COLLEGE STUDENTS' VIEWS ON WHO WOULD MAKE A GOOD SCIENCE RESEARCHER

A Thesis

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ABSTRACT

The number of women in the STEM field across academia and the workforce is growing, yet there remains a significant gender disparity. Career choices in science research positions are stereotyped in the gendered context of the intellectual abilities debate. The intellectual abilities debate argues men are successful in intellectual (brilliant) positions, while women will do better in hard work (dedication) positions. Many studies have focused on the developmental perspective of adults and children; thus, little is known about other developmental stages. The purpose of this study was to better understand the gendered aspect of career choices for emerging adults in science research positions. The study contributed to the empirical research on gender stereotyping in science-related careers through a mixed research methodology. This work examined gendered attitudes to explain why some careers are customarily stereotyped to be either male or female oriented. The researcher examined college students' (N=248) gendered recommendations about two science positions (dedication vs brilliance-oriented science positions) at a large research higher education institution. Results revealed that while both groups recommended females for the dedication job position, for the brilliance job position females are showing a crossover effect. Women from the study demonstrated a new perspective and outlook that women are deserving of these brilliance science positions. Findings suggest that emerging adults are starting to have different perceptions and views on the gendered aspect of career choices, where generational understanding, gender intervention, and changes can influence transformation within STEM fields across academia and the workforce. Overall, the goal of the study is to better understand the gendered aspect of career choices.

BIOGRAPHICAL SKETCH

Jamie Hom graduated from Ithaca College in 2013 with a Bachelor of Arts in Anthropology and Culture and Communication with a minor in Women's and Gender Studies. Following Ithaca College, in August 2014, she enrolled in Ball State University to pursue her Master of Arts in Student Affairs Administration in Higher Education. She is currently pursuing her Master's in Human Development at Cornell University. Her research explores developmental and social psychology to understand gendered aspects of career choices within emerging adults.

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INTRODUCTION

The representation of women in all of the science, technology, engineering, and math (STEM) disciplines (Ceci et al., 2014) is rapidly increasing. Regarding these fields, many studies have shown that the gender disparity is shrinking as the number of women in STEM grows, yet men continue to outnumber women in certain STEM fields (Leslie et al., 2015). In the 1970s, women earned about 10% of the bachelor's degrees in the geoscience, engineering, mathematics/computer science/ economics, and physical science (GEMP) fields, but have now attained 20 to 40% of those degrees (Ceci et al., 2014). Additionally, the National Science Foundation (2013) reported that about half of the Ph.D. recipients in molecular biology and neuroscience were women as opposed to, only about 20% of the Ph.D. recipients in physics and computer science. Women's representation in the life sciences, psychology, and social sciences (LPS) fields are two or more times higher than their representation in the GEMP fields (Ceci, 2017; Meyer et al., 2015). To explain this gender disparity, this study looks at two different science positions depicted regarding a hard-working versus intellectual innate or known as the brilliance versus dedication stereotype in the STEM field. This study aims to examine the gender stereotype of intellectual talent from the lens of emerging adulthood.

Bian et al. (2017) investigated the intellectual talent stereotype from the perspective of adolescent development. Findings showed that as early as 6 years old, many children associate brilliance with males (Bian et al., 2017). Other studies have explored the effects of the intellectual abilities stereotype on adult's self-perceptions (Leslie et al., 2015; Williams & Ceci, 2014). Yet, little is known about other developmental stages. This research challenges gender norming, and questions whether the stereotypes can be unlearned during the emerging adult

years from 18 to 25 (Arnett, 2004). This study will view emerging adults within a subset of college students.

This study analyzes gender disparity between two positions in the sciences in association with the participants' disclosed gender and their recommendation of a person for the position, which is the pronoun of the person the participant recommends for the job (or known throughout this study as the pronoun recommended). Participant's self-reported gender is the independent variable. The pronoun recommended is the key dependent variable of the study. The other variables, such as class year and major, may affect or confound the results. The overall prediction is that the participants will more likely recommend males than females for the brilliance job, but not the dedication job.

Biological and Environmental Factors

People have put forth a myriad of explanations for the phenomena of gendered imbalances in career choices and intellectual ability. There is evidence for both biological and environmental factors contributing to this debate; however, there is more compelling research supporting environmental factors over biological factors. Bian et al. (2017) reviewed two broad perspectives, "biological" and "societal." The biological perspective makes two critical claims: (a) men and women are inherently different in terms of their cognitive and socioemotional makeup, and (b) these differences influence men's and women's aspirations, performance, and career choices, thereby leading to the current gender disparities. Intelligence is debated only to be a biologically rooted factor (Ebisch et al., 2012, 2013; Perfetti et al., 2009).

Bian et al.'s (2017) above-mentioned study addressed general intelligence. Of all fields in which sheer brilliance is thought to be needed, mathematics is at the top (Ceci, 2017). Mathematics has been used as a reference point for the brilliance difference between males and

females. From a biological lens, one hypothesis states men are naturally endowed with higher mathematical and spatial abilities (cognitive abilities) than women (Bian et al., 2017). Another hypothesis points out the differences in cognitive styles between men and women. For example, when comparing "systemizing" and "empathizing," men are more prone to learn about objects and mechanical relationships, while women are more inclined to learn about people and their emotions (Baron-Cohen, 2002; Su & Rounds, 2015). In general, men have a strong drive to analyze the rules underlying the systems they observe in the world and to predict the output of such systems. In contrast, women have a strong drive to understand people's mental states and thoughts, and are able to respond intuitively to these emotions. Regarding the role of math-related career preferences, adolescent girls often prefer careers focusing on people as opposed to things (Ceci & Williams, 2010).

This may be further driven by the factor that in STEM fields, there are cultural messages which suggest that girls are not competent in math: "the more math, the fewer women" (Ceci et al., 2015). In addition to this misconception, a lack of female mentors may negatively influence the number of girls seriously considering STEM fields. Furthermore, other factors contributing to women's current representation in math-intensive fields include the typical family formation and gendered expectations for childrearing, lifestyle choices, work-life balance, and career preferences, as well as, gender differences in resources, abilities, and choices (Ceci & Williams, 2010; Upson & Friedman, 2012). In addition, within work environments, gender stereotypes exist in work-life balance and career preferences. Women are more likely to gravitate toward careers focusing on people, such as social work and teaching versus men who are more likely to focus on handling things, such as finances or engineering. The work environment is instrumental in producing or exaggerating these gender differences.

The brilliance and dedication stereotypes perseverate because of women's experiences in the school environment. What teachers say and do has discouraged early adolescent girls from pursuing advanced math and science coursework (Ceci, 2017). Formal schooling shapes girls' beliefs and stereotypes, and experiences have a long-term impact on girls' preparation for and participation in careers in GEMP fields. In a study by Tiedemann (2000), 52 elementary school teachers' perceptions of mathematics were assessed. Teachers revealed perceptions that mathematics is a subject more difficult for girls than boys, boys are more capable of logical thinking than girls, and girls have lower self-concepts of mathematical ability than boys. However, these perceptions exist past the post-secondary school and into the higher education setting as well. Therefore, these educational environments create gender imbalances that contribute to gender disparity in the work environment.

The Field-Specific Ability Belief Model

Bian's (2017) research on the Field-specific Ability Belief (FAB) model was one of the first to examine the effect of brilliance-focused messages on both adults and children. Bian's findings seem to suggest that in each discipline or profession, there are stereotypes of needing certain abilities to be successful in a certain discipline. These stereotypes might be passed on to children as early as the first year of primary education, that is, kindergarten, which is between the ages of 5 and 6 (Bian, 2017). On the other hand, Ceci's (2017) research examined the very GEMP fields in which women are the most underrepresented and where women successfully transition from undergraduate to graduate school to tenure track professorships. The FAB model contributed insights into women's underrepresentation in STEM, specifically in GEMP fields where beliefs about brilliance are commonly endorsed. The FAB model provides a framework

for viewing gender imbalances and the importance of addressing imbalances holistically, from education to the workplace.

Emerging Adulthood

College students have been the focus of many research studies, but most often grouped with a larger number of adults in social psychology studies. Yet, demographic shifts in industrialized societies have taken place over the past century that has made the late teens and early twenties, not simply a brief period of transition into adult roles but a distinct period of the life course, characterized by change and the exploration of possible life directions. The theory of emerging adulthood has conceptualized the development of today's young people; in American society and other industrialized societies (Arnett, 2014). The "college years" are the main years of emerging adulthood for those individuals who enter college right from high school. Today, college participation is an experience shared by the majority of emerging adults in American society and other industrialized societies (National Center for Education Statistics, 2018). As a new life stage, it must be distinguished from other life stages not just as an age range but because of what typically occurs during these years (Arnett, 2018).

In over a period of the last 20 years of research on emerging adulthood on college students, the most researched question has been: "Do you feel that you have reached adulthood?" (Nelson & Luster, 2015). Consistently, the most common response is neither yes nor no, but an in-between response: "in some ways yes, in some ways no". The feeling of becoming an adult is gradual, and the top three criteria for adulthood are accepting responsibility for self, making independent decisions, and becoming financially independent. According to Arnett (2004), there are five main features that comprise emerging adulthood: identity exploration, instability, self-focus, a feeling of being in-between, and possibilities/optimism.

Emerging adulthood has been labeled as the age of identity exploration (Arnett, 2007). Social and economic forces have impacted the exploration of identity and have prolonged entry into adulthood because of developmental challenges beyond the traditional adolescent years (Cote, 2014). Regarding the world of work, emerging adulthood is a meaningful age period because emerging adults are more independent than children and adolescents; but their parents and other people still actively influence their career opportunities (Arnett, 2004; Whiston & Keller, 2004). Additionally, a defining characteristic of the stage of emerging adulthood is that contexts are changing significantly, from family to independence or romantic relationships, from school to work or a disconnected state, and from dependent living to independent living arrangements (Wood et al., 2018). Emerging adulthood is a time of transition and transformation.

Present Study

The present study aims to understand whether there is an association between gender and perceived career choices in college students and examines the effect that the developmental roots of emerging adulthood have on the gender bias against females in careers portrayed as requiring brilliance. The study examines the recommendation of a male or a female for one of two science job positions. Furthermore, this study analyzed the participants' written responses to examine their cognitive and perceptual processes.

Expanding upon previous literature, this study built upon Bian et al.'s (2017) research on the stereotypes regarding intellectual abilities as they relate to gender disparity. Many studies have focused on adults and children. This study aims to highlight the perception of gender stereotyping by presenting two positions to both sexes and analyzing responses on emerging adults. More specifically, this study aims to assess the association between the self-described gender of traditional-age college students from an elite institution and the pronoun of the person

nominated for the job. Namely, the present study is motivated by understanding whether the student's gender affects how they recommend a gender for a particular science job.

It was hypothesized that both males and females would likely recommend males over females for the job whose description implied that brilliance was a necessary quality. Moreover, both males and females would likely recommend females over males for the dedication job.

It was additionally hypothesized how other demographic variables, such as class year and major could impact different outcomes. Participants with more years in higher education could be more likely to recommend the gender opposite of theirs to both the brilliance and dedication conditions because of older participants' increased age, identity exploration, and life experiences of dismantling gender stereotypes. Moreover, it was hypothesized that across different majors, a participant's major could influence their choice of a male or a female for either the brilliance or dedication job position, again, because of an increased pattern of identity exploration and life experiences. A positive relationship between gender, class year, major, and recommended pronoun was hypothesized.

Results of this study could help researchers, practitioners, and policymakers understand how this developmental stage affects the gender disparity that persists in STEM fields and careers, how we can continue to close the gender gap, and what efficient, effective interventions and implementations can be used to increase retention rates for women in all STEM fields.

METHODOLOGY

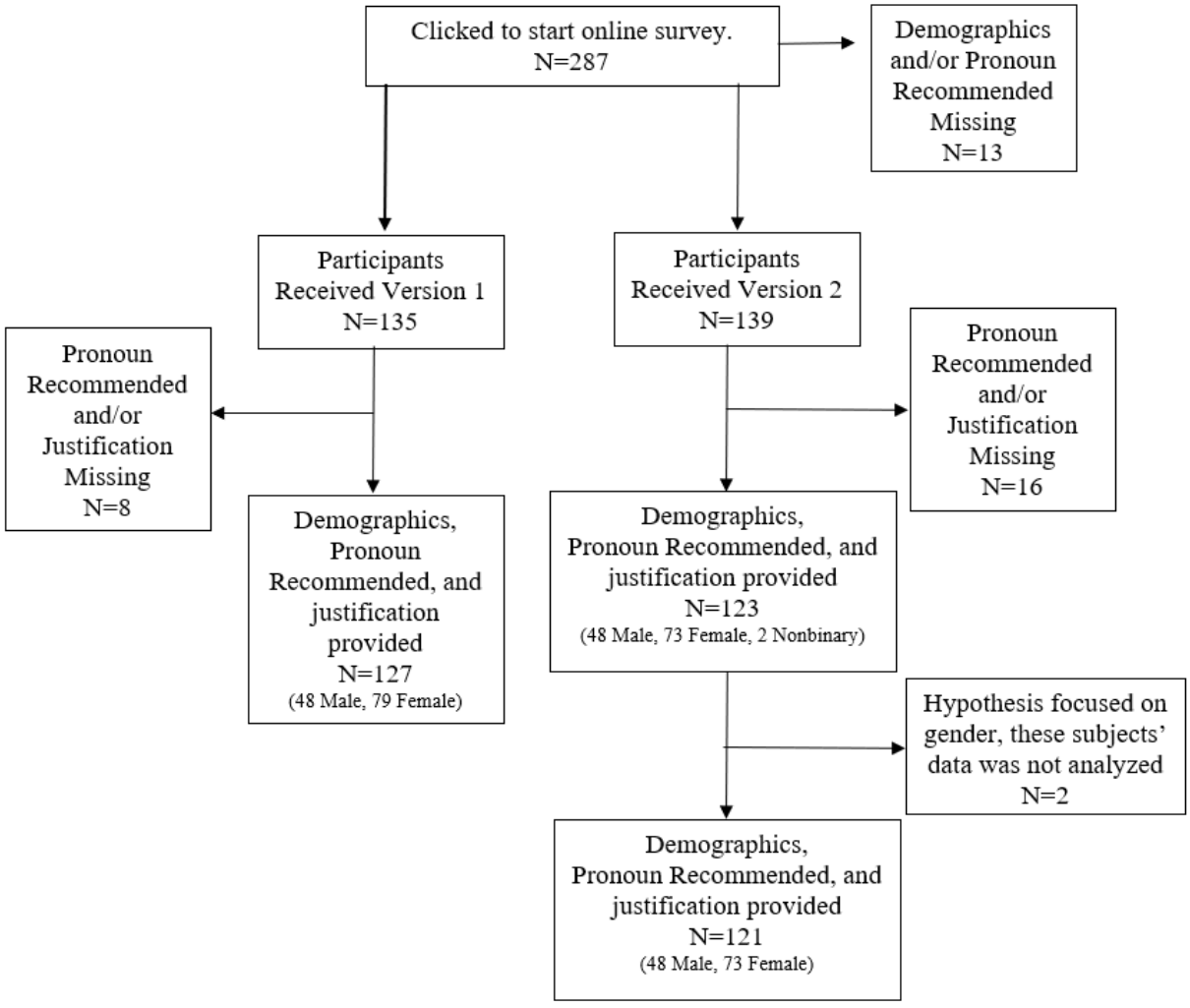
Participants

Participant eligibility criteria included identifying as a member of the Cornell community as a student, faculty, or staff member. A total of 287 students self-volunteered to participate in the study. No faculty or staff members were recruited. Participants each disclosed their class

year, their major, and their gender. Thirty-nine participants (13.6%) were excluded from the survey data because they did not either provide a response of the reasoning for their selection or because the primary research investigator was unable to code the participant's response to the main dependent measure. Moreover, two participants identified as nonbinary, and because our hypothesis focuses on the gender binary, these participants' data were excluded. Thus, the final analytic sample was 248 participants (86.4% of originally recruited) (Figure 1).

Figure 1.

Analytic Sample of Participants



Materials

All participants completed a Qualtrics online survey. After participants provided Informed Consent, they received one of two versions of the survey. Alternately, one participant got version 1 and the next participant got version 2. The two versions represented two different types of science positions based on different approaches: dedication or brilliance. The first job position or version 1: Cornell Science Lab Manager, emphasized dedication to the job, while the second job position or version 2, Cornell Science Lab Graduate Research Assistant, focused on the brilliance necessary for the job (full job descriptions in Appendix A).

Procedures

The data collection procedures were completed in several consecutive phases. The survey was distributed through several e-list serves based in association with different groups and organizations on the college campus and was advertised at several on-site events in multiple public areas on campus, such as libraries and service centers. For surveys that occurred during on-site recruiting, participants were compensated with either an Insomnia Cookie or a Dunkin' donut.

The survey included one of the job descriptions, then asked participants to recommend and name someone who would be a good fit for the position and explain why they would be a good fit. The job descriptions did not disclose if the conditions were based on dedication or brilliance but instead provided responsibilities of the job. The primary research investigator coded the recommended individual based on their pronoun using he or she. The preferred gender of the person recommended for the job was scored as a 0 if the participant suggested a male, and 1 if they suggested a female.

DATA ANALYSIS AND RESULTS

Quantitative Methods

Demographics were analyzed by significance (class year, major, and gender) using chi-square tests. Demographics and other characteristics were analyzed by outcomes (the pronoun of the person recommended) using a two-way analysis of variance (ANOVA) and chi-square goodness-of-fit test. A binary logistic regression model was chosen to assess the associations between the participant's (coded) gender with pronoun recommended gender. Moreover, the binary logistic regression model was adjusted for cross-tabulations of the class year and major. The Statistical Package for the Social Sciences (referred to as SPSS) Data Analysis and Statistical Software was used for all analyses. Significance criterion was set at $p < 0.05$.

Qualitative Methods

The qualitative method was the survey responses and the tool selected for coding was the Linguistic Inquiry and Word Count (LIWC2015) software tool. The LIWC2015 software tool allowed for synthesizing the data using a highly developed dictionary to analyze themes (Smith-Keiling & Hyun, 2019). LIWC2015 measures four variables: analytical thinking, clout, authenticity, and emotional tone. After going through all the words in the text, LIWC2015 calculates the percentage of each LIWC2015 category (Tausczik & Pennebaker, 2010). LIWC2015 was chosen to analyze the participants' explanations for their responses explaining why they'd recommended a particular individual

Frequency of Variables

Demographic characteristics of the analytic sample are presented in Table 1. From the chi-squared outputs, the data showed that major and position were not significant associations with how males and females made gender recommendations. However, there was a significant

correlation between the respondent's gender and the pronoun of the person they recommended, which is discussed in the next section.

Table 1:

Description of students by gender and version

	Total N (%) 248 (100)	Version 1 (Science Manager)				Version 2 (Graduate Researcher)			
		Male 37 (38.9)	Female 90 (58.8)	Version 1 Total 127 (51.2)	p-values	Male 58 (61.1)	Female 63 (41.2)	Version 2 Total 121 (48.8)	p-values
DEMOGRAPHICS									
CLASS YEAR									
Freshmen	170 (68.5)	28 (32.2)	59 (67.8)	87 (68.5)	.264	42 (50.6)	41 (49.4)	83 (68.6)	.552
Sophomore	17 (6.9)	3 (33.3)	6 (66.7)	9 (7.1)		2 (25.0)	6 (75.0)	8 (6.6)	
Junior	28 (11.3)	1 (6.3)	15 (93.8)	16 (12.6)		7 (58.3)	5 (41.7)	12 (9.9)	
Senior	21 (8.5)	2 (25.0)	6 (75)	8 (6.3)		5 (38.5)	8 (61.5)	13 (10.7)	
Graduate Student	12 (4.8)	3 (42.9)	4 (57.1)	7 (5.5)		2 (40.0)	3 (60.0)	5 (4.1)	
MAJOR									
Geoscience	4(1.6)	1 (2.7)	1 (1.1)	2 (1.6)	.132	0 (0)	2 (3.2)	2 (1.7)	.569
Economics	6 (2.4)	2 (5.4)	0 (0)	2 (1.6)		2 (3.4)	2 (3.2)	4 (3.3)	
Engineering	27 (10.9)	2 (5.4)	9 (10)	11 (8.7)		8 (13.8)	8 (12.7)	16 (13.2)	
Math/Computer Science	38 (15.3)	9 (24.3)	17 (18.9)	26 (20.5)		8 (13.8)	4 (6.3)	12 (9.9)	
Physical Science	15 (6.0)	1 (2.7)	6 (6.7)	7 (5.5)		3 (5.2)	5 (7.9)	8 (6.6)	
Life Science	55 (22.2)	12 (32.4)	16 (17.8)	28 (22.0)		11 (19.0)	16 (25.4)	27 (22.3)	
Psychology	5 (2.0)	0 (0)	3 (3.3)	3 (2.4)		0 (0)	2 (3.2)	2 (1.7)	
Social science	58 (23.4)	6 (16.2)	24 (26.7)	30 (23.6)		15 (25.9)	13 (20.6)	28 (23.1)	
Other	40 (16.1)	4 (10.8)	14 (15.6)	18 (14.2)		11 (19.0)	11 (17.5)	22 (18.2)	

P-values significant at < 0.05.

Intercorrelations among Measures

The description of students by their identified gender, the pronoun of the person they recommended, and version of the job descriptions: Science Manager and Graduate Research Assistant are shown in Table 2. 48 male participants received version 1 (Science Manager), and 19 of them (39.6%) recommended a male for the job, while 29 of them (60.4%) recommended a female. Additionally, 79 female participants were given version 1, of which 18 (22.8%) recommended a male and 61 (77.2%) recommended a female. This difference is significant ($p = .043$). For version 2 (Graduate Research Assistant), there were 48 male respondents, 36 of them (75.5%) recommended a male and 12 (25.0%) recommended a female for the job. There were 73 female participants given version 2. Of the females, 22 (30.1%) recommended a male and 51

(69.9%) recommended a female. This difference is significant (p= <.001). Additionally, the pooled versions showed there was 96 male participants total, and 55 of them (57.3%) recommended a male and 41 (42.7%) recommended a female, across both versions. While there was 152 female participants total, 40 of them (26.3%) recommended a male and 112 of them (73.7%) recommended a female. This difference is significant (p = <.001).

Table 2:

Description of students by pronoun recommended and version in the study

		Version 1: Science Lab Manager (dedication)					Version 2: Science Lab Graduate Research Assistant (brilliance)					Versions Combined Together				
Total N (%)	Chose Male	Chose Female	Total	p-value		Chose Male	Chose Female	Total	p-value		Chose Male	Chose Female	Grand Total	p-value	
Male Subjects	19 (39.6)	29 (60.4)	48 (100.0)	.149	.043	36 (75.5)	12 (25.0)	48 (100.0)	<.001	<.001	55 (57.3)	41 (42.7)	96 (100.0)	.153	<.001
Female Subjects	18 (22.8)	61 (77.2)	79 (100.0)	<.001		22 (30.1)	51 (69.9)	73 (100.0)	<.001		40 (26.3)	112 (73.7)	152 (100.0)	<.001	
Total Subjects	37 (29.1)	90 (70.9)	127 (100.0)			58 (47.9)	63 (52.1)	121 (100.0)			95 (38.3)	153 (61.7)	248 (100.0)		

Note: (Number of participants; Percentage is specific subgroup selected)
P-values significant at < 0.05.

Chi-Square Goodness-of-Fit Test

The chi-square goodness-of-fit test was used to determine whether the distribution of cases (e.g., participants) in a single categorical variable (e.g., gender, consisting of two categories: males and females) follows a hypothesized distribution (e.g., the proportion of males versus females that we anticipate recommending a particular gender for a STEM job description). Of the 248 participants recruited to the study, 96 identified as male and 152 identified as female. Chi-square goodness-of-fit tests were conducted to determine whether an equal number of participants from each of the two categories of pronoun recommended were

distributed to the study (Table 2). This study aimed to determine if the male gender shows gender bias in pronoun recommendation within version 1, given the result with 19 (39.6%) to 29 (60.4%) is compared to 50% to 50%. The minimum expected frequency was 24. The chi-square goodness-of-fit test indicated that the number of male participants within version 1 recruited to the study was not significantly statistically different ($\chi^2(2) = 2.083$, $p = .149$). On the other hand, within version 1, do women show gender bias in the recommendation process, which is 18 (22.8%) to 61 (77%) different from 50% to 50%? The minimum expected frequency was 39.5. The chi-square goodness-of-fit test indicated that the number of female participants recruited to the study was significantly statistically different ($\chi^2(2) = 23.405$, $p = <.001$), with just over half of the female participants recommending a female.

Additionally, a chi-square goodness-of-fit test was conducted in version 2. We questioned if the distribution was set at 50% and found 36 (75.5%) to 12 (/25%). The minimum expected frequency was 24. The chi-square goodness-of-fit test indicates that the number of male participants recruited to the study was significantly different statistically ($\chi^2(2) = 12.000$, $p = <.001$). Also, do female participants show gender bias, which is asking is 22 (30.1%) to 51 (69.9%) different from 50% to 50%? The minimum expected frequency was 36.5. The chi-square goodness-of-fit test indicated that the number of male participants recruited to the study was significantly different statistically ($\chi^2(2) = 11.521$, $p = <.001$).

Lastly, a chi-square goodness-of-fit test was conducted on combined versions among both genders to determine the pronoun recommended. Of all 96 male participants, the pronoun recommendation distribution was 55 (57.3%) to 41 (42.7%) with an expected difference between 50% to 50%. The minimum expected frequency was 48. The chi-square goodness-of-fit test indicated that the pronoun recommended categories were equally represented by the recruited

male participants ($\chi^2(2) = 2.042$, $p = .153$). Additionally, we questioned out of the 152 females in this study if gender bias was hypothesized with an equal proportion set at 50% and found 40 (26.3%) to 112 (73.7%). The minimum expected frequency was 76. The chi-square goodness-of-fit test indicated that statistically there is a significant difference ($\chi^2(2) = 34.105$, $p = <.001$).

Two-Way Analysis of Variance

A two-way ANOVA was conducted that examined the effect of the respondent's gender and version on the pronoun recommended (Table 3). A two-way ANOVA was conducted to evaluate the effects of pronoun recommended to the version of the survey given to the gender of participants. A two-by-two factorial design has four conditions. The two independent variables or factors in this study are gender (male or female) and version of the survey (dedication or brilliance). The dependent variable is the pronoun recommended (male or female).

The primary goal of running a two-way ANOVA was to determine whether there was an interaction between the two independent variables: gender and version. A residual analysis was performed to test the assumptions of the two-way ANOVA (Laerd Statistics, 2017). Outliers were assessed by the inspection of a boxplot; normality was assessed using Shapiro-Wilk's normality test for each cell of the design and homogeneity of variances was assessed with Levene's test. There were no outliers, residuals were normally distributed ($p > .05$), and there was homogeneity of variances ($p = .003$).

There was a statistically significant interaction between the respondent's gender and survey version and the pronoun recommended, $F(1, 244) = 5.679$, $p = .018$, partial $\eta^2 = .023$. Moreover, a Bonferroni adjustment was applied to the level at which there was a declared statistical significance (Laerd Statistics, 2017). This was done by dividing the current level of statistical significance (i.e., $p < .05$) by the number of simple main effects being made (i.e., 2).

Thus, an analysis of the simple main effects for the version received was performed with the statistical significance receiving a Bonferroni adjustment and being accepted at the $p < .025$ level. There was not a statistically significant difference in the mean value for the pronoun recommended for version 1, so $F(1, 244) = 4.13$, $p = .043$, and partial $\eta^2 = .017$. For version 2, there was a statistically significant difference, where $F(1, 244) = 28.59$, $p = <.001$, and partial $\eta^2 = .105$. Lastly, for the gender variable, there was a statistically significant difference in the mean pronoun recommended by males, for which $F(1, 244) = 14.77$, $p < .001$, and partial $\eta^2 = .057$, and for females, a mean difference of $F(1, 244) = 1.01$, $p = .317$, and partial $\eta^2 = .004$, which was not statistically significant.

All pairwise comparisons were run for each simple main effect with reported 95% confidence intervals and *p*-values Bonferroni-adjusted within each simple main effect (Laerd Statistics, 2017). The mean values for the pronoun recommended by males responding to version 1 and version 2 were .60 (*SD* = .49) and .25 (*SD* = .44), respectively. For version 2, males had a statistically significantly lower mean in the pronoun recommended than version 1 males, where -.35, 95% CI [-.54, -.17], $p < .001$. Additionally, the mean value for the pronoun recommended for version 1 and version 2 females were .77 (*SD* = .42) and .70 (*SD* = .46), respectively. Results showed that among version 2 females, there was a significantly statistically lower mean for pronoun recommended than among version 1 females, so that -.07 (95% CI, -.22 to .07), and $p = .317$. Overall, the gender response was influenced by the version the participant received. This indicates that the hypothesis that the effect of gender of the recommended person depends on which version was received.

Table 3:

Two-way Analysis of Variance for Pronoun Recommended

Source	*SS*	*df*	*MS*	*F*	*p*
Gender	5.589	1	5.589	27.415	<.001
Version	2.689	1	2.689	13.189	<.001
Gender X Version	1.158	1	1.158	5.679	.018
Within (Error)	49.748	244	.204		
Total	153.000	248			
Corrected Total	58.609	247			

Binary Logistic Regression

To test the hypothesis that males would recommend a male over a female on the condition of brilliance, a binary logistic regression was conducted. The regression tested the pronoun of the participant's recommendation (0 = Male, 1 = Female) as predicted by gender for this study, a categorical variable composed of male and female. A binomial logistic regression estimates the probability of an event (in this case, selecting either a male or female). Through a series of assumptions tests that were carried out, the dependent variable was measured on a dichotomous scale (i.e., the pronoun of the recommendation was male or female). There were several independent variables based on the participant's class year, major, and gender disclosed, and the study had independence of observations, where each participant was only counted as one observation, and there was a linear relationship between continuous independent variables and the logic transformation of the dependent variable.

A binomial logistic regression was performed on version 1 to ascertain the effect of gender on the likelihood that the participants would recommend a male for the position. The logistic regression model was statistically significant, $\chi^2(1) = 4.01$, and $p < .045$. The model explained 4.4% (Nagelkerke R^2) of the variance in selecting a male and correctly classified 70.9% of cases. Sensitivity was 100.0%, specificity was 0.0%, and the positive predictive value (selecting female) was 29.1%. The predictor variable, gender, was also statistically significant (Table 4). Females were 2.22 times more likely to select a female than a male.

Table 4:

Logistic Regression Predicting Pronoun Recommended based on Gender in Version 1

	B	SE	Wald	*df*	*p*	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
Gender	.80	.40	4.00	1	.046	2.22	1.02	4.85
Constant	.42	.30	2.05	1	.152	1.53		

Note: Gender is for males compared to females.

Additionally, a binomial logistic regression was performed on version 2 to ascertain the effects of gender on the likelihood that participants recommend a male for the position. The logistic regression model was statistically significant, $\chi^2(1) = 24.20$, $p < .001$. The model explained 24.2% (Nagelkerke R^2) of the variance in selecting a male and correctly classified 71.9% of cases. Sensitivity was 81.0%, specificity was 62.1%, the positive predictive value (selecting a male) was 75.0%, and the negative predictive value (selecting a female) was 69.9%. The predictor variable, gender, was statistically significant (Table 5). Males were 6.96 times more likely to select a male than a female.

Table 5:

Logistic Regression Predicting Pronoun Recommended based on Gender in Version 2

	B	SE	Wald	*df*	*p*	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
Gender	1.94	.42	21.35	1	<.001	6.96	3.06	15.83
Constant	-1.10	.33	10.86	1	<.001	.33		

Note: Gender is for males compared to females.

Correlation of the LIWC Variables

Language semantics encompasses deeper meaning and content, which could be hidden within vocabulary and context (Smith-Keiling & Hyun, 2019). The brilliance versus dedication ability messages were embedded in the job descriptions themselves (Bian et al., 2017). Of the 14 dimensions (dictionaries) to use during analysis within LIWC, 8 dimensions were selected with

15 sub-dimensions deemed by the primary researcher as correlating to the built-in dictionaries for analyzing the study's themes of gender and career. The coded dictionaries of the analytic sample are presented in Table 6.

Table 6:

LIWC content of pronoun recommended as a function of gender and job position

Dimensions Mean Percentage (SD)	Version 1: Science Manager			Version 2: Graduate Research			Total	
Pronoun Recommended	Male N = 37	Female N = 90	Total N = 127	Male N = 58	Female N = 63	Total N = 121	Male N = 95	Female N = 153
SUMMARY DIMENSIONS								
Word Count	49.81 (38.42)	41.27 (23.59)	43.76 (28.81)	46.45 (40.66)	47.30 (28.20)	46.89 (34.59)	47.76 (39.63)	43.75 (25.67)
Dictionary Words Count	89.34 (4.66)	88.65 (5.51)	88.85 (5.27)	86.27 (5.85)	87.11 (6.20)	86.70 (6.02)	87.46 (5.97)	88.02 (5.83)
Analytical	46.31 (26.20)	42.65 (27.67)	43.72 (27.20)	55.46 (28.21)	47.96 (23.93)	51.56 (26.23)	51.89 (27.67)	44.84 (26.24)
Clout	81.37 (15.78)	81.09 (16.46)	81.17 (16.21)	75.90 (14.92)	72.51 (16.52)	74.13 (15.80)	78.03 (15.41)	77.56 (16.97)
Authentic	6.70 (13.26)	5.04 (10.21)	5.53 (11.16)	8.16 (17.93)	9.04 (17.26)	8.62 (17.51)	7.59 (16.21)	6.69 (13.65)
Tone	84.35 (28.08)	84.21 (25.77)	84.25 (26.35)	87.80 (23.99)	87.79 (23.91)	87.80 (23.85)	86.45 (25.57)	85.68 (25.00)
FUNCTION WORDS	54.79 (6.63)	55.18 (6.57)	55.07 (6.57)	52.12 (7.81)	54.56 (5.55)	53.39 (6.81)	53.16 (7.45)	54.92 (6.16)
Personal Pronouns	7.81 (4.21)	8.09 (3.52)	8.01 (3.72)	7.61 (2.90)	7.18 (2.70)	7.39 (2.79)	7.69 (3.45)	7.72 (3.23)
AFFECT	7.69 (3.01)	7.10 (4.55)	7.27 (4.15)	7.94 (4.76)	7.00 (3.82)	7.45 (4.31)	7.84 (4.15)	7.06 (4.25)
Positive Emotions	6.32 (3.14)	6.48 (4.26)	6.43 (3.96)	6.95 (3.82)	6.57 (3.50)	6.75 (3.65)	6.70 (3.57)	6.52 (3.95)
SOCIAL	14.46 (6.82)	13.88 (5.32)	14.05 (5.78)	10.90 (4.41)	10.28 (3.52)	10.58 (3.97)	12.29 (5.71)	12.40 (4.98)
COGNITIVE PROCESSES	14.02 (5.93)	11.20 (6.57)	12.02 (6.49)	13.34 (9.11)	13.04 (6.26)	13.18 (7.72)	13.60 (7.99)	11.96 (6.49)
PERCEPTUAL PROCESSES	2.30 (3.45)	1.68 (2.52)	1.86 (2.82)	1.19 (2.02)	1.16 (2.17)	1.17 (2.09)	1.62 (2.71)	1.47 (2.38)
DRIVES	15.10 (6.76)	13.62 (6.08)	14.05 (6.29)	12.34 (5.46)	10.92 (4.43)	11.60 (4.98)	13.42 (6.12)	12.51 (5.61)
Affiliation	2.69 (3.07)	2.84 (3.87)	2.79 (3.64)	1.82 (2.79)	1.56 (1.99)	1.69 (2.40)	2.16 (2.92)	2.31 (3.28)
Achievement	7.38 (5.95)	5.69 (4.12)	6.18 (4.76)	5.01 (3.70)	4.44 (3.24)	4.71 (3.47)	5.94 (4.82)	5.17 (3.82)
Power	3.81 (3.96)	3.04 (3.36)	3.26 (3.55)	2.78 (2.84)	2.27 (2.23)	2.51 (2.55)	3.18 (3.34)	2.72 (2.97)
Reward	3.23 (2.81)	3.49 (2.76)	3.41 (2.77)	3.09 (2.92)	3.06 (2.72)	3.08 (2.81)	3.14 (2.87)	3.32 (2.74)
Risk	.71 (1.86)	.22 (.76)	.36 (1.20)	.71 (2.03)	.54 (1.70)	.62 (1.86)	.71 (1.96)	.35 (1.24)
Personal Concerns								
Work	11.94 (6.81)	11.39 (5.08)	11.55 (5.62)	12.58 (6.36)	11.24 (5.47)	11.89 (5.93)	12.33 (6.51)	11.33 (5.23)
Money	.14 (.54)	.24 (.65)	.21 (.62)	.26 (1.11)	.17 (.79)	.21 (.95)	.21 (.93)	.21 (.71)

Note: Numbers reflect the mean percentage of the words from the position descriptions by gender that fall within a given category. SDs are represented in parentheses below the means.

This study hypothesizes that females would select females less in the job position when exposed to messages emphasizing the importance of brilliance. Both job descriptions aligned with Baron-Cohen's (2002) research on the bias that women are better at connecting and working with others, while men have a stronger drive to analyze the rules underlying systems in the environment. By comparing brilliance-focused and dedication-focused job descriptions to each other in the experiment, we tested the effect of mean messaging on college students' interest in two science job opportunities. The open-ended responses from all participants explained their decision by listing the abilities of the recommended individual to the responsibilities noted in the job description the participants' received. Participants' open-ended responses were submitted to a linguistic analysis program (LIWC), which then compared the frequency of coded words across conditions for females and males.

This study analyzed the participant's language used to justify their responses. Reflecting the mean percentage of words (SDs are represented in parentheses) from the position descriptions that fall within a given category by gender, for version 1, both males and females were more likely to recommend a female for the role. Within the summary dimensions, the results showed that *analytical thinking* showed up in 46.31% (26.20) of the responses from males compared to 42.65% (27.67) of the responses from females. *Clout* appeared in of 81.37% (15.78) from males to 81.09% (16.46) from females, *authentic* was mentioned in 6.70% (13.26) to 5.04% (10.21), and *tone* showed up in 84.35% (28.08) to 84.21% (25.77) for males and females, respectively.

Furthermore, results within version 2 from the mean percentage of words used in the given text showed 55.46% (28.21) of male response to 47.64% (23.69) of female response for *analytical thinking*. Among the other summary dimensions results showed 75.90% (14.92) to

73.02% (16.51) for *clout*, 8.16% (17.93) to 74.38% (15.78) for *authentic*, and 87.80% (23.99) to 88.13% (23.62) for *tone* between males and females responses respectfully.

All LIWC data was further disaggregated where the mean percentage of words within each dictionary was converted to the mean average word count (SDs are represented in parentheses) within each dictionary. This was done by taking the word count per individual response divided by 100 and multiplied by the percentage of words with each dictionary. Results showed the average word count in each dictionary per individual, which was rounded to whole numbers. Then average word count within each dictionary per individual was converted to find the mean average word count and standard deviation within each dictionary. Means and standard deviations were rounded to the hundredths of the decimal. Table 7 reports the average number of words per category within LIWC.

Table 7:

LIWC average word count per person of pronoun recommended as a function of gender and job position

Dimensions Mean Word Count (SD)	Version 1: Science Lab Manager (dedication)						Version 2: Science Lab Graduate Research Assistant (brilliance)						Versions Combined Together		
Gender	Male N= 37			Female N = 90			Male N =58			Female N = 63					
Pronoun Recommended	Chose Male N = 19	Chose Female N = 29	p-value	Chose Male N = 18	Chose Female N = 61	p-value	Chose Male N = 36	Chose Female N =12	p-value	Chose Male N = 22	Chose Female N = 51	p-value	Male N = 95	Female N = 153	p-value
SUMMARY DIMENSIONS															
Dictionary Words Count	42.95 (40.77)	34.66 (22.06)	.133	46.11 (24.13)	37.80 (21.11)	.485	37.89 (33.63)	36.75 (25.43)	.877	44.41 (39.91)	42.29 (24.66)	.181	41.97 (34.81)	38.62 (22.82)	.060
Analytical	30.79 (45.84)	19.72 (21.77)	.158	23.44 (16.70)	20.89 (18.78)	.483	28.97 (34.17)	22.83 (18.69)	.419	20.68 (14.55)	26.00 (24.66)	.232	26.37 (30.83)	22.52 (21.41)	.411
Clout	39.47 (41.56)	30.45 (19.07)	.137	40.22 (20.96)	34.87 (20.26)	.764	32.92 (24.92)	29.17 (17.27)	.671	35.05 (27.93)	35.45 (22.50)	.804	36.11 (28.73)	33.78 (20.55)	.129
Authentic	1.16 (2.17)	2.34 (4.73)	.091	6.56 (12.01)	1.59 (3.30)	<.001	4.17 (14.98)	2.08 (3.53)	.302	4.77 (8.11)	4.94 (8.89)	.737	4.16 (11.32)	2.89 (6.12)	.026
Tone	41.95 (44.10)	32.97 (19.79)	.178	41.61 (26.20)	36.61 (22.95)	.587	38.47 (37.56)	38.42 (30.75)	.797	44.95 (36.93)	44.16 (28.28)	.377	41.26 (36.51)	38.58 (25.09)	.133
FUNCTION WORDS	25.37 (22.31)	20.83 (13.35)	.160	28.50 (14.91)	23.59 (12.88)	.449	23.14 (20.21)	22.58 (15.37)	.934	26.82 (25.35)	26.41 (14.75)	.209	25.45 (20.87)	23.93 (13.82)	.060
Personal Pronouns	3.00 (2.65)	2.76 (2.26)	.627	4.11 (2.42)	3.57 (2.62)	.723	3.22 (2.71)	3.17 (1.99)	.581	3.95 (4.10)	3.33 (2.17)	.179	3.52 (3.01)	3.31 (2.36)	.062
AFFECT	3.74 (2.67)	2.76 (1.68)	.018	3.33 (1.97)	2.66 (1.74)	.596	2.89 (2.27)	3.75 (4.31)	.033	3.82 (3.39)	3.22 (2.01)	.072	3.36 (2.59)	2.95 (2.12)	.127
Positive Emotions	3.16 (2.48)	2.62 (1.72)	.228	2.72 (1.71)	2.41 (1.65)	.973	2.50 (2.01)	3.25 (3.67)	.071	3.55 (3.10)	3.06 (1.89)	.048	2.92 (2.33)	2.73 (1.97)	.380
SOCIAL	6.42 (6.77)	4.97 (3.09)	.121	6.94 (3.86)	5.87 (3.82)	.846	4.58 (3.86)	4.58 (3.45)	.805	5.86 (6.67)	4.92 (3.42)	.043	5.69 (5.27)	5.28 (3.53)	.035

Note: Numbers reflect the mean count of the words from the position descriptions by gender that fall within a given category. SDs are represented in parentheses below the means.
P-values significant at < 0.05.

Table 7: Continued

COGNITIVE PROCESSES	6.26 (4.86)	4.41 (3.70)	.182	7.44 (4.53)	5.18 (3.82)	.444		5.36 (6.13)	6.42 (5.13)	.912	7.95 (8.41)	5.94 (4.42)	.010		6.54 (6.26)	5.39 (4.12)	.013
PERCEPTUAL PROCESSES	.74 (1.24)	.52 (.57)	.064	1.11 (1.41)	.66 (.91)	.057		.33 (.68)	.25 (.62)	.578	.77 (1.02)	.51 (.78)	.372		.66 (1.07)	.55 (.79)	.053
DRIVES	7.95 (8.57)	5.59 (3.21)	.026	6.44 (3.75)	5.26 (3.26)	.842		4.86 (4.00)	4.67 (4.40)	.315	5.95 (5.17)	5.43 (3.96)	.445		6.03 (5.46)	5.33 (3.57)	.108
Affiliation	1.68 (2.69)	1.07 1.41)	.197	1.06 (1.66)	1.02 (1.22)	.702		.61 (.73)	.58 (.79)	.747	1.05 (1.56)	.76 (1.01)	.044		1.01 (1.67)	.91 (1.17)	.299
Achievement	3.32 (3.18)	2.14 (1.25)	.002	3.33 (2.45)	2.23 (1.83)	.196		2.17 (2.06)	1.67 (1.83)	.908	2.00 (1.67)	2.31 (2.06)	.318		2.58 (2.36)	2.20 (1.81)	.052
Power	2.47 (3.70)	1.66 (2.16)	.161	1.56 (1.38)	1.21 (1.39)	.757		1.17 (1.61)	1.00 (.85)	.168	1.91 (2.05)	1.29 (1.77)	.206		1.67 (2.26)	1.31 (1.66)	.041
Reward	1.42 (1.43)	1.38 (1.18)	.462	1.22 (.94)	1.38 (1.16)	.358		1.22 (1.10)	1.42 (1.83)	.046	1.36 (1.33)	1.43 (1.30)	.578		1.29 (1.18)	1.40 (1.26)	.513
Risk	.42 (.90)	.07 (.26)	<.001	.22 (.73)	.10 (.30)	.026		.25 (.65)	.42 (.90)	.241	.23 (.53)	.16 (.42)	.236		.27 (.69)	.14 (.42)	<.001
Personal Concerns																	
Work	6.11 (7.51)	4.62 (3.77)	.340	5.33 (3.71)	4.74 (3.25)	.231		5.50 (4.32)	3.33 (1.30)	.005	5.50 (4.96)	5.82 (5.16)	.714		5.59 (5.08)	4.97 (4.02)	.212
Money	.05 (.23)	.14 (.35)	.054	.11 (.32)	.11 (.32)	.933		.03 (.17)	.00 (.00)	.244	.27 (.70)	.08 (.34)	.003		.11 (.40)	.10 (.32)	.708

Note: Numbers reflect the mean count of the words from the position descriptions by gender that fall within a given category. SDs are represented in parentheses below the means.
P-values significant at < 0.05.

Independent Samples t-Test

An independent-samples t-test was run to determine if there were differences in the dictionary categories to pronoun recommended between males and females. Inspection of a boxplot revealed that pronoun recommended was normally distributed for both groups in each version and combined versions and that there was homogeneity of variance as assessed by Levene's Test for Equality of Variances. Within version 1, there were 37 male and 90 female participants. Among the 37 male participants, 19 recommended males and 29 recommended females. In the dictionary, *affect*, male participants ($M = 3.74$, $SD = 2.67$) used more words compare to female participants ($M = 2.76$, $SD = 1.68$), a statistically significant difference, $M = 0.98$, 95% CI [-0.43, 2.39], $t(27.443) = 1.425$, $p = .018$. Other categories with a statistically significant difference were *drives* between males and females, with males responding more than females, $M = 2.36$, 95% CI [-1.91, 6.63], $t(21.349) = 1.149$, $p = .026$ and *achievement* between males and females, with males having a higher mean average word count than females, $M = 1.18$, 95% CI [-0.41, 2.77], $t(21.659) = 1.539$, $p = .002$. There was a statistically significant difference

in *risk* category between males and females, with males using more risk-oriented words than females, $M = 0.35$, 95% CI [-0.91, 0.80], $t(19.945) = 1.658$, $p = <.001$. On the other hand, within version 1, among the 90 female participants, 18 recommended males and 61 recommended females. There was a statistically significant difference in *authentic*, $M = 4.97$, 95% CI [-1.05, 10.98], $t(17.763) = 1.735$, $p = <.001$ and *risk*, $M = 0.12$, 95% CI [-0.25, 0.49], $t(18.717) = .701$, $p = .026$ dictionaries between males and females, with males using words more in these dictionaries than females.

Additionally, an independent-samples t-test was conducted in version 2. There was 58 males and 63 females. Males recommended 36 males and 12 females. There was a statistically significant difference in mean *affect* word count between males and females, $t(13.085) = -.662$, $p = .033$. *Reward* had a statistically significant difference between males and females, with females having a higher mean average word count in this dictionary category than males, $M = -0.19$, 95% CI [-1.40, 1.01], $t(13.732) = -.347$, $p = .046$. Since $p = .005$ is less than the chosen significance level $p = 0.05$, then the null hypothesis can be rejected, and conclude that the mean word count for males recommending males and females using *work* related words is significantly different, $M = 2.17$, 95% CI [0.53, 3.80], $t(45.846) = 2.668$, $p = <.005$. Furthermore, within version 2, females recommended 22 males and 51 females. There was a statistically significant difference between males and females, with males responding more in each of these dictionaries than females in mean *positive emotions,* $t(28.368) = .699$, $p = .048$, *social,* $t(25.893) = .628$, $p = .043$, *cognitive processes,* $t(26.148) = 1.062$, $p = .010$, *affiliation,* $t(28.935) = .778$, $p = .044$, and *money,* $t(25.278) = 1.237$, $p = .003$.

Lastly in table 7, an independent t-test was run on the data with a 95% confidence interval (CI) for the mean difference between pronoun recommended males and females in

combined versions. There were 95 males and 153 females. There was a statistically significant difference in mean word counts between pronoun recommended males and pronoun recommended females in authentic, social, cognitive processes, power, and risk dictionaries. Data showed statistically significant difference in *authentic*, $M = 1.27$, 95% CI [-1.23, 3.77], $t(128.612) = 1.005$, $p = .026$, *social*, $M = 0.41$, 95% CI [-.80, 1.62], $t(146.534) = .676$, $p = .035$, *cognitive processes*, $M = 1.15$, 95% CI [0.28, 2.58], $t(144.923) = 1.591$, $p = .013$, and *power*, $M = 0.37$, 95% CI [-0.16, 0.90], $t(156.243) = 1.368$, $p = .041$. Additionally, there was a statistically significant difference in the *risk* dictionary, with males using more risk-oriented words than females, $M = 0.14$, 95% CI [-0.02, 0.29], $t(136.485) = 1.740$, $p = <.001$. Among the 23 dictionaries and sub-dictionaries comparing pronoun recommended males to pronoun recommended females there were repeated statistically significant difference in mean word counts in authentic, affect, social, cognitive processes, and risk dictionaries. While in positive emotions, drives, affiliation, achievement, power, reward, work, and money dictionaries there was one statistically significant difference between the means in the two unrelated groups.

Furthermore, an independent samples t-test was chosen to compare the means of two independent groups: gender (males and females) by pronoun recommended (males or females) to determine whether there is statistical evidence that the associated population means are significantly different (Table 8). In version 1, pronoun recommended of males were compared to both males and females participants. There were 19 pronoun recommended males by males compared to 18 pronoun recommended males by females. Results showed the *authentic* dictionary had more words coded by female responses for recommending a male ($M = 6.56$, $SD = 12.01$) than male participants for recommending a male ($M = 1.16$, $SD = 2.17$), a statistically significant difference, $M = -5.40$, 95% CI [-11.43, 0.64], $t(18.049) = -1.879$, $p = .002$. Based on

the results for both males and females to recommend 29 to 61 females, in version 1, there was a significant difference in mean word count in the *achievement* category, $t(77.051) = -0.278$, $p = .031$.

In version 2, there was a statistically significant difference in mean word count in *affiliation* and *money* for 36 to 22 pronoun recommended males between males and females, $t(26.697) = -1.228$, $p = .006$ and $t(22.454) = -1.608$, $p = <.001$, respectfully. Lastly, the pronoun of the person they recommended, 12 to 51 females was compared between males and females' participants, where *affect*, $M = .534$, 95% CI [-2.24, 3.31], $t(12.152) = .419$, $p = .010$, *positive emotions*, $M = 0.191$, 95% CI [-2.18, 2.56], $t(12.406) = .175$, $p = .035$, *risk*, $M = .260$, 95% CI [-0.32, 0.84], $t(12.138) = .975$, $p = .006$, and *work*, $M = -2.490$, 95% CI [-4.12, -.086], $t(60.566) = -3.055$, $p = .010$, showed a statistically significant difference. In the work dictionary, female participants used twice as many words compared to males in the mean word count. Overall, table 8 highlights the authentic, achievement, affiliation, money, affect, positive emotions, risk, and work dictionaries reject the null hypothesis, and conclude that the that the mean word count for pronoun recommended males and pronoun recommended females are significantly different.

Table 8:

LIWC average word count per person of comparison pronoun recommended amongst gender and job position.

Dimensions Mean Word Count (SD)	Version 1: Science Lab Manager (dedication)						Version 2: Science Lab Graduate Research Assistant (brilliance)					
Gender	Male N = 37	Female N= 90	p-value	Male N = 37	Female N = 90	p-value	Male N = 58	Female N= 63	p-value	Male N = 58	Female N = 63	p-value
Pronoun Recommended	Chose Male N = 19	Chose Male N =18		Chose Female N = 29	Chose Female N = 61		Chose Male N = 36	Chose Male N = 22		Chose Female N = 12	Chose Female N = 51	
SUMMARY DIMENSIONS												
Dictionary Words Count	42.95 (40.77)	46.11 (24.13)	.327	34.66 (22.06)	37.80 (21.11)	.884	37.89 (33.63)	44.41 (39.91)	.448	36.75 (25.43)	42.29 (24.66)	.580
Analytical	30.79 (45.84)	23.44 (16.70)	.156	19.72 (45.84)	20.89 (18.78)	.945	28.97 (34.17)	20.68 (14.55)	.167	22.83 (18.69)	26.00 (24.66)	.572
Clout	39.47 (41.56)	40.22 (20.96)	.305	30.45 (19.07)	34.87 (20.26)	.888	32.92 (24.92)	35.05 (27.93)	.981	29.17 (17.27)	35.45 (22.50)	.781
Authentic	1.16 (2.17)	6.56 (12.01)	.002	2.34 (4.73)	1.59 (3.30)	.138	4.17 (14.98)	4.77 (8.11)	.685	2.08 (3.53)	4.94 (8.89)	.085
Tone	41.95 (44.10)	41.61 (26.20)	.567	32.97 (19.79)	36.61 (22.95)	.424	38.47 (37.56)	44.95 (36.93)	.793	38.42 (30.75)	44.16 (28.28)	.390
FUNCTION WORDS	25.37 (22.31)	28.50 (14.91)	.370	20.83 (13.35)	23.59 (12.88)	.725	23.14 (20.21)	26.82 (25.35)	.528	22.58 (15.37)	26.41 (14.75)	.559
Personal Pronouns	3.00 (2.65)	4.11 (2.42)	.980	2.76 (2.26)	3.57 (2.62)	.872	3.22 (2.71)	3.95 (4.10)	.571	3.17 (1.99)	3.33 (2.17)	.882
AFFECT	3.74 (2.67)	3.33 (1.97)	.134	2.76 (1.68)	2.66 (1.74)	.983	2.89 (2.27)	3.82 (3.39)	.125	3.75 (4.31)	3.22 (2.01)	.010
Positive Emotions	3.16 (2.48)	2.72 (1.71)	.199	2.62 (1.72)	2.41 (1.65)	.496	2.50 (2.01)	3.55 (3.10)	.091	3.25 (3.67)	3.06 (1.89)	.035
SOCIAL	6.42 (6.77)	6.94 (3.86)	.410	4.97 (3.09)	5.87 (3.82)	.414	4.58 (3.86)	5.86 (6.67)	.123	4.58 (3.45)	4.92 (3.42)	.598
COGNITIVE PROCESSES	6.26 (4.86)	7.44 (4.53)	.805	4.41 (3.70)	5.18 (3.82)	.482	5.36 (6.13)	7.95 (8.41)	.105	6.42 (5.13)	5.94 (4.42)	.609
PERCEPTUAL PROCESSES	.74 (1.24)	1.11 (1.41)	.508	.52 (.57)	.66 (.91)	.108	.33 (.68)	.77 (1.02)	.062	.25 (.62)	.51 (.78)	.076
DRIVES	7.95 (8.57)	6.44 (3.75)	.098	5.59 (3.21)	5.26 (3.26)	.503	4.86 (4.00)	5.95 (5.17)	.223	4.67 (4.40)	5.43 (3.96)	.565
Affiliation	1.68 (2.69)	1.06 (1.66)	.393	1.07 1.41)	1.02 (1.22)	.971	.61 (.73)	1.05 (1.56)	.006	.58 (.79)	.76 (1.01)	.732
Achievement	3.32 (3.18)	3.33 (2.45)	.426	2.14 (1.25)	2.23 (1.83)	.031	2.17 (2.06)	2.00 (1.67)	.582	1.67 (1.83)	2.31 (2.06)	.670
Power	2.47 (3.70)	1.56 (1.38)	.079	1.66 (2.16)	1.21 (1.39)	.114	1.17 (1.61)	1.91 (2.05)	.129	1.00 (.85)	1.29 (1.77)	.154
Reward	1.42 (1.43)	1.22 (.94)	.084	1.38 (1.18)	1.38 (1.16)	.564	1.22 (1.10)	1.36 (1.33)	.129	1.42 (1.83)	1.43 (1.30)	.213
Risk	.42 (.90)	.22 (.73)	.179	.07 (.26)	.10 (.30)	.359	.25 (.65)	.23 (.53)	.714	.42 (.90)	.16 (.42)	.006
Personal Concerns												
Work	6.11 (7.51)	5.33 (3.71)	.606	4.62 (3.77)	4.74 (3.25)	.803	5.50 (4.32)	5.50 (4.96)	.927	3.33 (1.30)	5.82 (5.16)	.010
Money	.05 (.23)	.11 (.32)	.202	.14 (.35)	.11 (.32)	.540	.03 (.17)	.27 (.70)	<.001	.00 (.00)	.08 (.34)	.098

Note: Numbers reflect the mean count of the words from the position descriptions by gender that fall within a given category. SDs are represented in parentheses below the means.
P-values significant at < 0.05.

DISCUSSION

The current study aims to expand upon the prior work in the domain of stereotypes about intellectual abilities within the STEM field, by examining the developmental life stage of emerging adulthood, as well as multiple environmental factors that may affect the recommendation of a male or a female for certain science careers.

Gender and Pronoun Recommended

Results demonstrated that as predicted, gender matters in college students' predilection to recommend a male or female for the brilliance or dedication job position. There was no significant association between class year and the pronoun of the person recommended, nor was

there a significant association between major and the pronoun recommended. It was initially hypothesized that male and female participants would demonstrate a bias of recommending males for the brilliance condition. However, contrary to the initial hypothesis, results indicated that female participants demonstrated a bias toward selecting a female over a male for the job with the brilliance condition in the job description. This study resulted in 69.9% of the time females selected females for the brilliance of the job, while 75.5% of males said males for the brilliance position.

While prior works have examined many aspects that influence children's and adults' evaluation and affiliation choices (e.g., in-group favoritism) based on the developmental roots of the bias against females in careers portrayed as requiring intellectual talent (Bian, 2017; Ceci & Williams, 2014), this research presents an examination of the developmental stage of emerging adulthood and its effect on the bias against females in careers portrayed as requiring intellectual talent. The present work marks an advance in our scientific understanding of the developmental course of emerging adults' gender stereotypes and implicit bias, which affect perception, intelligence, and career choices within STEM. The study's findings seem to suggest that these gender stereotypes are reevaluated and potentially changed during this developmental stage. Additionally, the study shows that these gendered stereotype beliefs are not fixed and the brilliance versus dedication stereotype in STEM fields is complex.

Bian et al. (2018) tested whether there was a bias against women in referrals for jobs in contexts that emphasized high-level intellectual ability. In this study, they recruited 347 adults. Participants were asked to refer acquaintances for a job where half were told the job was for brilliant individuals, while the other half was not. The study showed participants were less likely to refer women in the condition that emphasized intellectual ability (40.5% [35.1 to 46.1%]

female referrals) than in the control condition (52.5% [46.8 to 58.0%]). Women were referred at a 38.3% lower rate when the job description mentioned brilliance. Yet, the study showed that women were more likely to refer women than men were (56.3% [51.2 to 61.2%] and 32.9% [27.3 to 38.8%] female referrals, respectively). The study mentioned above was consistent with evidence from this study that, as a whole, both men and women were less likely to refer to a woman in the condition that emphasized intellectual ability, though the gap was less than expected and the gap has shrunk since Bian et al.'s study. Additionally, this study found there is a relationship between the gender of the participants and the gender of the referrals.

Moreover, the study showed consistency with the general tendency to favor one's own gender group (e.g., Dunham et al., 2011). In another study, Bian (2017) investigated whether the stereotype of brilliance in certain activities was already present in childhood. Out of two novel games ("Zorb" and "Tever"), one demonstrated the brilliance condition, while the other game was the baseline condition. Children were assigned only one of the conditions. Results showed a significant effect of gender. Both boys and girls selected their teammates mainly based on their own gender (boys: $t[95] = 7.94$, $p < .001$; girls: $t[95] = 11.25$, $p < .001$). Bian's study is consistent with this study's findings that there was strong favoritism toward one's own gender group within version 2 (brilliance condition). The analysis of version 2 provided evidence that messages about brilliance had a neutral effect on females, but not on males.

The effect of brilliance-focused messages on the implicit bias responses to the messages are being reevaluated in terms of female competence in STEM careers. These findings demonstrated the existence of new perspectives and characterizations of STEM careers in that both men and women can pursue prestigious, intellectually demanding careers. Some examples of efficient and effective interventions and implementations to increase retention rates for

women in all STEM fields are discussed below. Perhaps, interventions, including providing women mentorship and building a sense of community and engagement, are environmental changes causing women to narrow the gap in these STEM fields from their entrance into science fields, persistence in pursuing such positions, and staying in science. Activities, educational experiences, and encouragement from one's social network can persuade individuals to remain on a particular career path or in some cases to select another path that is more valued or in which one has more confidence (Messersmith et al., 2012). Female role models are important for recruiting girls and women into science fields and keeping them there.

However, Cheryan et al. (2011) argue that the role model, whether male or female, can have a negative effect on women's beliefs about being successful in STEM fields. Their study found when computer science role models embodied stereotypes of the field it had a negative impact on women's anticipated success. Thus, students' beliefs and their potential for success in that field can be impacted because of the interaction even if brief with a member of a field. Females face numerous obstacles when pursuing careers that are portrayed as requiring intellectual brilliance compare to males, such as sexual harassment, male favoritism, or lack of community. Studies show that males are deeply socialized in teachings and influences that lead males to believe that other males should be in positions of brilliance. To reinstate, 75.5% of males recommended males in the brilliance position. Findings were familiar with the gender stereotype. Males three-quarters of the time preferred males for the brilliance job, while only a quarter of males believed females could hold a job position requiring brilliance. The social and contingency of gender learning is so strong that another opportunity for intervention needs to be addressed towards males. Currently, within the STEM field, the male gender dominates men's mentorship, community, and engagement. Thus, intervention in creating mixed mentorship roles

where female mentors mentor male mentees could address gender dynamics and stereotypes. It is unclear and requires further study, if the issue lies in socialization, which is so deeply ingrained where the mindset and lived experience really shape an individual's belief, that the gender disparity can only be resolved over time, placing the burden on females.

Yet, it must be addressed that females also put other females in the dedication position 77.2% of the time. Women themselves believe the stereotype that women are better at organization, conscientiousness, and management detail work. Women are saying the same thing as men 60.4% of the time - they believe women should be recommended for the dedication position. It shows women have a stereotype or perhaps, to some extent, reflect popular thinking among both sexes, regardless of ability. Women are supporting the notion more than men, that these traditionally female positions of dedication roles are female-oriented. However, a job position focused on the demands of management and detail orientation to intellectually demanding work can come down to a life choice of outcome versus opportunity.

Celebration is still in order as this study found approximately 70% of women recommend women for the brilliance position. This pushes against a narrative of gender disparity and gender stereotypes and the effect it can have on future academia and employment. Our understanding of the gendered aspect of career choices is due to gendered attitudes in why some careers are customarily stereotyped to be either more male or female-oriented. Responses for women in both versions included positive language that placed emphasis on ability, achievement, research, and hard work. The once strong barriers and perceptions of gender norms are shrinking. Mediating gender discrepancies, gender role beliefs, self-perception socialization, and exposure to sociocultural stereotypes are thus malleable. By addressing this problem with an examination of emerging adulthood, we have a better understanding of how men and women are reshaping and

redefining how they perceive their own intellectual abilities and thus, how gender-based stereotypes and gender bias messages about math and science manifest and change throughout the lifespan. These findings will allow researchers, practitioners, and policymakers to provide evidence for their interventions in order to increase persistence and retention rates for women in STEM fields.

Implications

This study was cross-sectional in design and not a longitudinal study. Future studies utilizing a longitudinal methodology will be able to further understand the relationship between gender and gender perception and could assess the effect of growth on gender perception, thus impacting research on gender disparity in career choices. Furthermore, a longitudinal study could yield changes in gender and gender perceptions at different points in life and use the data to establish a sequence of events when looking at different developmental stages and address why these developmental shifts take place.

Limitations and Future Directions

Although this study reviewed some important findings, we must also note its limitations. First, the study focused solely on participants from a large higher education research institution, also considered an elite university. Because of the participants' enrollment at this elite university, they were considered high achieving students, stereotyped to have high academic achievement, high self-concept, and high career aspirations. Thus, we cannot generalize these findings to other students from other higher education institutions. Secondly, the study collected demographic data on each participant's gender, class year, major, and the pronoun of the person they would recommend for an imagined job. In viewing the participants as traditional-age college students or emerging adults, age was not a part of the demographics. Thus, participants disclosed class year

as the variable for age. Lastly, each participant's race was not collected. Thus, the study cannot be analyzed in terms of a race/ethnicity framework.

Moreover, the online surveys yielded biased responses because responses were self-reported and impacted by social desirability and recall bias. A self-reported recommendation is both beneficial and limiting as a variable. Self-reporting may lead to social desirability, which may impact responses, in particular, responses regarding whom they would recommend for the job. Self-reported pronoun recommendation and reasoning is subjective because it is an assessment of an individual's perception of the person they nominate. Moreover, recall bias could have influenced the recommendation and justification based on the participant's relationship with the individual in past events or experiences because they might incorrectly recall the person's qualities. Despite this limitation, the pronoun recommended is an important variable to examine because it was simple to ask participants to name an individual and provide a justification statement. It reduced the burden for participants to do any follow-up, such as coming back multiple times and investing a significant time to participate in the study.

Additionally, the study faced volunteer bias because of recruiting efforts. Participants were compensated with either an Insomnia cookie or a Dunkin' donut at each tabling event, while participants who were recruited electronically through list serves were not compensated with food. Food could have been an incentive for in-person participants to take the survey.

Regardless of the limitations in this study, continued research is needed to understand emerging adults and their varied experiences. For example, the participants were traditional-age college students studying at an elite university. Future research could examine how diverse intersectionalities influence the brilliance versus dedication stereotype. Though there was no significant association between major and the pronoun of the recommendation, future research

could look at how specific disciplines contribute to perceptions of the brilliance versus dedication stereotype beyond STEM fields. Additionally, reviewing each class year separately could provide another layer for understanding the brilliance versus dedication stereotype, as every class year was combined and analyzed under the developmental stage, that is, emerging adults.

Another research opportunity would include considering additional demographics. Demographics, such as race, were not a factor in this study. The study lacks data about whether race might moderate these stereotyped beliefs. It will be important to test whether these findings on emerging adults would extend beyond participants in an educational setting or a U.S. cultural context. Moreover, the sample used in this study was drawn from a single institution, so future research would be valuable to understand this brilliance versus dedication stereotype on a multiple-institution level and cross-cultural context. In addition, understanding the intellectual ability and career perception within the STEM field through institutionalized forces can lead to further understanding of how social, economic, and political construction impacts both individual and various (e.g., by gender, racial, or age) groups experiences.

Conclusion

The present study demonstrates that the developmental period of emerging adulthood is marked by a significant change to college students' perceptions about gender stereotypes on intellectual ability, such as the relationship between gender and gender recommendation. Furthermore, this study shows that female emerging adults show a crossover effect where they see women are deserving of these brilliance jobs. It is reassuring that these emerging adults, in particular women from the study, don't show the traditional stereotyped gender perception among both women and men, that believes men should be in the brilliance positions. There is

hope based on the cohort effect that the previous stereotypes of dedication and brilliance in the future can be replaced with more representation of women in the science field, such as younger female faculty. Lastly, this study demonstrates that both male and female college students are equally likely to recommend females for positions that require dedication. Findings show that it is not a simple story of males having gender stereotypes and females not having the same stereotypes. The finding of females recommending females for positions of brilliance as an emergent change in society should be celebrated, as it pushes against a narrative of gender stereotyping and the impact it can have on society.

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APPENDIX

Appendix A

Job descriptions used in the study

Version 1: Science Lab Manager (dedication)

A science department seeks a manager to assist the director of a large research group. Key skills include well-developed organizational abilities, meticulous attention to detail, and the ability to work well with others and help anticipate and resolve conflicts among the staff. Must be conscientious, diligent, hard-working, and dependable. The lab manager will also be tasked with locating published research articles and organizing them for the lab director.

Version 2: Science Lab Graduate Research Assistant (brilliance)

A science department seeks an exceptional beginning researcher to join a large research group. Key skills include exceptional quantitative ability, and innovative ideas relevant to designing, conducting, analyzing, and writing up experiments for submission to journals under the guidance of the lab director. Outstanding analytical ability required along with a superb academic record. Successful applicants will have demonstrated extraordinary talent in the domain of science.

Appendix B

Consent form

We are asking you to participate in a study titled *"College students' views on who would make a good science researcher."* This form is designed to give you information about this study. We will describe this study to you and answer any of your questions. The Principal Investigator of this study is Professor Wendy M. Williams, Department of Human Development, Cornell University. The graduate student working on the project is Jamie Hom, Department of Human Development.

What the study is about
The purpose of this research is to learn about the types of people college students feel would make good research-lab employees.

What we will ask you to do
You will be asked to describe a person from your high school or hometown who would be a good candidate for a science position at Cornell University.

Risks and discomforts
Questions involve you recollecting people from your high school or hometown. We do not anticipate any risks for participating in this study.

Benefits
There are no direct benefits to you other than the opportunity to think about who would do well in a STEM field. Indirect benefits include contributions to scientific knowledge.

Compensation for participation

There is no compensation for your participation.

Privacy/Confidentiality/Data Security
The data from this study will be stored on a password-protected computer and server system that can only be accessed by members of our research team. Identifying information such as this consent form will be kept separate from research data. Your confidentiality will be kept to the degree permitted by the technology being used. We cannot guarantee against the interception of data sent via the internet by third parties.

We anticipate that your participation in this survey presents no greater risk than your everyday use of the Internet.

This is a one-time study. You will not be contacted for a follow-up.

Taking part is voluntary
Your participation is voluntary. You may refuse to participate before the study begins, discontinue at any time, or skip any questions that make you feel uncomfortable. There will be no penalty and no effect on your academic standing, record, or relationship with Cornell University.

Data Sharing
De-identified data from this study may be shared with the research community at large to advance science and health. We will remove or code any personal information that could identify you or any other person before files are shared with other researchers to ensure that, by current scientific standards and known methods, no one will be able to identify you or any other person you name from the information we share. Despite these measures, we cannot guarantee the anonymity of your personal data.

If you have questions
The Principal Investigator is Professor Wendy M. Williams, Department of Human Development, Cornell University. The graduate student working on the project is Jamie Hom, a Master's student at Cornell University. Please ask any questions you have now. If you have questions later, you may contact Jamie Hom at jlh478@cornell.edu or Wendy M. Williams at wendywilliams@cornell.edu. If you have any questions or concerns regarding your rights as a subject in this study, you may contact the Institutional Review Board (IRB) for Human Participants at 607-255-6182 or access their website at http://www.irb.coorenlee.edu. You may also report your concerns or complaints anonymously through Ethicspoint online at www.hotline.cornell.edu or by calling toll-free at 1-866-293-3077. Ethicspoint is an independent organization that serves as a liaison between the University and the person bringing the complaint so that anonymity can be ensured.

Statement of Consent
I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

- Yes, I consent to take part in the study
- No, I do not consent to take part in the study