



A Series of Singular Testimonies: A New Way to Explore Unearned Advantages and Unearned Disadvantages

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Abstract

This paper describes the development of a unique interview method based on Peggy McIntosh's "serial testimony" technique. Our "singular testimony" technique preserves many of the hallmarks of the serial testimony technique, specifically:

1. Giving participants the opportunity to share their personal narrative, or testimony, about unearned advantages and unearned disadvantages as they perceive them;
2. Allowing participants to speak uninterrupted;
3. Exhibiting no judgment and expressing no rebuttal to participant responses;
4. Returning to a particular advantage/disadvantage for further exploration and follow up questions in additional "rounds."

We have piloted our interview technique with recent engineering graduates, and found it to be efficacious for eliciting participants' perceptions of unearned advantages and disadvantages related to their engineering education. In this paper, we (1) describe how we adapted the serial testimony technique into a singular testimony interview method, (2) present our results related to participants' perceptions of unearned advantages and disadvantages, and (3) discuss how a particular trait can be perceived as an advantage by one participant, but as a disadvantage by another. We will also present specific examples of certain unearned traits (such as economic status) that some participants simultaneously viewed as both advantages and disadvantages in pursuing their engineering education. We end with implications for using this method to illuminate visible and invisible forms of privilege and oppression, underrepresentation, and marginalization that undergraduates may experience during their engineering education.

Background

In her distinguished lecture entitled: "A Bell Labs Daughter Speaks About Equity in Engineering Education" at the 2014 American Society for Engineering Education conference, Dr. Peggy McIntosh challenged the engineering education community to use its position of privilege to redesign the system of engineering education. She advocated for the community to recognize the "colossal unseen dimensions" of built-in privilege and to launch substantive collaborative efforts to change the traditional norms in the institution of engineering education.

It is with McIntosh's challenge in mind that we turn our focus to unearned advantages and disadvantages experienced by students within engineering education. Scholars have written about engineering education as being a "raced, gendered and classed" institution. This is a way of saying that the system educating engineers has historically been designed by and for White men, mainly in the upper-to-middle class¹⁻⁵. Unfortunately, it is this history that has consequences even today for the content of engineering curriculum as well as who becomes an engineer^{3,6,7}. Even now, women, students of color, first generation college students, lower-

income students, and/or students who start college significantly later than 18 years of age are at best underrepresented, and at worst socially marginalized in many engineering classrooms.

Furthermore, McIntosh explains that the myth of monoculture assumes that there is a single “normal” experience⁸. Recognizing and acknowledging that a “monoculture” is embedded deeply in the engineering education system may not be easy for those of us who are engineering educators and researchers. McIntosh points out that such a monoculture mirrors that of the US social system, not merely by what she calls “active forms” of interlocking oppressions, but more deeply—in embedded forms—forms which “member[s] of the dominant group are taught not to see”⁹. These embedded forms are not made up of “individual acts of meanness by members of [the dominant group],” but by institutional history⁹.

In her distinguished lecture, McIntosh addressed White privilege and the surrounding myths that people can unknowingly propagate. She began by speaking of her upbringing in a “normal” family and of her father working as an engineer at Bell Labs. As circumstance in her life gave her reason to pause and reflect, she realized that as a White woman, she was allowed to consider herself normal, as she was part of what society considers normal. She referred to her seminal work, *White Privilege: Unpacking the Invisible Knapsack*, in which she discussed earned strengths and unearned powers⁹. These unearned powers accrue into unearned advantages that one may have, and not even realize. Conversely, one may also experience unearned disadvantages. During her lecture, McIntosh introduced the audience to her “serial testimony” technique. This technique encourages participants to discuss what she called “unearned advantages” and “unearned disadvantages” that result from living in a monoculture society where privilege is embedded and granted to members based on race, gender and social class^{8,10,11}. By asking attendees to personally share unearned advantages (UA) and unearned disadvantages (UD) with a partner during her lecture, she demonstrated how the technique is used to encourage participants to share their truths by facilitating equitable sharing in a group, typically allowing each person to speak uninterrupted in each round.

During the lecture, McIntosh asked audience members to form pairs with someone they did not know. She explained that participants would speak uninterrupted to the other person for a period of 90 seconds. During each person’s turn, he or she would articulate personal examples of unearned advantages from their own life experience. She warned that it would indeed feel uncomfortable and odd to speak to another audience member about this, and feel even stranger because the other person was instructed to sit there without rebuttal, comment, affirmation, or discouragement. Participants took turns discussing unearned advantages, and then traded unearned disadvantages, which McIntosh warned might be even more uncomfortable than identifying unearned advantages.

Some members of our research team participated in McIntosh’s lecture and serial testimony exercise. As a White woman, Aubrie recalls that it was difficult to speak to her partner, a woman from India, about fairly personal things regarding her family, race, and culture. Aubrie cringed while she communicated some of these topics in front of a stranger, confirming McIntosh’s statement about the participant discomfort. However, this exercise helped Aubrie to realize that there are traits, both UA and UD, which she would have never recognized or thought to ask her

partner about because they were foreign to her own experiences in life. The serial testimony elicited these traits that would have otherwise been left in silence.

Our Research Team's Response to McIntosh's Challenge

This paper describes our research team's response to McIntosh's challenge to the engineering education community by developing an adaptation of her serial testimony technique for one-on-one interviews, which we term "a series of singular testimonies." We have operationalized the serial testimony technique into a research protocol as a way to investigate the UA and UD of recent engineering graduates, and the relationship of these unearned traits to their experiences in engineering higher education. In our work, we define testimony as: speaking the truth of one's experience and perspective.

We have piloted our interview technique with recent engineering graduates, and found it to be efficacious for eliciting participants' perceptions of unearned advantages and disadvantages related to their engineering education. In this paper, we will (1) describe in detail all adaptations to McIntosh's serial testimony method (3) present our results related to participants' perceptions of unearned advantages and disadvantages, and (4) discuss our results that reveal/confirm how a particular trait can be perceived as an advantage by one participant, but as a disadvantage by another. We will also present specific examples of certain unearned traits (such as economic status) that some participants simultaneously viewed as both advantages and disadvantages in pursuing their engineering education.

Method Development

"Serial Testimony" Adaptations to Create a "Series of Singular Testimonies"

In developing our method, the team first discussed how the serial testimony technique could be adapted to be more appropriate for an individual interview. Three researchers from our team (Julie, Aubrie and Rachel) attended McIntosh's lecture at the 2014 ASEE Annual Conference in Indianapolis and had the opportunity to not only learn her techniques for introducing terms and motivating thoughtful responses of UA and UD, but also to engage with others in the room and actually participate in a guided serial testimony with another individual. The first-hand experience of participating in a serial testimony gave us insight and knowledge about how it felt to participate, which helped the research team to adopt the serial testimony technique to a one-on-one interview method.

We carefully considered how to tailor this technique for an interview by considering the key components of the serial testimony, such as: timed limit for responses, the back-and-forth nature of sharing testimonies, and allowing the participant to speak uninterrupted and without comment or rebuttal. We understood that various components would need adaptation, and these processes and justifications are explained in this paper.

One key component of McIntosh's serial testimony technique is to allow the participants to tell their story without any influence or interruption (verbal or nonverbal) from the other participant. That being said, we debated about how the interviewer (Julie) would maximize each participant's understanding of the questions being asked, to increase the participants likelihood of providing

thoughtful answers that were completely their own. Because we were introducing terminology that was potentially unfamiliar to the interviewees such as “testimony” and “unearned advantages” and “unearned disadvantages,” we prepared a document to send to participants prior to the interview containing a glossary of terms and a table of potential unearned traits. This list was meant to serve as a beginning guide to help generate thoughts of potential UA and UD. Julie explained that the sample list in Table 1 was neither exhaustive, nor applicable to each participant. Indeed, one item on the list may be experienced as an advantage to one person, but a disadvantage to another, and vice versa.

Table 1. Examples of potential unearned traits. Similar traits may be considered as an advantage by one individual but a disadvantage to another, and vice versa.

<ul style="list-style-type: none"> ● A person’s birth order and/or number of siblings ● A person’s family economic status ● A person’s medical condition ● A person’s race/ethnicity ● A person’s cultural or religious beliefs or customs ● A person’s gender ● A person’s age ● A person’s sexual orientation 	<ul style="list-style-type: none"> ● A person’s family history or heritage ● A person’s physical appearance ● A person’s nationality ● The language(s) a person speaks ● A person’s dialect or accent ● The educational background of a person’s parent(s) or guardian(s) ● The customs, traditions, or expectations of a person’s family or their community
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While conducting the interviews, Julie first explained our definitions of “testimony” and “unearned advantage/disadvantage;” the participants were also asked if they desired clarifications or had any questions about the document or the interview. This step helped us to verify that each participant understood the terminology before beginning the interview, and helped to build rapport between the interviewer and participant. Once any questions had been addressed, Julie began the interview.

As the goal of the interview was to elicit the participants’ personal testimony of their unearned advantages and disadvantages with respect to their engineering education, we chose to adopt a semi-structured interview format beginning with two very open-ended questions: 1) Please tell me about any unearned advantages that have impacted your life, and 2) Please tell me about any unearned disadvantages that have impacted your life. After the participant had completed his or her testimony for each of these two questions, Julie asked follow-up questions related to how their testimony may potentially be linked to their engineering education experiences. Depending on the participant’s testimony, Julie further explored some of responses regarding selection of engineering as a college major, persistence in engineering, classroom or non-classroom experiences, or professional experiences.

We felt that the semi-structured format was essential to this technique because this gave the participants the freedom to “tell their story” while also providing us with the opportunity to ask follow-up questions specifically related to their testimonies. It is important to note that McIntosh’s serial testimony method relies on an equitable testimony sharing format between two participants; however, our singular testimony method employs a process in which the interviewer poses the two key questions with follow-up questions tailored specifically to each testimony, giving us the unique ability to take the testimony further to explore participants’ experiences more deeply. One hallmark of McIntosh’s serial testimony we preserved in our singular

testimony method is allowing the participant to speak uninterrupted until finished and refraining from giving any form of facial/vocal cues commonly employed during interviews (e.g., nodding of the head, words of acknowledgement). This gave the participants the space to speak freely without judgment, comment, or rebuttal until he or she was finished.

We initially debated the importance of using a time limit in the individual interview setting. The team members who participated in the serial testimony at the conference agreed that the time component to McIntosh's serial testimony technique was important in that it encouraged talking honestly as the "clock was ticking," and without the time element, there is less pressure to fill the "space" with talking. Furthermore, some research team members felt that without the time limit, participants might discuss just a few instances of UA and UD. As a result of this debate, Julie tried out the necessity of the time limit in our first interview by asking the participant to speak uninterrupted for at least 90 seconds per question. Feedback from our first participant indicated that the time element was unnecessary (meta-question data about this topic follows in a subsequent section). Before conducting the second singular testimony interview, we re-evaluated the time component as a group. We considered the fact that, unlike the serial testimony technique, the one-on-one interviews did not encompass equitable sharing by more than one person. We therefore decided to remove the time limit component. This decision was justified when all five of the participants spoke for much longer than 90 seconds, typically for several minutes, without interruption.

Sampling

Engineering Background

The goal of our work was to gain a deeper understanding of the experiences of undergraduate engineering majors by eliciting descriptions of their unearned advantages and disadvantages. To do this effectively, we had to consider how our sampling choices might affect the quality of the data. For example, we felt that it was important to select participants who were capable of producing thoughtful descriptions of their experiences. Initially, we considered interviewing current undergraduate engineering students, but decided against their inclusion because we believed that it was possible that some (or many) may lack the temporal distance from their education necessary to thoroughly reflect on their experiences. While our team discussed this aspect of the sampling, we agreed that our perspectives and interpretations of our own educational events had shifted after graduation. We ultimately decided not to include current students in the initial sample, but to focus on professionals who had completed engineering degrees. We felt this would increase the likelihood that the participants had the maturity to reflect upon their educational experiences.

We identified participants via a combination of chain and convenience sampling.¹² While three members of our research team (Freddy, Lindsey and Shannon) identified personal contacts fitting our criteria, the interviewer (Julie) and the researcher who primarily analyzed the data (Rachel) were unaware of each participant's background prior to the interview. Thus, we were confident that the interview and analysis would not be biased by familiarity with the participants. The identified participants were early career professionals holding a BS in Engineering. We decided to define "early career" as someone who had graduated from an undergraduate engineering program within the last ten years. We chose this the ten-year timeframe because we wanted

participants who could speak about the current state of engineering education. Additionally, we intentionally used the term “professional” instead of “engineer” because we recognized that some graduates may have pursued other career paths but could still have relevant insights. In addition to other professionals, we interviewed one graduate student who had completed a BS and was currently in an engineering graduate program.

Diversity

McIntosh’s serial testimony was originally developed to identify UA and UD related to race. Therefore, one might think that it would be appropriate to exclusively invite participants who are considered underrepresented in engineering. However, our series of singular testimonies method is designed to elicit unearned and perhaps unseen advantages and disadvantages. As researchers, we cannot possibly predict these unseen dimensions of a person’s experience; that is, we cannot assume to know a participant’s reality before they have presented their testimony. In order to avoid making judgments about a potential participant’s unearned advantages and disadvantages, we did not select/reject any participant based on our perception of their race, gender, sexual orientation or any other demographic characteristic. We also did not purposefully collect data about participant demographics. Some participants offered up information about how they identified with demographic categories during their testimony, while others did not.

Data Analysis

Our data analysis consisted of multiple steps and involved all members of the research team in some way. A succinct summary of how we adhered to quality considerations in “making” and “handling” the data appears in Table 3. This section primarily addresses the interactions that took place among the research team during the analysis process.

Julie began the analysis immediately after each interview by memoing about the content of the participant’s testimony. Since we were in the process of developing and refining a method, she also memoed about the meta-questions she asked participants after each interview, as well as her ideas and insights regarding refining the singular testimony method (see next section for details). She verbally shared a paraphrased version of her memos with the research team after each interview. After a professional transcriptionist transcribed the interviews, Rachel and Freddy employed parallel coding for one of the five interviews. They compared findings to ensure that they had identified and analyzed themes in a similar way. They shared their coding with the entire team, making us confident that their interpretations were consistent with each other and honored the testimony of the participant.

Rachel led the remainder of the data analysis, with support from Freddy and Aubrie. She independently coded the remaining four transcripts, periodically peer debriefing with Freddy and Aubrie to gain their perspectives and verify her interpretations. Once she had coded all five interviews, Rachel and Freddy shared the findings with the rest of the team in the form of a table identifying each advantage and disadvantage reported by participants. The team discussed themes that were identified as advantages by some participants and as disadvantages by other participants. Rachel then re-evaluated her coding scheme based on feedback from the team. For example, the team suggested merging some sub-themes in favor of more general definitions. Rachel then constructed an updated table of theme definitions and descriptions (a detailed

codebook) and shared the codebook with Freddy and Aubrie to seek their feedback; during this step they reduced 27 themes to 20 themes. The coders then made a second pass through the data after peer-debriefing with the entire research team, and conducted several more meetings for continual codebook revisions and peer-debriefing. Rachel made a third pass through the data, and after analyzing two codes for further review, sent them to Aubrie and Freddy for specific feedback. The coders agreed upon a final list of 18 different themes that emerged from participants' unique stories.

Using Meta-Questions and Interview Data to Refine the Method

To determine the effectiveness of using our singular testimony approach, we asked the participants meta-questions that solicited direct feedback immediately following each interview. These meta-questions allowed us to collect data that assisted us in revising our protocol. Our team had previously debated whether or not to include a time limit or minimum when asking participants to share their UA and UD. Julie told the first participant that he had "90 seconds or more" to talk about his UA. He spoke for about four minutes before finishing and moving on to UD. So at the close of the interview, she asked his opinion on the time component. He commented that he did not pay attention to the time limit but thought that other people might, saying:

"Ninety seconds is really not a lot. I mean to some people it is a lot when you think about more the time limit than the actual thought process you're going through."

As we previously mentioned, the method was revised to exclude the time component, and we participants spoke at length about both their UA and UD. On the topic of speaking uninterrupted or without rebuttal, one participant noted that,

"I just, you know, sometimes I feel like I go off on a tangent and I start talking about stuff that's not related to whatever you asked. So you know, maybe a little gesture like a head nod or something, to make sure that I'm not talking about random things that aren't really important."

Yet when reminded that in this setting, he was the sole judge of what is important, he admitted that the uninterrupted speaking was "great" in that regard.

We also carefully considered another aspect of the method: the order of asking the UA and UD. We wanted to be cognizant of any potential influence the order might have on participants' testimonies. Julie experimented with the order during the pilot interviews (sometimes asking for UA first, sometimes for UD first, some participants were given a choice) and included a meta-question asking participants for their opinion on the ordering. Our meta-data results regarding this aspect were inconclusive. Some participants noted no real preference and were content to have us choose a starting point. One participant felt that asking the UD first may set a negative tone in the interview and put someone "on the defense":

"I think it may have had a difference . . . so I like the fact that you asked about the positive things first."

Another participant would have preferred to talk about both at the same time,

“I thought it was difficult to separate them. It would be easier, not necessarily correct, but I think it would be easier to say everything and then [sort] later what each one is . . . because then you don’t think about while you’re talking but you just tell your story.”

We mentioned earlier that one of our primary concerns prior to conducting the pilot interviews was finding a way to ensure that participants had a sufficient understanding of UA and UD to answer the questions based on their own life experiences. Julie asked participants about the clarity of the material in the pre-interview guide; one participant responded, “I thought it was very good. It was very clear . . .” We have included our pre-interview document in the Appendix.

Another participant admitted that she had not viewed the initial email, but that the list was very helpful:

“I guess it’s hard to, I guess I never have really thought about it before . . . I mean I’ve thought about it but I’ve never really put it into words. So that’s probably the most difficult part about it . . . I’m just going to go, go off your list because it’s pretty representative list and I can list which ones I’ll talk about and then I’ll go deeper into them.”

Based on the results from our meta-questions as well as the testimony data itself, we believe that the combination of sending the guide prior to the interview and going over the terminology at the start was effective. In fact, we found that even if some participants started discussing unearned traits based on the general categories included in the list, the participants generally spoke freely of their life experiences, providing powerful examples of UA and UD that transcended the initial list.

Using Meta-Questions and Interview Data to Demonstrate Efficacy of the Method

The testimonies demonstrated that there was no one “monoculture” experience of engineering higher education. Reflecting on UA and UD, participants were able to connect their experiences in a powerful way. Although our singular testimony method only asked two broad questions, participants responded with a range of specific scenarios unique to their personal engineering education experience. The open-ended nature of our interview technique encouraged participants to tell their story as they experienced it. Participants described detailed scenarios involving their parents’ careers, influences of peers as they grew up, involvement with athletics and clubs, gender influences, various jobs they held, and religious influences.

At the end of his interview, one participant gave his view on our interview technique:

“I mean I think for me personally, you know, it’s only after the fact I think you can really step back and try to pinpoint some of these things as advantages or disadvantages.”

Some themes (such as family educational background) were mentioned by each of the participants in different ways, highlighting the uniqueness each person’s experience. Family

educational background was exhibited as an UD for one participant because his mother's lack of a college degree hindered him in some ways:

“... I didn't know how to maneuver in that setting [college], and I really did not have anyone who could tell me what things I would run into.”

While one participant's family educational background was an UD because his parents did not attend college, he admitted that is also proved to be an UA:

“I mean, since my parents really didn't have any higher learning they kind of motivate you to want to be the first, you know what I mean, [being] the first of anything is good . . . I was the first male to graduate from college in my family and that was motivation right there, to be the first . . . and then you have family members, even if they don't have higher learning, it's kind of like, I guess like pride, to have a nephew or a grandson to graduate from college, to get a degree . . . even though they didn't have it, it makes them happy to see that someone in our family can do it and I guess kind of start a tradition...”

The same participant expressed family education background as an UA. His sister, who was in college, influenced his educational experience by introducing him to her friends in engineering:

“See, I think, now if I didn't have her and the friends, to know them, it would've been much harder in my opinion. I'm going to say to the point where I wouldn't have got through engineering...”

Family upbringing was another salient theme that most participants described as an UA. One participant's mother was “an extremely ambitious woman,” as she held a computer science degree and had encouraged all of her children to attend college:

“So college wasn't really an option so I had to kind of follow the trend and that's just always been my mindset and so basically, I guess, what I would call an unearned advantage.”

Family economic status and parental marital status was both an UD and an UA for one participant. He mentioned that his parents were divorced and he had to start working at a young age, which was a disadvantage on one hand; on the other hand, their economic situation gave reason for his mother to always ensure he was able to go to decent schools, which was advantageous to his education:

“... my mother always found some affordable living situation for us in [name of town]. And even if we didn't, I guess between you and I, we still used the [name of town] addresses so I could go to school in [name of town].”

Table 2: Summary of Results

Codes	Unearned Advantage (UA)	Unearned Disadvantage (UD)	Both UA and UD
Economic Status		Pilot 4	Pilot 2
Family Educational Background	Pilot 3	Pilot 2 Pilot 4 Pilot 5	Pilot 1
Language Barrier		Pilot 2	
Medical Condition/ Disability			Pilot 2
Attended Good Schools	Pilot 2 Pilot 4 Pilot 3		
Race & Ethnicity		Pilot 4 Pilot 1	Pilot 3
Physical Appearance		Pilot 1	
Gender		Pilot 3	
Parents Divorced		Pilot 4 Pilot 3	
Employment	Pilot 5	Pilot 2	
University Employment			Pilot 5
Family Encouragement	Pilot 4 Pilot 5 Pilot 1		
Family Upbringing & Example	Pilot 4		Pilot 3
Provided Self-Motivation	Pilot 2 Pilot 4 Pilot 1		
Religion	Pilot 4	Pilot 2	
Sense of Identity	Pilot 4 Pilot 3		
Social Experiences	Pilot 3 Pilot 5 Pilot 1		
Death of a Parent		Pilot 3	

Limitations and Quality Framework

We recognize that other researchers may face some obstacles when utilizing our method. Some participants may have difficulty opening up, so interviewers must be cognizant of each participant's comfort level and dedicate additional time towards building rapport if necessary. Additionally, novice interviewers may find it unnatural or even difficult to refrain from reacting or acknowledging participants' responses during testimony delivery. Finally, we recognize the potential influence that a pre-interview guide can have on participant responses; too many/overly specific examples could restrict or influence testimonies. We carefully considered this potential influence in designing the protocol. Participants' testimonies themselves as well as the meta-data collected from participants indicated that participants simultaneously felt that the pre-interview guide was useful, and did not inhibit participants' ability imagine and share unearned advantages and disadvantages that transcended the initial list.

We exercised quality considerations in our research design. Table 3 provides the quality assurance measures we employed for both "making" and "handling" the data¹³. Additionally, we include suggestions for other researchers applying this method in their practice. We utilized the quality management framework adapted from Walther, Sochacka, and Kellam¹³ in an effort to mitigate threats to reliability and validity in interpretive engineering education research. This framework is especially useful in considerations of quality in that it gives researchers the ability to both establish quality considerations and to communicate them to an engineering education audience. The definitions herein are those of Walther, Sochacka, and Kellam¹³. *Theoretical validation* concerns the fit between the social reality under investigation and the knowledge produced. *Procedural validation* concerns elements of the research design that alleviate threats to the overall validation. *Communicative validation* concerns the social construction and communication of the internal and the external customers of the research. *Pragmatic validation* concerns the compatibility of theory with reality and the utility of interpretation. *Ethical validation* concerns aspects of integrity and responsibility/role of the researcher in the entire process. And lastly, *process reliability* concerns mitigating the random influences upon the research process by carefully documenting and striving for consistency.

Table 3. Quality management model adapted from Walther, Sochaka & Kellam¹³ as applied to this work.

Description	Making the data	Handling the data
How can we improve the research findings' capacity to appropriately capture and represent aspects of the social reality observed?	Do we get to see what we think we see?	Is the researcher's version grounded in the versions of the participants'? Do we call things by the right names?
<p><u>Theoretical validation:</u> Do the concepts and relationships of the theory appropriately correspond to the social reality under investigation?</p>	<p>The research process needs to be able to capture the full extent of the social reality studied.</p>	<p>Interpretations need to reflect the coherence and complexity of the social reality under investigation.</p>
	<ul style="list-style-type: none"> -We developed an interview guide inspired by McIntosh's Serial Testimony (turned singular testimony) designed to allow participants to tell their story and uncover both unearned advantages and disadvantages they may experience, and that may have had an effect on their journey to obtain their degree -We provided a pre-interview guide to participants to explain and define singular testimony and UA/UD -We carefully documented the process of developing the singular testimony method following questions designed to help formulate the conversation -We used carefully crafted interview questions to elucidate experiences through engineering education 	<ul style="list-style-type: none"> -We remained completely open to possibilities and concepts that emerged -Proper methods of doing justice to our participants' testimonies through the dissemination of our findings took form with careful evaluation during the pilot study -We aim to share the testimonies in such a way that will give voice to the participants' experiences and the implications for current and future students in engineering education (this paper is the first of our dissemination)
<p><u>Procedural validation:</u> Which features of the research design improve the fit between reality and the theory generated?</p>	<p>Strategies need to be implemented in the research design to mitigate threats to contextual validation. Features, processes, mechanisms</p>	<p>Processes need to be implemented to mitigate risks of mis-constructing the participants' reality in the researcher's interpretations.</p>
	<ul style="list-style-type: none"> -Singular testimony gives the participants uninterrupted time to talk freely, and we used their responses to structure the remainder of interview -We planned our word choice in the pre-interview guide and interview prompts carefully so as not to restrict or influence participants' testimonies -We utilized meta-questions (asking for participants' opinions and thoughts on answering the questions), which helped for reflection and continual revision of the method -We used input from team and peer-debriefing meetings throughout 	<ul style="list-style-type: none"> -We sought peer-debriefing and continual analysis of interview questions and responses elicited, particularly in the pilot study, to refine potential questions for future interviews -We implemented a pass system comprised of levels of reading transcripts, skimming transcripts, writing structured memos, listening to recorded interviews and memoing, peer debriefing over memos and findings, and possibly moving forward with follow-up interviews if necessary. -We recommend keeping a detailed log trail of your pass system for analysis and revision.
<p><u>Communicative validation:</u> Is the knowledge socially constructed within the relevant communication community?</p>	<p>The data gathering needs to capture the respondents' inter-subjective reality.</p>	<p>The researcher's abstract interpretations need to be grounded in the accounts of the participants. The knowledge produced needs to be represented in accordance with the meaning conventions of the research community.</p>
	<p>We used our pre-interview guide to define UA/UD as well as 'testimony' We verbalized to participants their right to follow up with thoughts, questions, or a follow-up interview.</p>	<p>We used discussions and memoing to compare participants' version of their story to interpretations We recommend presenting raw transcript data to research team for peer debriefing for appropriateness of the methods of analysis and conclusions.</p>

	-We communicated the importance of participants' stories to the overall project and to the community of engineering education	-We recommend listening to the recorded interviews to "hear" the testimonies and to facilitate adhering to the participants' reality during analysis. -We co-construct meaning-making within the research team so as not to mis-construe or stray from participants' testimony
<i>Pragmatic validation:</i> Do the concepts and knowledge claims withstand exposure to the reality investigated?	The concepts underlying the research design need to be compatible with reality in the field.	The knowledge produced needs to be meaningful in the social context under investigation.
	-Singular testimony elicits UA and UD, and open participants to begin thinking and sharing their experiences; and we are prepared to guide or help elucidate responses without putting words into participants' mouths. -Several members of our research team attended McIntosh's talk and were consulted on serial testimony	-We intend to share findings with the community so that our findings and publications are meaningful to students in engineering education, employed engineers, instructors and those in positions to enable change and understanding, and to the engineering education community -We hope others can use this method to expose both the visible and invisible barriers that can marginalize people in engineering education
<i>Process reliability:</i> How can the research process be made as independent as possible from random influences?	The data needs to be collected and recorded in a dependable way	Procedures for generating and representing knowledge need to be established and documented.
	We read through and corrected transcripts while listening to recorded interviews We utilized the essence of McIntosh's serial testimony in the implementation of our singular testimony (allow participants to speak, uninterrupted and without rebuttal) We made sure to communicate to participants that at any point of discomfort in the interview, they may "pass" and move on from the topic without question	We used multiple researchers to analyze transcripts and employ continuing discussions. We recommend employing parallel coding and memoing for comparison · Coded both thematically and freely to look for themes We recommend follow-up interviews to allow for emergent ideas to be explored if found to be salient to the study as it unfolds from pilot data As themes emerged, we re-investigated and coded for them. We fostered consistency through continual meetings of the research team and adhering to the same pass system We kept a carefully documented log trail

Summary

Throughout this paper, we have discussed the considerations we addressed during the development, testing and refinement of a "singular testimony" interview method inspired by Dr. Peggy McIntosh's 2014 ASEE Distinguished Lecture. We have demonstrated that our method, as piloted with early-career engineers, is effective in eliciting powerful testimonies of both unearned advantages and disadvantages related to engineering education. We contend that our method is both an effective and efficient way of "busting the myth" of monoculture in engineering higher education; that is, in demonstrating that there is no single "normal" student experience. Our research team's future plans include combining our technique with relevant theoretical frameworks in the analysis phase to better understand the range of diverse experiences students bring to their engineering education.

Conclusions

In many ways, the historical account of an individual has been used to educate society on a particular topic or concept. The testimony of an individual is a powerful statement providing evidence of the existence of a particular occurrence. There is much to learn about the diverse

ways different groups in engineering exist within the monoculture embedded at most institutions of higher education. When investigating “invisible occurrences” such as the effects of social structures on an individual, testimonies can provide effective data to researchers. By adapting Dr. McIntosh’s serial testimony technique to a one-on-one interview protocol, our research team has begun to respond to her call for action in the engineering education community. We have operationalized her serial testimony technique into a research method termed “singular testimony.” It is our hope that our careful attention in developing this specific type of interviewing protocol will warrant its usability and transferability for other engineering education researchers. This tool will potentially assist others who wish to illuminate visible and invisible forms of privilege and oppression, underrepresentation, and marginalization that undergraduates may experience during their engineering education.

Bibliography

1. Hacker BC. Engineering a new order: Military institutions, technical education, and the rise of the industrial state. *Technology and Culture*. 1993;34(4):1-27.
2. Frehill LM. The Gendered Construction of the Engineering Profession in the United States, 1893-1920. *Men and Masculinity*. 2004;6(4):383-403.
3. Pawley AL. What counts as “engineering”: Towards a redefinition. In: Pawley AL, Riley DM, eds. *Engineering and Social Justice: In the University and beyond*. West Lafayette, IN; 2012:59-85.
4. Riley DM. Engineering and Social Justice, Synthesis Lectures on Engineers. *Technology and Society*. 2008;3(1):1-152.
5. Riley DM, Pawley AL, Slayton AE. Social Justice and Inclusion. In: Johri A, Olds BM, eds. *Cambridge Handbook of Engineering Education Research*. New York, NY: Cambridge University Press; 2014:335-356.
6. Pawley AL. Universalized Narratives: Patterns in How Faculty Members Define “Engineering.” *Journal of Engineering Education*.. 2009;98(4):309-319.
7. Pawley AL. Drawing the line: Academic engineers negotiating the boundaries of engineering. 2007.
8. McIntosh P. White Privilege: An account to spend. *Saint Paul Foundation*. 2009.
9. McIntosh P. White Privilege : Unpacking the Invisible Knapsack. *Peace and Freedom*. 1990;49(1988):1-5.
10. McIntosh P. White people facing race: Uncovering the myths that keep racism in place. *Saint Paul Found*. 2009.
11. McIntosh P. Toolkit for Beyond the Knapsack. *National. SEED Project Wellesley Centers for Women, Wellesley Coll*. 2013. Available at: <http://www.tolerance.org/meaningful-discussions>.
12. Creswell JW. *Qualitative Inquiry and Research Design: Choosing among Five Approaches*. 3rd ed. Los Angeles, CA: Sage; 2013.

13. Walther J, Sochacka NW, Kellam NN. Quality in interpretive engineering education research: Reflections on an example study. *Journal of Engineering Education*. 2013;102(4):626-659.

Appendix

Pre-Interview Information for Participants:

In this interview, you will be asked to share your story, or “testimony”, about “unearned advantages” and “unearned disadvantages” as you perceive them. This interview is confidential and I/we are not here to judge you. I/we will not react or speak while you share; this is out of respect for your experiences and so that I/we can listen intently to what you have to say. In speaking, please stay true to your own experiences and feelings and reflections, knowing that you will not be judged.

Glossary of Terms:

We have included a glossary of terms that will be used during your interview. Some of the terms may be unfamiliar to you, or— for the purpose of this interview—may be defined in a different way than you have previously used them. These terms will be the focus of the interview, so please do not hesitate to ask for clarification if something is unclear.

Term 1: *Testimony*: Speaking the truth of one’s experience and perspective; giving evidence

Terms 2 & 3: *Unearned advantage, unearned disadvantage*: an ascribed trait or status; something that is the result the circumstances of your birth, the way you were raised, or other involuntary circumstances; something not by your own doing or potentially not even within your control

Unearned traits could take many forms. Note that the list below is not exhaustive, nor does each example apply to everyone. In fact, one item on the list may be experienced as an advantage to one person, but a disadvantage to someone else, and vice versa.

A person’s birth order and/or or number of siblings	A person’s sexual orientation
A person’s family economic status	A person’s family history or heritage
A person’s medical condition	A person’s physical appearance
A person’s race/ethnicity	The language(s) a person speaks
A person’s cultural or religious beliefs or customs	The educational background of a person’s parent(s) or guardian(s)
A person’s gender	The customs, traditions, or expectations of a person’s family or their community
A person’s age	