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People Like Me: Providing relatable and realistic role models for underrepresented minorities in STEM to increase their motivation and likelihood of success

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People Like Me:
Providing Relatable and Realistic Role Models for Underrepresented Minorities in STEM to Increase their Motivation and Likelihood of Success

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***Abstract* - Despite efforts to increase participation of racial and ethnic minorities (excluding Asians) in science, technology, engineering and mathematics (STEM) in the United States, this group remains underrepresented in these fields. Many efforts to increase minority participation focus on support structures to help this group "get through" the pipeline. However, less attention has been paid to increasing their intrinsic motivation to pursue careers in STEM. Our work is focused on increasing this intrinsic motivation, looking at role models as external influences. Underrepresented minorities are faced with a limited role model pool and in many cases with role models (who we call outliers) whose paths to success and extraordinary achievements are difficult to emulate for the large majority of students. In this study of a representative sample of underrepresented minority students at a predominantly white small private liberal arts university, we show that students are accepting of non-outlier role models who are relatable and embody the qualities typically associated with the existing role models that they value. The evidence suggests that a larger more diverse pool of role models, that represent more feasible paths to success, can be created for this group. We envision a "People Like Me" website based on such a pool as a tool for increasing motivation and persistence of underrepresented minorities in their pursuit of STEM professions.**

Index Terms – Motivation and success, Role models, Underrepresented minorities in STEM.

INTRODUCTION

The National Science Foundation's (NSF) National Center for Science and Engineering Statistics 2017 report on "Women, Minorities, and Persons with Disabilities in Science and Engineering" shows that ethnic and racial minorities (Asians excluded) are still underrepresented in the Science Technology Engineering and Mathematics (STEM) workforce [1]. According to this report, underrepresented minorities comprised about 32% of the working age population (18-64 years) in 2014 and earned about 20% of STEM degrees at the bachelors level, about 14% at the masters level, and about 8% at the doctorate level [1]. In 2015, they only constituted about 12.7% of the total STEM workforce [1].

There are many initiatives nationwide to encourage federally-recognized minorities in STEM to pursue STEM careers and to support them in this pursuit. The National Society of Black Engineers published a report in 2016 identifying nine different strategies for facilitating underrepresented minority engineering students' success [2]. Of the nine, seven are strategies that can be considered support structures. The other two strategies focus on what influences students' motivation to succeed: "positive self-efficacy development" and "positive identity development". Motivation, in particular intrinsic motivation, has been shown to be a big influence for persistence in STEM [3]. Self-efficacy and identity both play a role in motivation, and have been shown to have a big influence on minority students [4]-[6]. Students' positive self-efficacy and identity development can be impacted by the experiences of others in their field who are "like themselves" through any number of shared characteristics [7]-[9]. This leads us to the idea of a role model as a potential source of motivation to succeed for underrepresented minorities in STEM.

We are particularly interested in facilitating students' access to role models as a strategy for increasing their likelihood of success. Having race- and gender-matched role models, specifically, has been shown to result in higher academic achievement than having no role models or unmatched ones [10]. However, for underrepresented minority students in STEM, disciplinary role models are limited. Furthermore, many of the more visible potential role models tend to be what we call outliers: individuals who are extraordinarily successful (enjoying more of a celebrity status in their field), often through unique circumstances. This makes their path to success extremely difficult to emulate.

Our aim is to provide underrepresented minority students a wider pool of role models that represent more feasible paths to success. We believe that although the individuals in this pool (who we call non-outliers) have less extraordinary stories, they still possess the qualities students value in the outlier role models. In previous work, we identified these

qualities for a representative sample of underrepresented minority students, majoring in STEM, at a small private liberal arts university. We subsequently used this information to identify individuals who are apt to serve as potential role models with the intention of constructing a pool of non-outlier role models [11]. Here, we describe our approach to and results from testing students' acceptance of the proposed non-outlier role models pool.

Our results indicate that students are accepting of these non-outlier role models. Based on these results, we are interested in developing and testing a "People Like Me" website at the same institution. This website will contain profiles of non-outliers that we have identified to have the role model qualities desired by our student sample (Achieved Success, Constant Improvement & Resilience, Moral Character, Relatable, and Empathetic & Helpful) which are described in previous work [11]. We are particularly interested in whether this website is useful in recruitment and retention of underrepresented minorities in STEM and, in the longer term, whether it may serve as a motivational tool for persisting in STEM careers. Should we obtain positive results, we hope other institutions (both educational and workplaces) could develop their own "People Like Me" website to help with recruitment and retention efforts and help increase the representation of minorities in STEM.

STUDY DESIGN

The overall study consisted of three parts. The first two parts, described in our previous work, included identifying and verifying the qualities underrepresented minority students seek in role models [11]. The third part of the study, described here, focuses on development and testing of the non-outlier role model pool.

I. Participants

The participants consisted of students and alumni from a small private liberal arts university with a predominantly white population. To be eligible, participants had to come from one of the groups identified by the NSF as underrepresented in STEM. This definition includes Black, Hispanic/Latino, Mixed Race, Native American, and excludes, White, Asian and international students. In addition, participants had to be pursuing or have obtained a degree in one of the NSF-recognized STEM disciplines, which at this institution includes Animal Behavior, Applied Mathematical Sciences, Biology, Biomedical Engineering, Cell Biology/Biochemistry, Chemical Engineering, Chemistry, Civil Engineering, Computer Engineering, Computer Science & Engineering, Computer Science, Electrical Engineering, Geology, Mathematics, Mechanical Engineering, Neuroscience, and Physics.

Ia. Students

Student participants signed up to participate in all three parts of the study. Each student participant received a $25 gift card upon signing the consent form, not conditional on future participation. Of the 129 students at the institution who met our eligibility criteria, 18 initially agreed to participate. One dropped out before the study began due to scheduling issues, and another dropped out after the first part due to time constraints in their schedule. Our early results in [11] are based on the responses from the participants we had at each point (17 in the first part and 16 in the second part), and we received 10 responses for the last part of the study described here.

The pool of ten students in this third part of the study was diverse in terms of majors across the STEM spectrum (three in science from three different majors, six in engineering from four different majors, and one in mathematics), class year at the beginning of the study (three first years, four sophomores, two juniors, and one senior), race and ethnicities (Hispanic/Latino, Black/African American and Multiple Races), and traditional gender (six males and four females). Three participants graduated (the two juniors and one senior at the beginning) during the study.

Ib. Alumni

We chose alumni as the population from which to develop the non-outlier role model pool for this study in an effort to create an immediate point of relatability for the student participants. The quality "Relatable" is one of the five prominent qualities of a role model our student participants identified, as described in previous work [11]. We should note here that none of the participants (students or alumni) were aware of the qualities throughout the study (neither the names of the qualities or the fact that five prominent ones were identified).

Alumni participants were recruited in a three-step process. We contacted alumni from a list provided by the alumni relations office and the first step for interested respondents was to identify whether they were a U.S. citizen throughout their time at the institution. Unlike the student participants, we could not obtain citizenship status information at the time of enrollment at the institution for alumni Those who met the U.S. citizenship criteria then completed a survey that was designed to highlight their experiences that related to the five prominent qualities of role models valued by our student participant sample. We received 10 responses with sufficient information to create a meaningful potential role model profile, which we then presented to our student participants.

The pool of the ten alumni was very diverse in terms of majors across the STEM spectrum (four different types of engineers, three types of sciences, one math), graduation years (between 1962 and 2016), ethnicities (Hispanic/Latino, Black/African American and Multiple Races) and traditional gender (six males and four females). This diversity in background was especially important for the quality of "Relatable" since it increased the likelihood that students might find at least one alum who shared a similar background.

II. Proposed Role Model Profiles

IIa. Alumni Profiles

We used the alumni responses to create individual profiles that consisted of biographical information (including a

headshot if the respondent chose to provide and share one with the student participants) and seven short paragraphs, grouped as follows:

- A time I felt successful in my professional career: describing a success story from the alum's professional career in terms of action, decisions, personal development, outcomes, as well as challenges; this also included managing personal life at such times, particularly relationships with family and friends. *Quality highlighted:* Achieved Success
- A time I failed: describing a failure in a professional setting including the alum's feelings at the time and how they dealt with the failure and worked past it. *Quality highlighted:* "Constant Improvement & Resilience"
- A time I made a change to stand by my values: describing a time when the alum took a risk or made a crucial change in a professional context in order to stand by their values and/or beliefs. *Quality highlighted:* "Moral Character"
- My passions within professional work: describing the passion and drive the alum has in their professional work. *Quality highlighted:* "Constant Improvement & Resilience"
- What is was like (a) entering the institution, (b) at the institution (c) after graduating from the institution: describing what it was like for the alum academically and socially coming from their high school/community to the institution and how they managed the transition; what motivated the alum in college, what they aspired to become, and what mattered to them; and what it was like transitioning to the workforce from the institution. *Quality highlighted:* "Relatable."
- Giving back: describing any involvement the alum may have had in giving back to their community or towards another good cause, their motivation to get involved, and what the experience was like. *Quality highlighted:* "Empathetic and Helpful."
- My family: describing what kind of relationship the alum has with their family and how they maintain this relationship. *Quality highlighted:* "Empathetic and Helpful."

Figure I on the next page shows an example of a gender-neutral profile, created from (slightly-modified) answers from different respondents with a silhouette as the headshot. For profiles where the role model did not provide a headshot, that space was left blank.

The profiles are intended to show a brief, yet holistic, picture of the role model candidate, including their personal and professional lives and any interaction between the two, while highlighting the five different role model qualities. The presentation format provided a consistent structure to the story, which helped student participants in both navigating individual profiles as well as comparing profiles.

IIb. Student Profiles

Our previous work [11] showed that some students consider themselves to be role models as well. From that work, we had collected information from student participants that allowed us to create student profiles as well. The student profiles consisted of biographical information and four short paragraphs (each highlighting one of the qualities besides "Relatable") grouped as follows:

- A time I succeeded: describing an achievement of the student. *Quality Highlighted:* "Achieved Success."
- My values: describing values that the students holds most strongly and a time when they significantly expressed those values. *Quality Highlighted:* "Moral Character"
- A time I didn't give up: describing a time the student did not succeed at something the first time but gave it another try. *Quality Highlighted:* "Constant Improvement & Resilience."
- Giving back: describing how the student engages with their family, friends, and/or community. *Quality Highlighted:* "Empathetic & Helpful."

The student profiles were intended to match the alumni profiles in terms of structure as much as possible within the limitations of information available from the first two parts of the study. We did not seek additional information from the student participants as the development of this idea of "myself as a role model" was something we did not want to reveal until the pertinent portion of the study.

III. Role Model Aptness Survey

We distributed a role model aptness survey to our student participants. Those who had provided enough information for us to develop a student profile (nine participants) were presented with 11 profiles, 10 profiles of alumni and their own profile. Those who had not (one participant), were presented with 10 profiles of alumni. They were asked to state if they believe each of the profiles fit, is neutral to, or does not fit, their idea of a role model and to explain their stance on each profile. The students were then asked to share which attributes they recognized within the individuals that they perceived as apt to serve as role models.

Lastly, the final question in the survey sought to understand what was helpful in the way the profiles were presented, for future replication of the study and for the design of profiles on the future "People Like Me" website. In addition, as exactly half the alumni participants, five out of ten, provided headshots, we had an opportunity to look at whether this may create bias or otherwise influence student perceptions. Also, one alum asked that their identifying information not be shared so their profile was reworked to not reveal their identity. The student insight on how the profile presentation influenced their judgment is most valuable in future designs of role model profiles.

A Time I Felt Successful in My Professional Career: I was managing a project with a very significant public component. I learned to do interviews, media work, etc. it was very much outside the "normal" engineering box. I began giving lots of presentations, and received a lot of positive feedback. I had to make a choice to step outside my comfort zone and embrace this different role. It worked out really well for me, and I think my ability to communicate technical subjects to people without a technical background is a lot of the reason I have the job I have now.	**Biographical Info:** *Name:* Taylor Ford *Graduation Year: 1994* *Major:* Mechanical Engineering *Extracurricular Activities:* Varsity basketball, Greek Life, Staff writer and columnist for the University newspaper, History TA *Ethnicity:* Black/African American; Multiple Races *I Grew Up in:* A suburb area in New Jersey *Professional Background:* Staff Engineer, INTERMetro Design Engineer, Precision Castparts Corp. Project Engineer, Ford Motor Company	**Entering the University:** The University was very different than my high school community both socially and academically, but mostly academically. The average caliber of student was significantly higher than that of my high school. I managed the transition by developing my group of friends based on personality. Those with whom I got along with were, coincidentally, at different levels academically as they had all come from very different backgrounds. This was very helpful. **At the University:** Proving to my family and myself that I could be successful motivated me. While Academics were important to me, I wanted to make sure that I truly enjoyed my four years in school. I did not have a clear picture of where my career would lead long term, but I wanted to be a design engineer. **After the University:** I believe that the University prepared my very well for work as an engineer. One of the things that I found great about it, was that I felt prepared not only academically, but also socially.
A Time I Failed: I was laid off in 2002, and I felt like an incredible failure, even though nearly 20% of my company was laid off at the same time. It was embarrassing, even though in hindsight there was not to be embarrassed about. One of my dad's great life lessons has always been, "Play the cards you're dealt, because it's the only hand you've got." I was upset when I was laid off, but the next day I was calling contacts and doing everything I could to get another job. It turns out the job I got, right after, set me up perfectly to get a position later in a new city. If I had not been laid off, I never would have moved and gained the experience needed to excel at a larger utility. I can say with full confidence that getting laid off is one of the best things that ever happened to me.		**Giving Back:** I have supported and advised high school and college students regarding educational and career opportunities. Have worked with a big organization by reviewing grant request proposals from local organizations. I always enjoy meeting with students, hearing their plans for the future and providing input or feedback that can help them. Working with a big organization, I'm able to leverage the business knowledge I've gained to support a non-profit organization. My primary motivation in giving to the community is to meet what I consider my obligation to give back for what I have received.
A Time I Made A Change to Stand by My Values: I chose to leave a leadership position/role because the organization's financial requirements to reduce expense through staff reductions/layoffs became a personal burden due to the impact on team members.	**My Passions Within My Professional Work:** **In terms of my professional life, my passions** fall into two main categories: fixing broken processes and understanding how people make decisions. As a result, I find myself attracted to the type of work where I must not only solve problems, but win buy-in from people when implementing solutions.	**My Family:** I am very close with my family, which an aspect of life that is very important to me. After graduating from the University, I moved away from where I grew up and currently live between 2 and 5 hours away from most of my family members. I maintain my connection with family by always making the effort to stay in contact (via periodic phone calls) and attending, in person, as many special occasions as possible (holidays, birthdays, graduations, etc.).

FIGURE I
EXAMPLE ALUMNI PROFILE

RESULTS AND DISCUSSION

I. Aptness of Candidates in the Pool to Serve as Role Models

When presented with the candidate role model profiles, nine out of ten student participants found two or more in the pool (including themselves) apt to serve as role models. In addition, each alum had three or more students indicating that they fit their idea of a role model. In fact, seven out of the ten alumni had five or more students indicate that they fit with one alumni having eight of the ten students indicate that they fit. Some students described candidates as general role models, but not necessarily a good fit for them personally. In those cases, some students marked those candidates in the pool as fit and others marked them as neutral to their idea of a role model, but the accompanying qualitative data allowed us to control for this varying use of the fit scale.

Of the nine participants who were presented with a profile of themselves, five said they fit their idea of a role model, two said they did "not fit", one said they were "neutral", and one did not provide any answer. Of the five that said they "fit" their idea of a role model, three saw similar qualities in themselves that they value in role models. As for the other two, one found inspiration in potentially being a role model for others, and the other found motivation in the qualities they saw in themselves. The two who said they did "not fit" as a role model gave the reasons "I feel like I can't consider myself a suitable role model or not. That's not my right to determine in my opinion." and "I don't feel like I'm a very good role model."

When students were asked why they considered a particular candidate as fit, neutral, or does not fit their idea of a role model, most of the answers were about how "Relatable" the candidate was. We discuss this more in the next section.

When students were asked to note which attributes they recognized within the individuals that they selected as apt to serve as role models (fit), they provided a diverse range of answers with no one quality that was consistent across all students in their reasons for selecting particular individuals. While they did not specify the qualities we have identified explicitly (as a reminder, these were never revealed to participants), the majority of their responses could be directly linked to one of the five qualities. Below are two sample responses of participants, which we believe the first can show a direct link to the quality of "Constant Improvement & Resilience" and the second can show a direct link to "Empathetic & Helpful and Moral Character."

- "having successes and failures and learning from them, feelings of self doubt or frustration, striving towards the future"
- "The biggest factor for me was if a person takes numerous time out of their days to help others. Introspection is very important to me and that was something I was looking for in the profiles."

II. Relatability as a Key Factor

As mentioned previously, when explaining why a profile was fit to serve as a role model, student participants often noted that they have similar background, interests, and/or passions. This theme of "Relatable" was also evident when participants stated that a profile is neutral or does not fit their idea of a role model. They often echoed a difficulty with relating to the potential role model. Below, is an example of participant's explanation to the lack of fit of a profile: "She seemed very goal driven but she didn't seem that relatable to me. I couldn't find much in her bio that we shared in common." In fact the one student who did not find any of the alumni to fit their idea of a role model gave their reason in all cases as "I could not relate to them."

Interestingly, when asked specifically about the "qualities" (what we have termed "attributes" before to avoid confusion) they saw in the individuals they selected as a fit, relatability was not mentioned as much. This is probably because relatable is more circumstantial than an actual characteristic of a person. That is, having empathy, for example, is a trait that one can possess, being relatable is something that will vary with audience. Thus, participants might not be considering "Relatable" a quality as we have identified, even though it is a key factor in their decision-making.

III. Structure and Presentation of Profiles

Students seemed to appreciate having the story broken down into explicit sections, as well as the consistency of structure it provided for all the profiles. However, one student noted that formatting the sections as a table made it difficult to navigate within a profile. Two students wondered if presenting biographical information last or removing pieces that hinted at identity characteristics like gender would affect their responses. One of two noted that most of the candidates who fit his idea of a role model were male like himself. These responses seem to suggest that those students were more interested in the person's story than the person themselves, but may have felt influenced by identity characteristics.

Providing a headshot did not seem to make an alum more likely to be indicated as a fit. The alum with the most students indicating that they fit their idea of a role model did not provide a headshot. In fact, the alumni with headshots on average had fewer students indicating that they fit their idea of a role model than those without headshots. It is also interesting to note that the student who mentioned that the "photos helped 'connect' a little better with [the alumni]" had five alumni out of the six they chose as those who fit without headshots. One student did say that "Pictures may have pushed me towards biases. Different people presented themselves differently, and I based a lot of my decision on how they chose to talk about themselves" though they did not indicate how the pictures biased their decisions. It is possible that a lack of headshot made an alum more relatable by allowing the student the freedom to see the individual as they

chose. Also, keeping personal information confidential did not seem to affect that particular alum's chances of being selected as fit: five out of the ten students indicated that that alum fit their idea of a role model.

CONCLUSIONS AND FUTURE WORK

The results seem to indicate that students are accepting of non-outlier individuals as role models when these individuals are relatable and possess the qualities they value in a role model. This suggests that it is possible to create larger and diverse pools of role models for underrepresented minorities in STEM who represent a wide range of examples of feasible paths to success. Such a pool could influence student positive self-efficacy and positive self-identity development and potentially increase intrinsic motivation to pursue and persist in STEM. The next planned step in our work is examining whether this is the case.

We have begun conversations with the Admissions office at the same institution to develop a study that explores the effect of a "People Like Me" website on STEM student recruitment efforts. The website is intended to feature profiles of current students and alumni of the institution that are presented much like those we used here, modified based on the feedback we have received from participants. We would be interested in whether the website influences potential applicants' decision to apply to the institution and to enroll should they be admitted. The key issue to resolve here is how to separate the effects of the website from other existing or new efforts by the admissions office to increase the diversity of the applicant pool and entering class.

We also intend to work with Student Affairs at the same institution to evaluate the effect of a similar website on STEM student retention. The same issues in the admissions case apply here. Should we find the website to be effective, we intend to work with other institutions and workplaces to replicate the study to understand how the "People Like Me" concept applies in contexts beyond our initial study institution. Should these future studies also yield positive results, we intend to develop a toolkit based on our experiences to share with academic institutions and workplaces so they can reap the benefits of creating their own "People Like Me" website.

A question that has come up in discussions of our work with others and in our own reflection is how can the "People Like Me" concept help in effective mentorship? In fact, after presenting our previous work, we were approached by a colleague at another institution interested in using this approach to select student mentors for study groups (Trenshaw, Kyle F., personal communication, October 19, 2017). We anticipate more complexity in exploring the mentorship question because of the fact that the mentor must engage directly with the mentee with the aim of helping in the mentee's professional and/or personal development. This is in contrast to the pure role model case (where the role model is not also a mentor) where direct engagement is not required, rather individuals engage more with the experiences of the role model from afar. In this case, even when direct engagement exists, it is not with the aim of helping the individual develop. We believe the "People Like Me" concept can play a role in mentorship, at the very least in the matching process, and we hope to explore the various ways it can help soon.

GENERAL TAKE AWAY LESSONS

Individuals in a position to _____ role models, should consider the following:

1. designate
- Role models need not to be necessarily individuals with extraordinary stories.
- Being relatable is an indispensable aspect of a role model.
- Students' perception of success goes far beyond professional achievements.

2. serve as
- A holistic approach to the different qualities you portray is desired, including failures and struggles.
- Transparency and honesty is appreciated.
- Put yourself out there to those who have the potential of finding common ground with you.

3. seek
- Identify the qualities that matter to you, to help you find more suitable role models.
- Try to see in yourself a potential role model.
- Be attentive that your role models motivate and not discourage you.

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