

Work in Progress: Exploring the Attributes of a Prototypical Leader As Viewed by Undergraduate Engineering Students

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Dr. Lilley's research interests in engineering education focus on professional development of engineering students at the undergraduate and graduate level. In particular, she is interested in the nuances of how the intersection of race/ethnicity with gender affects professional development in the area of leadership and the long term career trajectory of an individual. Her other research interests are focused on syntheses of low dimensions materials and the characterization and modeling of their material properties.

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Introduction

The professional development of leadership skills by undergraduate engineering students is key to a successful long-term career. Increasing diversity and inclusion in leadership is also critical for technology companies as they become global enterprises. Within engineering education, the National Science Foundation funded a multiyear research project lead by the American Society of Engineering Education beginning in 2014 on “Transforming Undergraduate Engineering Education.” In particular, Phase I of this project included a multiday workshop heavily reliant on industry input of the Knowledge, Skills and Abilities traits (KSAs) of engineering students to be ready for the workforce in 2023.[1] In particular, the desired educational outcome is “a T-shaped engineering graduate who brings broad knowledge across domains and the ability to collaborate within a diverse workforce as well as deep expertise within a single domain [1], pg. 2.” In particular, it was found that, “Students also fail in meeting expectations in several skills accorded growing importance. These include leadership, decision-making, communication, and the ability to synthesize engineering, business, and societal priorities [1], pg. 4.” Yet, there is a gap in knowledge of leadership views, experiences, and skills for a diverse population of engineering students, especially millennials in engineering. To date, there are studies on

This research paper describes a subset of findings from a larger qualitative study on leadership views, experiences and skills/knowledge of undergraduate engineering students with self-identified leadership experience. Although the full interviews addressed several themes within leadership, this work in progress paper focuses on the positive (prototypical) traits of leaders for undergraduate engineering students that are all considered to be millennials (i.e. under 35 years of age [2]). The purpose of discussing this subset of analysis is to develop a model of a prototypical leader for millennial undergraduate engineering students, using intersectionality as the theoretical framework [3, 4]. This model will become: 1) the basis for comparing skills/knowledge millennial engineering student leaders have gained through the course of their education and serve as the foundation for future research on developing interventions to increase the prototypical skills sets for a broad and diverse community of current and future undergraduate engineering students, and 2) help develop future research on how the leadership views of millennial engineering students may influence their expectations when joining the engineering profession, and whether there is an impact on their short to long term retention and leadership ascension during their careers.

Methods

The investigator conducted 32 semi-structured, one-on-one interviews with undergraduate engineering students at a Research I university in an urban location. Since the theoretical framework for the analysis was to use intersectionality using a voice approach [5], the focus was to collect narratives that elicited differences in perspectives within social subgroups that are outside of the norm (i.e. a White male) for engineering professions. Thus, questions were developed in consultation with two social scientists with expertise on race and gender and qualitative research to draw out the views and personal experiences in leadership of the engineering students, while also extracting narratives that included their perceptions on whether or how race and gender impacted their experiences and views. In addition, two underrepresented

minority (URM) undergraduate engineering students were consulted, one male and one female, who were leaders in their engineering societies and who did not take part in the study. They were consulted on clarity and ease of understanding of the questions, as well as any additional questions that would provide additional insight on leadership from a student perspective that included race and gender-based experiences. The interviews took 60-90 minutes and included 32 questions. The research was approved by the institutional review board and all students signed a written consent prior to participation. Students were purposefully selected to gain a broad representation of the engineering disciplines (bioengineering, computer science, chemical engineering, civil engineering, electrical engineering, industrial engineering, and mechanical engineering) and age (millennials with a mean age of 22.1 years). The social groups used to identify the students reflected diversity in self-identified gender (15 female, 15 male, and 2 transgender) and race/ethnicity (9 Asian, 9 White, 4 Black/African American, 7 Hispanic/Latino, and 3 multiracial students). As mentioned above, students were asked open ended questions on attributes of leaders and the findings presented in this paper focus specifically on 10 questions related to prototypical attributes of leaders. Samples of these questions included: “If you could meet a leader for a one-on-one meeting, who would it be? What about them is interesting or inspiring?” “Who are the people who you’ve witnessed as leaders in your life and what makes them a leader?” “What distinguishes leaders from people who are just in charge?”

Results and Discussion

As outlined by Charmaz [6], the interviews were coded line-by-line using gerunds and the constant comparative method was used to develop a code book during the focused coding phase [6]. From the focused coding, the constructs, i.e. categories, of leader attributes and role models have been defined. Analytical memos were concurrently maintained during the coding processes. After reflecting on the categories and discussing with social scientists the meaning of empathy, the category of empathy was split into empathy and caring. The separation of the two categories was to clarify that empathy was a skill where the leader could read the emotional state of a person or understand the situation a person may be facing. The ability to read a person (i.e. “get” them) is used as information by the leader when making a decision, but empathy is independent of caring for a person or wanting to help a person. Caring involved knowing about a person’s distress or needs and taking these needs into consideration when leading, such as taking an action or making a decision. A caring leader also proactively helped those on their team through guidance, support, and mentoring. To date, 20 preliminary leader prototype characteristics have been categorized and defined as listed below:

- **Having Mystique:** Associated with charisma and being a person that others find intriguing in their personality, their approach to innovation or creativity in solving problems. Typically, a leader with mystique will inspire awe in a person.
- **Being a Pioneer:** This person is a trailblazer. For example, it could be a person that was a leader, despite it being against established societal conventions and achieved success in what they set out to do. A pioneer can also be someone who does not heed popular opinion or established beliefs and sets out to achieve a goal that is different or against these beliefs.
- **Knowing the Solution:** This trait is associated with “knowing the correct answer” to any problem. It is implied that knowing the correct answer also means that you have the “best” answer and the most efficient way to get to the answer or solution. You should also get to the answer quickly. Some other characteristics include that the person is technically and

academically excellent, they know the skills and knowledge of their team, and consider the input from their team in arriving to the correct and best answer to solve the problem.

- **Acting as a Guide:** This person acts as a mentor for others and provides help when needed to help others achieve success. They can also be a moral or spiritual guide that helps sustain a person's sense of following a "correct path."
- **Building Respect:** A leader who exhibits respect for all others in a group, community or organization. They model the desired positive behavior expected of the team and demonstrate positive examples for the team to follow. These behaviors include being respectful to all, working harder than the rest, listening and learning from others. The team feels that they are respected and valued; they want to follow their leader because they respect what the leader asks of them and value how they are treated.
- **Persevering:** A person that overcomes all challenges they face, such as lack of existing technology, supply or demand, to achieve success in achieving their goal. This person may also overcome opposition to their vision or solutions to achieve success in achieving their goal. They continue to work for their vision or goal and do not give up until they achieve success.
- **Having Conviction:** This person believes in the vision or goal as being "the correct thing to do" to solve a problem. Because of this belief, they do not waver in their efforts despite opposition or challenges to achieving their goal. A person with conviction remains steadfast that their actions and goals are correct despite any opposition or challenge they face.
- **Continuously Learning:** A person that is willing to learn new skills, either through educating themselves, seeking mentorships, or from others within their team. They pay attention to what is happening within their local environment or within society and address the issues that they perceive. They solve problems instead of letting them fester because they are aware of their environment.
- **Being a "Social Chameleon":** This leader can adapt to the group based on their knowledge and experience to gain social acceptance or "buy in" by followers to their leadership. The leader is perceptive of social cues and can mimic social interactions to fit in to a group and gain their respect. A social chameleon can encounter pushback when they are "caught" by their peers in their social mimicry.
- **Motivating Others:** They create a desire or ambition for a person to work towards achieving a goal set or being directed by the leader. They are also able to sustain the desire in others to continue their efforts, when obstacles or oppositions are encountered, until the goal is achieved.
- **Inspiring Others:** This leader induces positive emotions within a group/person to achieve a goal or become stronger/better individuals. The distinction between a motivator and an inspirer is that inspiration serves to create a positive feeling, but does not necessarily cause the person(s) to apply themselves to achieve the goal/improvement.
- **Serving Others:** The person serves a community or the needs of society. They are not leading for personal gain, but to help those in need or improve societal conditions. They solve problems in society through their technological or scientific advancements. They use the rewards of their success to help society.
- **Being a Communicator:** This person is assertive in their language and are confident when they speak. They are clear about their intentions when directing actions or asking others to contribute to the leaders efforts. They can clearly explain information to impart knowledge to

others. They speak in an understandable manner to those in the audience or to their team/group. They are approachable by others so that open discussions take place.

- Being a Thought Leader: This person proposes the future in technology, such as revolutionizing technology in an existing field, creating a new industry within technology, or solving critical societal needs by proposing new solutions using technology. Thought leaders are not self-designated, but are individuals that a group, such as experts within a field, refer to as the person who establishes the vision for the future and is widely accepted by the relevant community.
- Being Caring: This person cares for others and treats them as an individual. The leader tries to address the emotional needs of those on their team and takes into consideration their individual needs when making a decision or taking an action. This person is typically equitable or fair in their treatment of others.
- Having Empathy: A leader who understand the emotional state of those on their team or “gets me.” They can understand a person’s emotional situation and work around it.
- Being Stoic: This person maintains control of their emotions and remains calm in all situations.
- Being Prepared: This leader makes sure that the necessary resources or approvals are prepared in advance of working on a goal and/or are allocated in the correct places to achieve a set goal. They also prepare for problems in advance, so they have solutions available in order to achieve success.
- Succeeding: The leader has a demonstrated record of success in achieving a goal/vision.
- Taking Responsibility: A leader who accepts their share of responsibility for both a success and a failure.

Preliminary axial coding was performed using an intercategory analysis [7]. As a reference, gender research of predominantly White business students at the undergraduate and graduate level found that common prototypical attributes are considered as masculine and included having perseverance and conviction, being a strong communicator and having vision; while, some feminine attributes were associated with anti-prototypical attributes [8]. The masculine traits were consistent within this research. However, commonly perceived feminine attributes were also associated with a prototypical leader, such as having empathy, showing compassion, and serving others [8]. In addition, these findings appeared across different intersecting social groups (e.g. White male, URM female, URM male, etc.). Thus, there appears to be some broadening of prototypes based on gender among the millennial students in engineering. However, whether female attributes are viewed as prototypical when race/ethnicity is included, e.g. a White female vs. URM female or URM male, requires additional research to directly probe these intersections.

References

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