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# Textual comparison of role model and mentor profiles developed to increase participation of underrepresented minorities in STEM

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**Abstract**— This research work-in-progress paper is part of a larger project that aims to develop personal values-based matching of role models, mentors, and coaches with the populations they serve. In previous work, we developed a process for generating profiles of role models that reflected the values of the population the role models were serving (underrepresented minority students in STEM). In short, we performed qualitative emergent thematic analysis on focus group data from underrepresented minorities in STEM to identify the qualities this population valued in role models. These qualities were used to develop a survey for potential role models (STEM alumni of the same institution) and the survey was subsequently used to develop profiles for the role model candidates. These profiles were well received by our original focus group participants. We have since run an analogous study at another institution using nearly the same survey to develop profiles of potential mentors. Here the mentors are upperclassmen, and the population they are serving includes all students in introductory STEM courses, though we remain particularly interested in underrepresented minorities. In this paper we present a simple textual comparison of the two sets of profiles as a first step in a comparative analysis of these profiles. The results will inform future work as we seek to further differentiate between role models, mentors, and coaches, and develop a robust method for increasing access to/successful matching of these important support structures and the students who need them.

**Keywords**—systemically marginalized students, mentors, role models, underrepresented minorities, URM students

## I. BACKGROUND

In addition to the innate challenges of pursuing advanced degrees, underrepresented minorities (URMs) in STEM can face additional challenges related to their identities [1]. These include, but are not limited to, imposter syndrome and a lacking sense of belonging. Role models, mentors, and coaches are different forms of support relationships that can positively impact achievement of a variety of goals [2-3]. Here, we differentiate role models, mentors, and coaches with the following definitions: A *role model* inspires from a distance; they are seen by their junior in a particular context, but no personal relationship or interaction exists. A *mentor* engages with their mentee and is often an established individual whose own career is unaffected by the mentee's

success. A *coach*, the closest relationship, has “skin in the game;” their personal or professional success is tied to the success of those they coach.

While these relationships can be impactful, they largely depend on the quality of the match between the role model, mentor, or coach and the individual they are supporting (their junior). Matches can be dictated by convenience, availability, and perceived (often surface-level) similarities between individuals. A good match can provide essential support, whereas a poor match can leave an individual feeling continued (or increased) isolation. Access is another potential issue. By nature, there are fewer URMs in STEM compared to other populations [4], and thus, limited individuals to serve in these capacities when seeking demographics-based matches.

In an attempt to increase access to support structures for URMs specifically to role models, our previous work focused on identifying what URM students in STEM at a small, private, liberal arts institution valued in role models. Through a series of focus-groups and subsequent qualitative emergent thematic analysis, we identified five qualities (reported in previous work) that were valued by our URM student population [5]. We then surveyed potential role models (university alumni who themselves are URMs in STEM, based on evidence that race- and gender-matched role models may be more effective [6-9]) and created role model profiles that inherently highlighted the aforementioned qualities. Ultimately, we found that students viewed the individuals presented in these profiles as apt to serve as role models, confirming the effectiveness of our methodology [10].

In subsequent work, we have applied our findings to a mentoring relationship at another institution. Here, near-peer student mentors involved in teaching the peer-led team learning (PLTL) components of introductory STEM courses were given an almost identical survey to that previously used for alumni. These surveys were used to generate peer leader profiles that were made available to the registered students at the beginning of the semester. The goal of this work was to increase URM attendance during small-group, collaborative problem-solving sessions (using problem set sessions similar to what is often referred to as recitation, but with more emphasis on near-peer facilitated collaboration among

students), as the institution has evidence that session attendance is directly correlated with course performance and that URM students largely do not attend these beneficial sessions [11-12]. While analysis of this data is ongoing, preliminary results show higher session attendance from students who viewed the peer leader profiles, and that URM students attended more workshops on average than their majority population peers [13].

The results of these two studies are highly encouraging as we seek to strengthen support structures for URM students in STEM. We believe that this values-based approach to presenting potential role models, mentors, and eventually coaches, has great potential to increase the impact of these support structures.

Having used nearly the same survey to generate role model and mentor profiles in these two different cases presents a unique opportunity for comparative analysis of how potential role models and mentors answer these questions depending on their relative position to their audience. We are in preliminary stages of this comparative analysis, and, in this work, present simple textual comparison to gather a sense of the language used by the two groups as a precursor to in-depth qualitative analysis (described further in Conclusions and Future Work).

The profiles for the role model case were developed for a small, private liberal arts institution and intended to increase visibility of realistic role models for URM students in STEM. The potential role models were aware of whom their profiles were intended for, and the broad goals of the work. The profiles for the mentor case were developed for a study at a large, private research university looking at whether profiles made peer leaders for introductory STEM courses more relatable and encouraged URM students, who historically have had low attendance at these workshops, to attend more. Here, the potential mentors knew the profiles were intended for their workshop participants; however, they did not know of our specific interest in underrepresented minorities' attendance. These different populations (potential role models and potential mentors) answered similar questions, but had a different relation to their audience. The alumni knew they would likely never interact with the students who saw their profile, whereas the mentors would be interacting with their audience regularly. Additionally, the alumni are several years (sometimes decades) removed from their audience's experience, whereas the mentors have very recently been in their audiences' position. We are interested in how these differences in relative positioning between the potential role model/mentor and audience are reflected in their survey responses.

## II. METHOD

As this first step toward exploring how the survey responses differed between the two institutions, the raw data were input into the text analysis tool AntWordProfiler to compare the frequency with which words occurred [14]. The tool checks user-input files against a list of common words and totals the frequency of those words in each file. Survey response data were input into the tool in a spreadsheet format with the headings and extraneous text deleted. The survey

response data have been described in detail in previous publications [5, 10, 13] and will only be briefly summarized here for clarity. The role model case data includes 10 survey responses (10706 words total) from STEM alumni at a small, private liberal arts university, and the mentor case data includes 29 survey responses (26848 words total) from peer leaders in introductory STEM courses at a large, private research university. A comparison of the questions between the two surveys is shown in Table I.

While the STEM alumni were asked to respond to all questions, only two of the long-answer questions in the peer leader survey were required, as seen in **bold** on Table I. Peer leaders were encouraged to respond to as many questions as they felt comfortable. On average, peer leaders responded to 7 out of the 12 possible long-answer questions. The number of total words within the responses was used to weight the frequency counts generated by the AntWordProfiler analysis for direct comparison between the two data sets.

TABLE I. SURVEY QUESTIONS COMPARED

Role model Case	Mentor Case
Within the realm of your professional work, what is your passion? What drives you?	Within the realm of your work/studies, what is your passion? What drives you?
Do you have a close connection with your family? If so, please share how you maintain and support this connection and what it means to you.	Do you have close connections (with family and/or others)? Share how you maintain and support these connections and what they mean to you:
Describe your the community and area you grew up in. (please include the specific geographic location(s))	Describe the community/area you grew up in:
What motivated you in college? What did you aspire to become? What mattered to you?	What motivates you at <University Name>? What matters to you? <b>What do you aspire to become?</b>
What was it like coming to [college] from your high school/community socially and academically? How did you manage each aspect of the transition?	What was it like coming to the <University Name> from your high school and/or community, socially and academically? How did you manage each aspect of the transition?
Have you ever been involved in giving back to your community? Or taking action towards a good cause? If so, please tell about what it was like and what motivated you to do so.	Have you ever been involved in giving back to your community or taking action toward a good cause? Please tell about what it was like and what motivated you to do so:
Have you ever failed professionally? If so, please share how you felt and explain how you dealt with it and worked past it.	<b>Have you ever failed professionally/academically? Share how you felt and explain how you dealt with it and worked past it:</b>
Tell of a time that you took a risk or made a crucial change in a professional context in order for you to stand by your values and/or beliefs	Talk about a time you took a risk or made a crucial change in a professional/academic context in order for you to stand by your values and/or beliefs:
Extracurricular Activity	What kinds of extracurriculars are you involved with?

Role model Case	Mentor Case
Think of a time that you felt successful in your professional career. Please share your challenges and the way you handled your personal life at the time in terms of relationships with family and friends.	Thinking of a time you felt successful, share your challenges and the way you handled your personal life at the time in terms of relationships with family and friends:
Think of a time that you felt successful in your professional career. Please describe what your success entailed in terms of courses of action, decisions, personal development, outcomes.	Thinking of a time you felt successful, describe what your success entailed in terms of courses of action, decisions, personal development, and outcomes:
What was it like leaving [institution] and going into your workplace?	[no similar question]

Because this analysis is a work-in-progress and qualitative data analysis is still ongoing, we report only the single-word frequency comparisons performed through AntWordProfiler here. We acknowledge the limitation that single words can have multiple meanings and be taken out of context such that a one-to-one comparison of usage between two individuals or even two different instances within the same individual’s survey responses is difficult. However, we are not particularly concerned with this limitation as this is a preliminary analysis from which we are not drawing and do not intend to draw conclusive data. We instead seek greater familiarity with the language used by the two populations prior to further qualitative analysis. We also note that because 28 of the 29 peer leaders elected not to answer at least one survey question, the body of text generated by their responses is weighted toward particular questions in a way that the alumni survey responses are not to the same extent; however, many of the questions highlight interrelated concepts, so we feel that similarities are still productive to discuss and differences may highlight emergent themes among the responses from the different populations. We do believe that the populations are sufficiently comparable for this level of preliminary analysis, and will address this limitation in future work by comparing the findings that appear from the single-word comparisons to themes that emerge from deeper qualitative analysis.

### III. PRELIMINARY RESULTS

The weighted frequency of words from the role model and mentor profile data correlated positively and significantly ( $r(1163) = .72, p < .0001$ ), that is, there was a great degree of similarity in word frequency between the populations. However, this correlation included all words found in the data. To meaningfully compare the two data sets, several categories of words were removed from consideration, including prepositions (e.g., at, around, in, etc.), time-related words (e.g., always, sometimes, etc.), question words (how, what, when, etc.), and other nondescript words that do not convey inherent meaning without additional context (e.g., very, really, things, etc.). Words that appeared less than 0.05% of the time in either of the data sets were also removed. After these removals, the correlation between the two data sets decreased, but remained positive and significant ( $r(128) = 0.60, p < .0001$ ).

To further explore the differences after common, less meaningful words were excluded, themes within meaningful words that appeared at least twice as many times (weighted by total number of words) in one data set compared to the other were considered. The full list is shown in Table II. Some notable differences emerged related to the situational differences between the alumni and peer leaders. For example, the word “engineer” appears 45 times more often in the role model data set; indeed, the alumni population was more engineer-heavy, while the peer leaders were from more varied STEM and non-STEM disciplines. Further, the difference between alumni and upper-level students is evident; contrast words like “job,” “professional,” and “career” from the alumni with words like “course,” “club,” and “learn” from the upper-level students. These differences reflect the different roles and activities of a professional versus a student. Another notable difference is “teach” from the peer leaders compared to “organize,” “manage,” and “direct” from the alumni; all four words speak to leadership, just in different contexts.

TABLE II. SURVEY QUESTIONS COMPARED

Role model Case	Multiplier	Mentor Case	Multiplier
Engineer	45.1	Place	18/0*
Job	7.1	Realise	18/0*
Team	6.3	Course	14/0*
Current	5.9	Play	14/0*
Career	4.7	Love	8.8
Direct	4.0	Teach	7.2
Organize	3.8	Town	6.0
Stay	3.5	Club	4.0
Role	3.5	Goal	3.8
Science	3.2	End	3.6
Professors	3.0	Transit	3.0
Effort	2.9	Passion	2.8
Challenge	2.9	Learn	2.1
Professional	2.8		
Need	2.8		
Enjoy	2.8		
Matter	2.8		
Manage	2.7		
Connect	2.7		
Theme	2.5		
New	2.5		
Child	2.5		
Call	2.5		
Work	2.4		
Understand	2.2		
Summer	2.2		
Develop	2.1		
Choose	2.1		

Role model Case	Multiplier	Mentor Case	Multiplier
Change	2.1		
Move	2.0		
*Reported as the unweighted frequency divided by zero because no instances occurred in the Role model Case data set, and ratios were as such undefined.			

#### IV. CONCLUSIONS AND FUTURE WORK

These preliminary results indicate that, at the single-word level, STEM alumni and peer leaders in introductory STEM courses respond similarly to surveys about their personal journeys through academic and professional life. The differences observed appeared to come more from the contextual differences between the two groups than any substantive differences.

This analysis is a first step in our qualitative analysis. Next, we plan to complete a detailed emergent thematic analysis of the survey responses. In this future work we will directly code the original survey response (full clauses, sentences, or sections) and group into emergent themes. After our single-word level analysis we will pay particular attention to the context of the emergent themes, something we likely would otherwise have overlooked. We will look at emergent themes for the entire survey set for each population, as well as themes by question. The latter will address the limitation that the mentors were not required to answer each question, and thus their aggregate responses may be weighted towards particular questions. This analysis will also explore correlations between themes in response and demographic of the potential role model or mentor. As mentioned, the alumni in the role model study were themselves URMs (specifically Hispanic/Latino, Black/African American, or Multiple Races). By contrast, the peer leaders were predominantly from majority populations in STEM (25 of 29 identifying as either “Asian” or “White”). These combined analyses will provide greater insight into how potential role models, mentors, and coaches may describe their experiences based upon their relationship to their audience, and whether certain themes in experience are prevalent among specific racial or ethnic groups. Ultimately, this will inform future work in which we continue to increase access to and impact of the support structures of role models, mentors, and coaches.

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