative worldviews, which "holds that research inquiry needs to be intertwined with politics and a political change agenda to confront social oppression at whatever levels it occurs" [46, p. 9]. The authors acknowledge the potential detrimental effects that oppressive forms of communication can have on the subsequent decisions and actions of marginalized and minoritized students in disciplines like, but not limited to, engineering.

Results

We present each participant's description and describe why they are resistant to HC self-/advocacy. We will then present a within-case comparison of how participants discuss their resistance to self-/advocacy around HC. We note that the explanation of their resistance includes aspects of the UPHEME survey and other diversity, equity, and inclusion efforts to which they have previously experienced. As a note of caution, some of these responses contain overtly sexist and racist language.

Participant 384

Participant 384 is an electrical engineering undergraduate student in the US Southeast; he identifies as male, Hispanic/Latino/Chicano, and is a first-generation college student. Participant 384 decided to become an engineer because they "…make good money for a comfortable living." The participant describes engineering as "…who you know, not what you know…," and he mentions "…people with 2.0s [who] get degrees and go on to work for great companies because their daddy works there…" The participant implies that engineering is a lucrative workforce but access to it is not equitable and can vary based on familial and social connections. Participant 384 notes that because of social connections as a basis for engineering job potential, he tries "…to remain in contact but out of self-interest…," which "saddens him because it doesn't allow for too much room to find actual friends." The participant notes because social relationships in engineering can lead to competitive job opportunities, building social connection outside the utility of finding a job is difficult.

Participant 384 has advocated for a couple of his classmates that they "can retake Cal 2 [Calculus 2] and pass it," yet he does not "…have a soapbox…" and asks rhetorically, "Who am I to advocate for anything for anyone?" Therefore, Participant 384 does not feel that he has an ability or space to advocate for others, even though he has experienced engineering HC in the form of inequitable access to job opportunities and has advocated for himself and his friends to pass a course. Specifically, this participant does not "…intend to cry about it…" and wants to "…play the game." It is possible that Participant 384 does not want to change how engineers access positions because by also engaging in the process, he feels he has a better chance to get a lucrative position, which was his goal when deciding to become an engineer. Thus, Participant 384 is resistant to his own self-advocacy because he sees it as complaining and would rather engage with the current state of engineering networking, rather than try to change it.

Participant 622

Participant 622 is a mechanical engineering undergraduate student in the US Northeast; he identifies as male, White, and is non-traditional student. Participant 622 does not provide a reason for why he decided to become an engineer because the item was at the end of the survey and by that point, the participant noted "…I'm pretty much done giving useful feedback." While the participant does not explicitly name an emotion that he feels while discussing HC during the survey, he uses terms such as "preposterous," "ridiculous," and refers to himself as a "devil," which indicates that he is angered or frustrated by the survey and its content and responded with sarcasm. Further, he thinks that the vignette video implies HC that there is racism in engineering,

even though the video vignette contained multiple covert issues. Participant 622 refers the survey and vignette video as "fake news" from "progressive clowns making up problems that don't exist." Thus, this participant does not acknowledge HC about racism in engineering. Because the participant thinks that HC racial issues in engineering are nonexistent or imagined, and mentions, "…people like you calling me the devil," he feels demonized by the survey. Thus, this participant is limited in his self-/advocacy because he does not experience HC issues and does not think they exist for others; his self-/advocacy is also limited because he feels like he is targeted as the source of HC messages, even though the video vignette did not exclusively feature racism.

Participant 490

Participant 490 is a hydraulic engineering undergraduate student in the US Southwest; he identifies as male, White, and is a first-generation and non-traditional student. Participant 490 wanted to become an engineer because he "…likes to solve problems, and then see them applied. . .in real life." Thus, the participant is interested in the technical and applied aspects of the engineering field. When asked to define HC prior to the vignette video, the participant noted that HC is: "Faking and overexaggerating racism or lack of diversity in engineering to make me feel bad that I am a white male engineering student." Participant 490 is angry or frustrated, because as he perceived from the video vignette, there was racism in engineering. He believes that viewing the video was intended to make him feel bad because he is a White male. He expresses frustration with the survey because he is "…just fed up with professors shoving their political agendas down my throat." He also reveals that he "came to learn about engineering, not social issues." Thus, Participant 490 is frustrated that this survey highlights social issues in engineering that extend past the technical, problem-solving aspects that originally encouraged him to pursue engineering. Additionally, he is frustrated that the political and social issues target him. As a result of this targeting and implied benefits given to people with marginalized identities, he must "…work harder sometimes simply because I don't look different" because he is the "…stereotype, so I get forgotten."

Participant 490 focuses on the supposed targeting of his identity [White, male] in the survey, rather than other HC he has experienced, such as "no one in my family has graduated from college, and I definitely did not feel that I had a hand up in graduating…" Participant 490 implies that the benefits given to marginalized people are unwarranted, which is supported by his claims that racism or lack of diversity in engineering are false or overexaggerated. Thus, this participant is limited in his self-advocacy to change the frequency or severity of racism or sexism in engineering because he does not think it is a problem, and he thinks that engineering should not include social issues.

Participant 497

Participant 497 is a civil engineering graduate student in the US Southwest; he identifies as male, White, and is neither a first-generation nor non-traditional student. Participant 497 mentioned that he decided to become an engineer because of "helping other people, bettering society, and using my skills." While Participant 497 became interested in engineering to help

society, his example with HC was when the "female Hispanic teacher and Hispanic student attempted to insert her culture into class time, which was of a technical nature" in reference to the video vignette. He further noted that he "…would not want to see increased socio-cultural considerations in engineering education" and the focus of engineering should be about "techniques, equations, and theories. . .not the culture…" While the participant has the goal of helping society with engineering, he does not think that engineering should include societal aspects in the engineering curriculum.

Participant 497 acknowledges that "…financial disparity prevents brilliant individuals from unlocking their potential [in engineering]," and he is willing to "…encourage increased access (and other resources) to required education for talented individuals." The participant reiterates that some individuals (and some do not) have an inherent talent for engineering by stating: "Engineering requires critical thinking, attention to detail, and problem solving, which some people simply aren't apt to." Therefore, he implies that only those who have an inherent talent for engineering should receive financial support, should they need it. He states, "I would gladly encourage more women to join and remain in the engineering workforce," yet he does not mention avenues that would encourage more women to join and remain in engineering. So, while he holds that financial disparity is an issue that should be addressed in engineering education, he states that the benefits of diversity initiatives are "…hard to measure and potentially less impactful than in other areas." Participant 497 does not mention any explicit self-/advocacy yet discusses potential avenues that he or others in engineering could self-/advocate, such as increased resources for talented individuals. Overall, the participant emphasizes technical talent as the basis for resource allocation and implies that diversity initiatives are not as impactful.

Participant 65

Participant 65 is a hydraulic engineering undergraduate student in the US Southwest; he identifies as male, White, and is a non-traditional student. Participant 65 decided to become an engineer because he wants to "…piece something together that is new, attractive, and functional." The participant indicates that his reasons for choosing engineering align with his impressions of the scenarios in the vignette video: "Names and history are almost non-existent in our engineering courses, and numbers and equations are actually what we deal with…." Thus, the participant focuses on using engineering for new innovations and acknowledges that a historical lens is not used in the engineering curriculum at the institution he attends.

Participant 65 mentions his experiences with HC. He notes that in his senior design class, the "…instructor specified that the senior project leaders could not be White males. . .which was probably the biggest show of racism I have seen on campus." Additionally, the participant describes that his "biggest personal obstacle has been being a father during undergraduate and graduate work," and "it can sometimes be frustrating to be on the same grading scale as someone who has no dependents…." However, Participant 65 has advocated by getting "…less sleep…" and "…studying. . .between 9pm and 1am." The participant also notes that he received FAFSA (federal student aid) funding, and employer and university scholarships to assist with financial burdens associated with an engineering degree. In these situations, the participant has worked harder or sought resources for himself and his family as forms of self-advocacy. As far as

advocacy for others, he states that he "likes to encourage people to do engineering—regardless of their race or gender," yet he feels that "all people need the same opportunities, but it is completely moral to say that women and men have gender-dictated abilities and interests." For example, he mentions that his wife's disinterest in engineering "…represents a lot of feminine sentiment towards STEM fields" because: "It's the natural tendency, and we shouldn't be worrying ourselves trying to sway that."

While Participant 65 has experienced HC in engineering by being a non-traditional student, partner, and parent, he is limited in his advocacy for others by dismissing advocacy efforts to redistribute power in classroom settings (i.e., no White male group leaders) as racist. He also does not agree with efforts to recruit more women into STEM, particularly engineering, because he believes that women do not become engineers only because they do not want to be. It is possible that this participants' views of advocacy efforts are limited by his technical view of engineering, which he has reduced to numbers, equations, and new innovations, rather than acknowledging historical and modern exclusion of women and other marginalized people in engineering.

Participant 20

Participant 20 is a graduate student who attends an unnamed university. They elected to not disclose their gender. They indicated their racial identity as Kekistani, a meme identity typically used by White nationalists to critique political correctness and liberal ideas [47]. Participant 20 did not disclose why they decided to become an engineer.

When asked about HC, the participant responded, "Hidden curriculum is a social justice piece trying to social engineer the failed practice of multiculturalism…." They extend this disdain by describing the video vignette as "showing White people as privileged and racist." While they participate in "tabling events for an engineering club" at their university and advocate for women to join engineering, they state, "The number 1 reason women don't go into engineering is that they choose to do something else…." This participant also states, "Most of my classmates have been non-White; there is no systematic discrimination to keep POC out of engineering." Thus, this participant is limited in their advocacy efforts because they do not think that systemic discrimination has occurred in engineering, they do not acknowledge sexism that has been a factor for why women do not remain in engineering, and they disagree with curricular or advocacy efforts to change engineering culture, deeming it "…thought policing."

Participant 449

Participant 449 is a civil engineering graduate student from in the US Southwest; he identifies as a White, male, non-traditional student. Participant 449 joined engineering because of his family, and states, "I want to take care of my family. . .and go to my kid's sports events. I am an engineer to financially provide for the life I want to live." The participant acknowledges that engineering is a path to be financially stable, which is an important end-goal for him given the challenges he has experienced to become an engineer. For example, he mentions, "…I had depression" and failed statics as a result. He "…got on the right medication, and that leveled the playing field." He also describes financial difficulties in his engineering degree pursuit, such as:

"Both me and my wife also have paid our way through college and will be graduating with no debt" with "occasional help from my parents." Therefore, Participant 449 has self-advocated by seeking help for his depression, as well as working harder and seeking resources from his parents to pay for his education.

However, the participant seems frustrated by the survey and advocacy efforts to celebrate marginalize groups, particularly, "People go to great lengths to recognize women in engineering…." Also, he is frustrated "…whenever somebody highlights a minority, they make a big deal out of it," and racial and sexist issues "aren't a big deal" within and outside of his home state. He minimizes racism and sexism in engineering by stating, "I frankly do not care what color your skin is or what is between your legs; I care that the structure is safe and well-designed." The participant's comments indicate he does not think that racism and sexism are pertinent issues in engineering, and he is also likely frustrated because "…I don't like being told it is my fault and that I need to give them an advantage over myself." He expands on who should receive support by stating: "The person who deserves that money should be smart or in need, not have a vagina." Overall, Participant 449 self-advocates and believes that the basis of advocacy for others should be because of engineering ability or financial need yet does not think that someone who experiences historic or current racial or gender bias qualifies someone to be "in need." Rather, he considers them to have an unearned advantage, whether they are technically skilled or have financial need.

Within-case comparison

Participants shared similar facets from their experiences with HC in engineering, their reactions to the survey and video vignette, and their self-/advocacy and opinions about other advocacy initiatives.

Participants' justification to become engineers is useful to understand how they view the purpose of engineering and who should receive support to become engineers. Some participants (Participants 384 and 449) indicated that becoming an engineer is an opportunity to provide financial security for themselves and their families, whereas others are interested in the problem solving and technical opportunities that engineering brings (Participants 490 and 65). The potential for future financial security is consistent with how Stevens [26] described individuals' reasons for becoming engineers. While participants mentioned financial security as justification to become an engineer, several participants (Participants 384, 490, 65, 497, and 449) highlighted HC in the form of financial barriers they or others have experienced in engineering. Levine [48] highlighted that due to the cost of higher education and the complexity of the financial aid system, the price that individuals are expected to pay for their educations is still far too high for many. We note that in our ongoing research of the whole participant population ($N = 984$), male participants experienced the inflexibility of engineering, specifically affordability, as a common issue. Thus, the pursuit of engineering includes both financial opportunities and costs.

Participants (384, 65, and 449) describe other experiences with HC in engineering, such as shouldering non-traditional student and parent roles and observing individuals with social connections who receive preferential access to internship and career opportunities. The only

racist or gendered incidents the participants experienced were claims that the survey itself was racist against White people, although the design of the survey never implied this, and it was left to the interpretation of the participant to decide. Some participants (384, 490, 65, and 449) worked harder or sought financial resources from the federal government, scholarships, and family to navigate this engineering HC; Participant 497 supports providing resources to talented individuals in engineering. Perhaps because of the significant financial security and benefits that accompany an engineering degree, participants emphasize an equality (not equity) of opportunity and an inclination to self-advocate in their own challenges. The equality of opportunity expressed by these participants is consistent with meritocratic values previously described in engineering [23], [25], [26], [49]. The participants are also critical of those who have perceived unearned advantages. Thus, there is a distinction in participants' attitudes about what issues should garner advocacy, who should advocate, and how individuals should advocate.

While many participants described financial difficulties in their experiences with HC and have self-advocated, many were upset or frustrated in response to the survey and video vignette, which featured cultural contributions to engineering that were not allowed to be discussed in a course. Participants described the survey with terms such as 'thought policing' (Participant 20) and 'preposterous' (Participant 622). Some participants (622, 490, 65, and 20) described the survey and video vignette as racist against White people and felt frustrated or demonized by it. This could be related to stereotype threat, or the participants risking self-confirming a negative stereotype [50]. The participants may be afraid that they confirm a stereotype that White people are racist and display anger and frustration as a result. Some participants (622, 490, 65, 20, and 449) minimized the impacts of racism and sexism that people of color and women experience in engineering. Specifically, Participants 490 and 497 minimized racial and gender advocacy efforts by stating the focus of engineering should be on technical aspects, like equations and theories, and not on cultural or social issues. This echoes other findings of engineering students' fears that their technical instruction will suffer if professors include diversity education into their instruction [44].

For this case of participants, the high-stakes potential for lucrative career possibilities after graduation may feed an already competitive engineering environment. This competitive environment, coupled with financial barriers, may encourage students to resent those who have financial or social support when earning their engineering degrees. Without critical awareness (or acceptance) by participants to understand others' experiences with historical and current HC in engineering, it may seem like support to marginalized individuals is unwarranted and threatens the participants' engineering career opportunities. This threat to a lucrative financial future as an engineer, the threat to the perceived fairness of engineering meritocracy, and the perceived target to their identities in the video vignette and survey, led to the participants' frustration and anger in their responses. These factors led them to resist advocacy for others and in turn, to further perpetuate the status quo in engineering.

Table 3: Within-case comparison of participants' experiences around HC in engineering. Shared facets of participant experiences are displayed, and an "X" denotes that a participant shares this experience.

Participant ID	Emphasis on technical aspects of engineering	Discusses cost of engineering as barrier	Experience HC in engineering	Self-/advocates	Maintain status quo in self-advocacy	Everyone should be given equal treatment	Upset at survey	Racism/sexism are not serious issues in engineering	Believes they/others should not advocate
384			X	X	X				X
622	X						X	X	X
490	X	X	X	X	X		X	X	
497	X	X					X		
65	X	X	X	X	X	X		X	
20				X	X		X	X	X
449	X	X	X	X	X	X	X	X	X

Discussion

This explanatory case study-inspired approach allowed us to compare individuals' responses, which included anger and frustration, to a survey and accompanying video vignette about engineering HC. Additionally, this paper is the beginning of a discussion on ways we can uncover HC in engineering education while also trying to mitigate the potential resistance to this type of work. With that and in these early stages of discovery, we as authors do not have many recommendations. However, the real work here is to continue to uncover the potential resistance from individuals and groups so we can consider ways to identify and resolve the issues presented in this paper.

We found that participants utilized and upheld the status quo in engineering, which is meritocratic, masculine, competitive, to resist advocacy for others who they think received unearned support. We highlighted these participants' responses to show that this undercurrent of opinion in engineering is understudied but could explain continued underrepresentation and mistreatment of marginalized people [12], [13], [15] and other resistance to advocacy efforts. By identifying and addressing this resistance within engineering institutions, such as by embedding culturally relevant pedagogies [41] within engineering courses, we may be able to challenge the status quo in engineering.

This case of participants afforded us a glimpse into what they ascribe as the status quo, yet we would be remiss to not mention that we were limited by the small sample size (n = 7), indirect method of obtaining their responses as part of a larger mixed-methods survey, and by an inability to ask participants directly with more in-depth prompts. However, because of the relative dearth of literature around these resistant opinions in engineering, it is possible that

participants may be reluctant to share their opinions through other forms of elicitation (e.g., focus groups and interviews).

Implications and Future Work

We recommend that researchers and practitioners consider how this undercurrent of opinion in engineering could potentially manifest amongst their students and fellow researchers and engage methodological choices that will help them elicit opinions that while hidden, could be more widespread, given the stagnation of diversity efforts and persistent hidden curriculum in engineering. With that, an implication of this research is that engineering institutions should continue to find ways to identify and disrupt the status quo, such as by supporting curricular change, providing financial support to marginalized students, and advocating for affordability of the cost of an engineering degree for all students. Additionally, institutions should invest resources into unpacking the undercurrent of opinions that cause individuals to resist advocacy for themselves and others.

Future research by our team and other researchers should consider research methods that would allow them to comprehensively evaluate resistance to advocacy. As with this study, individuals could be more likely to share their covertly held opinions if they did so in an anonymous survey or if individuals were recruited specifically to share opinions that reflected resistance to self-/advocacy.

Conclusion

By using an explanatory case study-inspired approach, we determined that individuals were angered or frustrated by the UPHEME survey because it and other advocacy efforts are focused on marginalized people in engineering, which upsets the status quo in engineering. Future research will focus on exploring this undercurrent of advocacy resistance.

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