



The Portia Hypothesis: Mechanical Engineering Student Perceptions of Qualifications

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Abstract

The Portia Hypothesis, named for Shakespeare's Portia in *The Merchant of Venice* who disguises herself as a man so as to be able to participate in legal proceedings, postulates that individuals with masculine first names are more likely to be successful in legal professions. Various studies have demonstrated this effect in hiring for legal (Coffey & McLaughlin, 2009), musical (Goldin and Rouse, 1997), academic psychology (Steinpreis *et al*, 1999), and STEM fields (Moss-Racusin *et al*, 2012; Davidson, 2015) amongst others (Acosta and Callahan, n.d.). Racial discrimination has been similarly demonstrated in resume reviews (Bertrand & Mullainathan, 2003; Oreopoulos, 2011; Turczynski, 2019). Racial and/or gender bias is apparent in letters of recommendation (Dutt *et al*, 2016; Schmader *et al*, 2007; Trix & Psenka, 2003), awarding of research grants (Ginther *et al*, 2011), standards of competence (Biernat & Kobrynowicz, 1997), performance evaluations (Sackett, 1991), and hiring (Georgi, 2000; Sagaria, 2002).

Students are victims of these biases, resulting in stereotype threat potentially effecting field selection (Storage *et al*, 2016), classroom performance (Keller, 2007), and creating a perception amongst some students that they need to "whiten" their resumes (Kang *et al*, 2016) to be competitive in their job search. At the same time, students continue to propagate these biases. As noted in a recent *Physics Today* article on student evaluations of teaching (SETs), "The degree of disparity varies by discipline, course, level, institution, and other factors, but across the board, SETs penalize women, underrepresented minorities, nonnative English speakers, and older and physically less attractive instructors of both sexes," (Feder, 2020).

It is therefore of great interest to better understand the conscious or unconscious biases present in modern day students with respect to race and gender. Through understanding the biases of current students, one can better anticipate the intervention needs of the future workforce. For example, a recent study of nursing and psychology students identified an implicit bias against overweight individuals which enabled identification of possible nursing curricular revisions, such as teaching future nurses about the experiences of obese patients and methods to communicate "evidence-based recommendations for weight loss without stigmatizing patients," (Waller *et al*, 2012). Study of engineering student race and gender biases prior to entering the workforce will help inform educational interventions that may be taken to mitigate long-term effects of such biases on the workforce of the future.

With that in mind, and to frame a classroom discussion on diversity and inclusion, students in a required senior-level Mechanical Engineering course at George Mason University were provided one of two resumes to review. The two resumes contained either a typically female or male first name but were otherwise identical. When asked to provide both quantitative and qualitative assessment of qualifications of the two candidates, participating students gave the female resume lower quantitative marks and honed in on non-technical and language skills more so than they did in their evaluations of the male candidate. This paper presents the findings of this initial study and outlines a path toward a more comprehensive look at gender-bias in engineering student perceptions of qualifications.

Introduction

In the Fall of 2019, the author taught a required, senior-level mechanical engineering course intended to develop student career readiness through discussions and guest lectures on topics such as ethics, codes and standards, financial management, business conduct, leadership, communication, etc. . . . Early in the semester, the students were asked to update, peer review, and submit copies of their resume as an assignment. Under the auspices of “another resume exercise,” in opening to a lecture on diversity and inclusion, the author provided each student in attendance one of two resumes. The resumes, provided in Appendices A & B, were developed to reflect experiences familiar to students at the author’s institution, and were identical with the exception of utilizing a traditionally female vice traditionally male first name. The resumes were distributed to students in attendance randomly. Students were given approximately 5-10 minutes to review the resume then, using real-time polling software *Poll Everywhere* (2019) asked one quantitative and one qualitative question regarding the qualifications reflected in the resume before them.

Findings

A total of 36 students participated in this exercise. Students who received Candidate 1’s resume (first name on resume: “Julie”) were asked “You are the recruiter at a defense contractor seeking to fill an entry level structural engineering position. How likely are you to offer Candidate 1 an interview?” Students were provided response options on a 5-point Likert-type scale, which was displayed as a bar chart in real time for the class. As shown in Figure 1, no students indicated a “Very high likelihood” of offering Candidate 1 an interview and one student indicated a “Very low likelihood” of offering Candidate 1 an interview. Weighting responses on a scale of 1-5, 5 correlating to the highest rating, Candidate 1 received a mean evaluation of 3.35. Students were then asked “What traits stood out about Candidate 1?” The results were displayed in real-time in the form of a word cloud, in which repetition of the same word causes the word to grow larger on the display, with final result as shown in Figure 2. Respondents particularly noted Candidate 1’s experience and language skills.

You are the recruiter at a defense contractor seeking to fill an entry level structural engineering position. How likely are you to offer Candidate 1 an interview?



Figure 1: Quantitative evaluation of Candidate 1 (“Julie”); N=20.

What traits stood out about Candidate 1?



Figure 2: Qualitative evaluation of Candidate 1 (“Julie”).

The same questions were then posed to the students reviewing Candidate 2 (“John”)’s resume. Three students indicated a “Very high likelihood” of offering Candidate 2 an interview, while no students selected “Very low likelihood” for Candidate 2’s interview prospects. Candidate 2’s weighted mean evaluation was 3.44. When asked which traits stood out about Candidate 2, experience was again the most commonly included response, but the student evaluators also remarked on Candidate 2’s capstone project and programming language skills.

You are the recruiter at a defense contractor seeking to fill an entry level structural engineering position. How likely are you to offer Candidate 2 an interview?

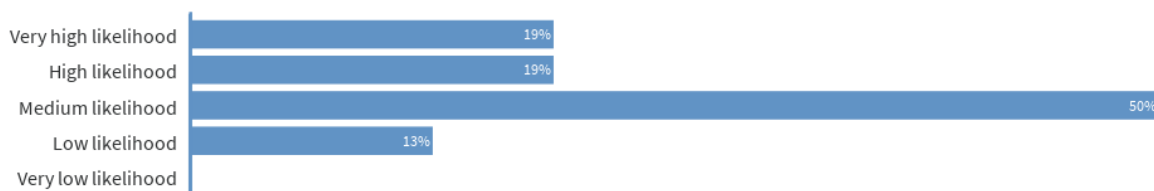


Figure 3: Quantitative evaluation of Candidate 2 (“John”); N=16.

What traits stood out about Candidate 2?



Figure 4: Qualitative evaluation of Candidate 2 (“John”).

Coding the qualitative traits assessment for each of the candidates highlights the disparity between non-technical and language skills for “Julie” vice technical and business skills for “John.” A summary of the coding approach with findings is presented in Table 1.

<i>Trait (sample language used¹)</i>	<i>Julie Percent of responses (count)</i>	<i>John Percent of responses (count)</i>
Business (<i>Landscape</i>)	0% (0)	5% (1)
Technical (<i>Honors, Undergraduate research, CAD, Publication, Engineering, Skilled, CoolCapstoneProject, Worked-in-lab, Handcycle, Intern, 3-programming-languages</i>)	35% (7)	37% (7)
Non-Technical (<i>Active, No gap, Barista, Hard worker, Motivated, Focused</i>)	20% (4)	16% (3)
Language (<i>German, Bilingual</i>)	15% (3)	0% (0)
Criticism (<i>too brief, lack of structural simulation, simple</i>)	0% (0)	16% (3)
Experience (<i>Experience, Experienced, RelevantExperience</i>)	30% (6)	26% (5)

Table 1: Traits assessment for resume of “Julie” versus “John”

¹ The polling software treats each word in an entry as a separate statement in generating a word cloud; as such, student respondents often merged and/or hyphenated phrases.

An interesting observation was that there was “no gap” on “Julie’s” resume; no similar comment was made on “John’s” resume. Furthermore, it is noteworthy that “John,” while quantitatively rating higher than “Julie,” received critical responses to the qualitative question, including a technical criticism, whereas “Julie” received no such criticism. This is perhaps a reflection of Biernat and Kobrynowicz’s (1997) findings related to gender-based lowering of minimum standards.

Summary

While sample sizes were small (N=20 female resume, N=16 male resume), the female resume received lower quantitative marks – a 3.35 mean score vice a 3.44 mean score for the male resume. The most extreme positive and negative evaluations correlated to the male and female resumes respectively, as summarized in Figure 5. Similarly, in response to the qualitative question which sought to identify noteworthy traits of each candidate, the respondents keyed into business and technical skills for the male candidate more so than they did for the female candidate.

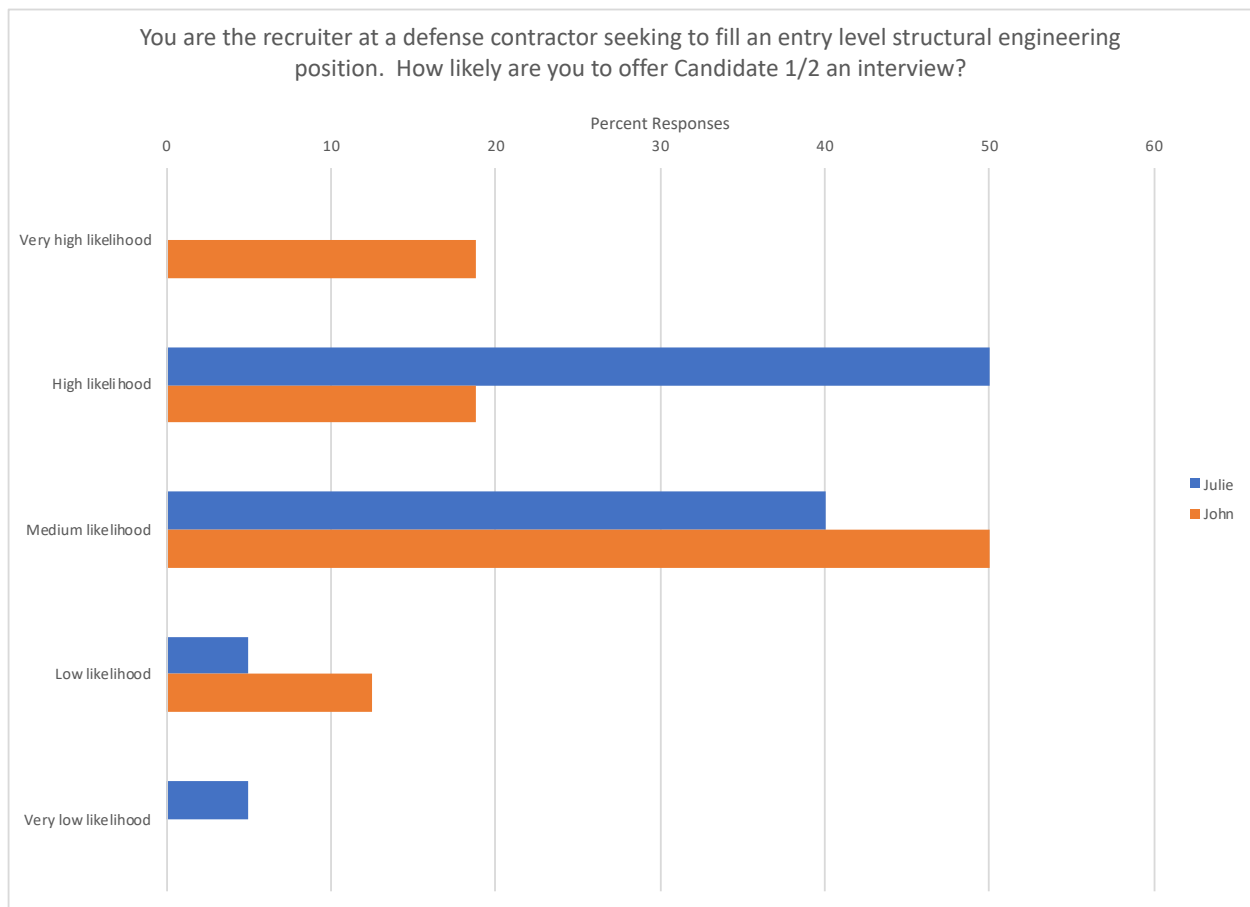


Figure 5: Clustered bar chart showing quantitative evaluation of Candidate 1 (“Julie”) versus Candidate 2 (“John”).

Limitations

Much of the existing literature on audience response systems focuses on the contributions such tools can make to an active learning environment and/or the adverse effects of poor implementation (see, for example, Kay & LeSage, 2009; Pettit *et al*, 2015). Studies have delved into the use of

audience response systems as data collection tools in replacement or supplement to traditional survey instruments (McCarter & Caza, 2009; Gray *et al*, 2016; Bryant-Moore *et al*, 2018). That said, it was not the aim of this study to assess the effectiveness of audience response systems vice traditional survey formats for acquiring such data. This preliminary study arose from novel findings from a classroom exercise that utilized real-time, live polling, and it is worth noting that the real-time, live-display nature of the preliminary data likely resulted in peer influence upon each other's responses. While the resumes were referred to in class as Candidate 1 and Candidate 2, vice using first name, the ordering of the resume evaluations may have also influenced the responses. And conceivably some participants may have noticed classmates near them reading a nearly identical resume and surmised the intent of the exercise. If this preliminary study is to be used for a future larger scale study of student perceptions of qualifications, further consideration must be given to the mechanism of data collection, be it via traditional surveying, audience response system, or some combination thereof.

Recommendations for Future Study

The data utilized in this preliminary study draws from a small sample set with 36 respondents between the two resumes evaluated. It would be of interest to conduct this study over a larger sample size of engineering students by comparison to humanities students, at multiple institutions, to determine if there are generalizable conclusions that can be drawn with respect to gender and racial bias in student perceptions of qualifications. Such a study would emulate studies in professional environments seeking to identify if there is a correlation between gender of evaluator and perceived qualification of applicant (Turczynski, 2019) and the influence of presumed applicant race and ethnicity on perceptions of qualifications (Bertrand and Mullainathan, 2004; Oreopoulos, 2011; Turczynski, 2019). Furthermore, future study should seek to provide greater refinement in quantitative and qualitative metrics to facilitate more rigorous assessment than permitted by this preliminary data.

If conducting a larger scale study of engineering and non-engineering students on multiple campuses, and evaluating multiple resumes for gender and racial biases, questions for such work should include demographic data, quantitative and qualitative resume assessment of candidate's level of qualification for position, likelihood of offering candidate an interview, and listing of key positive candidate traits or conversely reasons a candidate would not be selected for interview. Such study could then probe:

- The influence of applicant gender and race on student perceptions of qualifications.
- Correlation between applicant and reviewer gender and race on student perceptions of qualifications.
- Influence of major (engineering student versus non-engineering student) on student perceptions of qualifications.
- Correlation between age of reviewer and bias in assessment of applicant qualifications.

Furthermore, longitudinal study to evaluate if and how student perceptions evolve over time would assist in identifying trends and would help inform training and other interventions needed to support a diverse and equitable workforce.

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Appendix B – Candidate 2

JOHN MCDANIEL
123 4TH STREET, FAIRFAX, VA 22030
JOHN.MCDANIEL@EMAIL.COM | (123) 456-7890

OBJECTIVE:

Seeking a position utilizing my mechanical engineering background in service to the defense industry. Particular interest and expertise in structural engineering of truss-built structures such as airframes and ground vehicles.

EDUCATION:

George Mason University Mechanical Engineering BS 2020
Minor: Entrepreneurship

Capstone Design Project: Ergonomic and performance improvements of a hand-powered bicycle utilized competitively by a wounded veteran.

PROFESSIONAL EXPERIENCE:

Summer 2019 Naval Research Enterprise Internship Program (NREIP) Engineering Intern
Naval Surface Warfare Center, Carderock Division
Conducted experimental research in structures laboratory assessing failure modes of novel alloys.

2018-2019 Undergraduate Researcher in Professor Structures Guru's laboratory
Supported graduate researcher's design of experiments seeking to quantify material properties of lab-developed composite sandwich structures.

Summer 2017 & 2018 Landscaper
Self-employed performing residential landscaping duties for 10 houses.

2017-2018 Barista, Starbucks

HONORS:

2019 Naval Research Enterprise Internship Program selectee
2018-2019 Office of Student Scholarship, Creative Activities, and Research (OSCAR) Scholar

SKILLS:

Proficient language skills in spoken and written German
Experience writing code in C++, Java, and Python
Proficient in AutoCAD
Proficient with the MS Office Suite of software

PUBLICATIONS:

McDaniel, J., and Guru, S., "Material properties of composite sandwich structure XYZ," under review by *Journal of Composites*, 2019.