Examining interests and goals as predictors of gender differences in engineers’ pursuit of managerial roles

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Abstract

Background: Given the gendering of engineering roles and competencies, the evidence that the skills required for engineering management are widely referred to as social, and the fact that men engineers are stereotyped as more technical, and women as more social, it might be theorized that (a) those that occupy managerial (vs. technical) roles in engineering are more socially oriented, and (b) that this will especially be the case for women. However, no research has empirically tested the relationship between having socially oriented characteristics and being in managerial roles within the engineering profession, nor have gender differences been examined.

Purpose: We test whether social interests and communal goal strivings are linked to engineers’ positioning in managerial roles and explore gender as a moderator of these relationships. Additionally, because enterprising interests and agentic goal strivings have been linked to managerial roles in other occupations, we test these as additional predictors of engineers’ positioning in managerial roles.

Method: In a field survey of 274 industry engineers from multiple organizations and subfields, we tested the relationships described using hierarchical linear regression analysis.

Results: Enterprising interests and agentic goals, but not social interests and communal goals, were associated with being in managerial roles, and there were no gender differences in these relationships.

Conclusions: Our findings challenge perceptions that managerial roles in engineering, and particularly women’s positioning in these roles, are associated with socially oriented tendencies. Findings have implications for research on gender stereotyping and intraoccupational gender segregation in engineering and hold educational implications for curriculum, instruction, and advising.

Keywords
career paths, engineering profession, gender, goal striving, social/technical dualism, vocational interests
1 | INTRODUCTION

Although it is well known that engineering is one of the most highly and persistently sex-segregated occupations in the United States, what is less referenced are the patterns of intraoccupational sex segregation that appear to exist within engineering, such that women and men are segregated into different roles and career paths inside the profession (Cardador, 2017; Cardador & Hill, 2018; Cech, 2013). In particular, men occupy the most technical roles, and women are crowded into less core technical subfields (e.g., engineering management; Cech, 2013), roles that are often perceived to be associated with social primary work activities (e.g., supervision and administration; Cech, 2013; also refer to Cardador, 2017 and Cardador & Hill, 2018), and project management (Faulkner, 2000). In their comprehensive study of 5500 female engineers, Fouad et al. (2012) report that 54% of current women engineers have a managerial rank. While movement into supervisory and managerial roles would appear to be a good thing for women engineers’ careers, research suggests that this may not necessarily be the case. For example, as Faulkner (2007) notes, “Women also tend to get stuck in lower-level management jobs, such as project or team management, which can be dead-ends in terms of progression into more powerful seats of management: there is a glass ceiling in engineering management as elsewhere” (p. 349). Additionally, women engineers in managerial roles report greater intention to turnover, lower work satisfaction, and lower identification with their engineering colleagues (Cardador & Hill, 2018).

This pattern of intraprofessional gender segregation maps readily onto the technical/social dualism—a salient ideology within engineering that artificially separates technical work from social work and elevates technical over social skills (Cech, 2013; Faulkner, 2000). Technical skills are perceived as the highest status, most characteristic of “real engineering,” and stereotypically masculine, while social skills are perceived as lower status and are stereotypically feminine (Cech, 2013, p. 1152; also refer to Faulkner, 2000, 2007; Poor & Walden, 2009; Jolly, 2007). Additionally, roles like engineering supervision and management are perceived as social, not technical. Building on the notion of the technical/social dualism in engineering and the stereotyping of engineering jobs, Cardador (2017) describes an inverted role hierarchy in engineering whereby, in contrast to business contexts where managerial positions are considered to be high status and most suitable for men due to their connection to traits such as agency and assertiveness (Eagly & Karau, 2002), managerial (vs. technical) roles in engineering are devalued and feminized due to their connection to “soft” or “social” skills (Faulkner, 2007, p. 348), such as working well with others and being effective in communication, coordination, and interpersonal interaction (e.g., Faulkner, 2000; Shuman et al., 2005). Consistently, Male and colleagues have noted that “the gender stereotyping of engineering jobs causes important stereotypically feminine competencies to be seen as less important” (Male et al., 2009, p. 456).

Given the gendering of engineering roles and competencies, the evidence that the skills required for engineering management are widely referred to as “social” (Faulkner, 2007, p. 348), and the fact that men engineers are stereotyped as more technical while women engineers are seen as more social (McIlwee & Robinson, 1992; Ridgeway & Erickson, 2000; Woodfield, 2000), it might be theorized that (a) those that occupy managerial (vs. technical) roles in engineering are more socially oriented, and (b) that this is especially the case for women engineers. However, to our knowledge, no research has empirically tested the relationship between having socially oriented characteristics and being in managerial roles within the engineering profession, nor have gender differences been examined. This is a significant oversight given pervasive gender stereotyping that women engineers are more socially oriented than men engineers and that managerial roles are more associated with the people-side of engineering.

To address this gap, we examined two socially oriented characteristics—the social, vocational interest type (Holland, 1997), and communal goal striving (Abele & Wojciszke, 2014; Diekman et al., 2011)—as predictors of engineers’ positioning in managerial roles and explored gender differences in these relationships. We focused on interests and goal striving because both have been shown to be associated with career decisions and choice of career roles (Cardador et al., 2021; Dawis & Lofquist, 1984; Diekman et al., 2011; Evans & Diekman, 2009; Fouad et al., 1989; Su et al., 2009; Yang & Barth, 2015), and should thus be relevant to engineers’ intraoccupational career development. Vocational interests (referred to henceforth as interests) are dispositional characteristics that represent favorability toward distinct types of work (Holland, 1997; Holland & Gottfredson, 1992), and goal striving refers to how individual goals related to work are framed and what they entail (Diekman et al., 2011; Evans & Diekman, 2009). Social interests relate to a preference for working with and helping others, as well as developing relationships (Holland, 1997), and those with communal goals are motivated to cooperate with and focus on others (Diekman et al., 2011). Thus, both social interests and communal goals represent a social orientation toward one’s work—one is associated with finding satisfaction working with others (social interests) and the other is associated with having a desire to achieve cooperative and social goals (communal goals).
Additionally, given evidence from prior research that enterprising vocational interests (Holland, 1997) and agentic goal striving (Martell et al., 1998) are associated with the pursuit of managerial roles in other professions, we also examine these additional predictors of engineers’ positioning in managerial roles above and beyond social interests and communal goals. Enterprising interests are tied to a preference for work activities that entail leading, managing, and persuading others to attain organizational goals or economic gain (Holland, 1997), and those with agentic goal strivings are motivated by ambition, dominance, and competition (Diekman et al., 2011). While enterprising interests refer to preferences for work that allows one to lead or manage, agentic goals are associated with motives to achieve, have dominance over, and compete with, others.

We focus our analysis on these two variable clusters—social interests/communal goals and enterprising interests/agentic goals—because they, respectively, represent socially oriented versus leadership-oriented preferences and motives. As we have described, one cluster (socially oriented tendencies) is stereotyped to be associated with managerial roles in engineering, especially for women, and the other cluster (leadership-oriented tendencies) has been found to be linked with pursuing managerial roles in nonengineering samples. Overall, we answer the following questions with this research:

1. To what extent do social interests and communal goals predict engineers’ positioning in managerial roles, and what gender differences, if any, exist in these relationships?
2. To what extent do enterprising interests and agentic goals predict engineers’ positioning in managerial roles, above and beyond social interests and communal goals?

2 | BACKGROUND

2.1 | Predictors of positioning in managerial career paths in engineering

Prior research on technical/social dualism relates directly to the dominant career paths in engineering. Tremblay and colleagues describe the managerial and technical career paths in engineering industry jobs as two main career paths that engineers can pursue (Tremblay et al., 2002; also refer to Johnson & Sargeant, 1998). On the managerial path, a successful engineer is assigned to jobs with increasing administrative responsibility. On this path, the engineer engages in engineering management activities, such as project or product management, and/or gradually drops technical issues to concentrate on organizational and business activities. On the technical path, technical activities remain at the center, and engineers climb a specialized technical career ladder. They may also be involved in a succession of technical projects which broaden their technical skills instead of specializing in a particular sector.

The limited research on predictors of engineers’ choice of specific career paths within engineering firms has shown that increased tenure and engineers’ desire for advancement both predict orientation toward managerial paths (Tremblay et al., 2002). Additionally, identification with the profession has been linked to the pursuit of technical versus managerial roles in engineering, with the theory that those with a high level of identification with the profession should be more likely to seek recognition within the scientific community, and thus, show a preference for working in a path where they are most able to directly contribute to the advancement of technology science (Tremblay et al., 2002).

Specific to women’s positioning in managerial roles in engineering, research has shown that women are often advised by supervisors to take on managerial and supervisory roles. For example, Cardador (2017) describes how women engineers are noticed by supervisors for characteristics such as extraversion and proficiency at tasks that require communication and organizing skills (i.e., people skills) and subsequently are groomed for managerial roles independent of interest. Others have noted that “moving out of narrowly technical roles is likely to feel, and be perceived as, more ‘gender authentic’ for them [women] than men” (Faulkner, 2007, p. 348) because of the largely unchallenged notion in the engineering of “the technical” and “the social” as mutually exclusive and the widely held assumption that women engineers have stronger social tendencies than men engineers (Faulkner, 2007, p. 350).

While this prior research has offered valuable insights, it has not tested whether engineers’ socially oriented interests and/or goal strivings are indeed gendered or whether they are associated with being in managerial versus technical roles in engineering. Further, researchers have not explored whether socially oriented tendencies are more predictive of occupying managerial roles for women engineers than men engineers. This is a significant oversight in light of the persistent, artificial ideological separation between technical and social engineering tasks and roles linked to gender stereotypes (Faulkner, 2000).
2.2 The technical/social dualism and gendered positioning in managerial career paths

Consistent with the technical/social dualism in engineering, technical and social realms are seen as mutually exclusive, such that “To be ‘technical’ is to be ‘not-social’” and vice-versa (Cech, 2013, p. 1151; also refer to Faulkner, 2007). Engineering scholars have noted that although this dualism is a false representation of engineering in practice, it has been resistant to change despite professional engineers’ lived experience (Downey & Lucena, 2004). Moreover, this dualism’s assumed connection to gender has also been resilient to change. Technically focused (e.g., design-, science-, math-related activities, technical problem-solving) are gendered as masculine, and those thought to be socially focused (e.g., organizing, communicating with employees and clients) are gendered as feminine. Given this perceived connection between gender and the people-side of engineering (Cardador, 2017; Cech, 2013; Fletcher, 1999; Male et al., 2009), the association between having socially oriented tendencies and being in managerial roles is often made without empirical examination (refer to Cardador’s, 2017 analysis of how women engineers are groomed toward managerial roles because they are seen by their managers as being more social and having people skills). These gendered perceptions are further entrenched by findings that women, on average, score higher than men on social and communal tendencies (Diekman et al., 2010; Diekman & Steinberg, 2013; Eccles, 2007; Robertson et al., 2010; Su et al., 2009; Woodcock et al., 2013), and that women engineers are stereotyped to have stronger people skills (McIlwee & Robinson, 1992).

To test the empirical validity of the aforementioned association, we examined the role of social interests and communal goal strivings as predictors of managerial role occupancy in engineering and explored gender differences. Examining the role of vocational interests and goal strivings is important for at least two reasons. Our focus allowed us to investigate the presumption that engineers, and women particularly, will be in what are often perceived to be more socially oriented roles (such as managerial career paths) when they have more socially oriented interests and goals.

In addition to testing the roles of social interests and communal goal striving, we also tested the roles of enterprising interests and agentic goal striving. Enterprising interests have been consistently associated with preference for and positioning in managerial and leadership roles across many industries and occupations (Chan et al., 2000). Similarly, agentic qualities, values, and goals (e.g., ambition, assertiveness, directedness) have long been linked to leadership roles and are considered required for success as a leader (Eagly & Carli, 2007; Koenig et al., 2011). We wanted to test whether these associations extend to the engineering profession. Given that prior research has not shown gender differences in the endorsement of enterprising interests (Proyer & Häusler, 2007; Su et al., 2009), nor consistent differences between men and women in their agentic attributes and goal striving (refer to Eagly & Diekman, 2003 for a review), we did not expect gender to moderate these relationships.

2.3 Overview of research

In this study, we tested the association between social interests and communal goal striving and industry engineers’ positioning in managerial roles and examined gender differences. Further, we tested the association between enterprising interests and agentic goal striving (above and beyond social interests and communal goal striving) and engineers’ positioning in managerial roles. (Refer to Figure 1 for the conceptual model of the relationships examined.) We tested these relationships in a field sample of industry engineers using hierarchical regression. Using a large field sample of engineers improved the external validity of our findings, and hierarchical regression analysis allowed for the evaluation of the contributions of our focal variables above and beyond previously entered controls and predictors.

3 METHOD

3.1 Participants and procedure

We sampled 274 industry engineers from multiple subfields (e.g., civil, mechanical, chemical, and aerospace). We recruited study participants from a variety of sources, including a database of alumni of an engineering program in the mid-western United States and postings on engineering professional association social media sites. Participants completed an online survey.

The participants represented 20 engineering subfields and 108 unique companies. Participants were 40% women and had an average professional tenure of 9.9 years (SD = 9.2). We recruited women engineers to participate at
percentages above their representation in the workforce (women represent about 15% of the overall engineering workforce; NSF, 2015) by posting study information on the social media sites of professional associations for women in engineering (e.g., Society of Women in Engineers).

Of note, these data are part of a larger survey analyzing the engineers’ career paths (Cardador & Hill, 2018); however, none of the variables used in the current study, except for gender, have been included in prior published research.

3.2 Measures

Table 1 includes a summary of all study measures and associated question stems, as well as scales, sample items, and scale alpha coefficients (i.e., the degree to which the scale items are reliable or internally consistent).

Gender. Participants were asked to indicate their gender. Gender was dummy coded, women = 1 and men = 0.

Social interests. Social interests were measured with 10 items from Holland’s six vocational interest types: Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional (C) (RIASEC; Holland, 1997; Holland & Gottfredson, 1992). Participants were asked to “Read each question carefully and rate how much you would enjoy performing each, on a scale of 1 = strongly dislike to 5 = strongly enjoy.” They were further prompted to “Try not to think about if you have the training to do the work or how much money you would make doing the work, but rather if you would like or dislike doing the work.” Sample items included “Help people with personal or emotional problems” and “Give career guidance to people” ($\alpha = .79$).

Enterprising interests. Enterprising interests were measured with 10 items from the RIASEC (Holland, 1997; Holland & Gottfredson, 1992). Using a 5-point Likert scale (1 = strongly dislike, 5 = strongly enjoy), participants responded to the same prompt used for social interests. Sample items included “Manage a department within a large company” and “Negotiate business contracts” ($\alpha = .82$).

Communal goals. Communal goal striving was measured with nine items from the scale by Diekman et al. (2010). Participants responded on a 5-point Likert scale (1 = not at all, 5 = extremely) to a list of goals following the stem “How important is each of the following to you at work?” Examples of communal goals listed included “Working with people” and “Connecting with others” ($\alpha = .84$).

Agentic goals. Agentic goal striving was measured with 14 items from the scale by Diekman et al. (2010). Participants responded on a 5-point Likert scale (1 = not at all, 5 = extremely) to the same question stem used for communal goals. Examples of goals listed were “Achievement” and “Status” ($\alpha = .80$).

Managerial path. Consistent with prior research (Tremblay et al., 2002), the managerial path was measured with a single question, “When I think about my career trajectory, I am taking or have taken a managerial path” with a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Control variables. We controlled for variables that have previously been identified as related to the pursuit of managerial roles in engineering. We controlled for participants’ identification with engineering because high identification with the profession has been linked to the pursuit of technical versus managerial roles in engineering (Tremblay et al., 2002). We measured engineering identification with six items from Meyer et al. (1993), adapted for engineering. The only adaptation was that the original measure referenced nursing and nurses ($\alpha = .85$), which we changed to...
reference engineering and engineers. We did not use the measure of identification used by Tremblay et al. (2002) because their measure was from one of three dimensions from a dated professionalism instrument by Bartol (1979). The measure contained only three items and had a lower reliability. Participants responded on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) to the following sample items: “Engineering is important to my self-image” and “I do not identify with the engineering profession” (reverse coded) (α = .82). We controlled for professional tenure (the number of years working in the engineering profession) as advancement into managerial roles should be associated with advancing tenure (Tremblay et al., 2002). Professional tenure was measured with a single question: “For how many years have you been a practicing engineer?” Additionally, based on research showing that desire for advancement

## Table 1
Summary of measures, question stems and scales, sample items, and scale alphas

| Measure                  | Question stem and scale                                                                                           | Sample items                                                                                       | Scale alpha |
|--------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------|
| Gender                   | Gender was dummy coded, women = 1                                                                               | Women, men                                                                                         |             |
| Social interests         | “Read each question carefully and rate how much you would enjoy performing each, on a scale of 1 = strongly dislike to 5 = strongly enjoy. Try not to think about if you have the training to do the work or how much money you would make doing the work, but rather if you would like or dislike doing the work” | Help people with personal or emotional problems, Give career guidance to people                   |             |
| Enterprising interests   | “Read each question carefully and rate how much you would enjoy performing each, on a scale of 1 = strongly dislike to 5 = strongly enjoy. Try not to think about if you have the training to do the work or how much money you would make doing the work, but rather if you would like or dislike doing the work” | Manage a department within a large company, Negotiate business contracts                         |             |
| Communal goals           | Participants responded on a 5-point Likert scale (1 = not at all, 5 = extremely) to a list of goals following the stem “How important is each of the following to you at work?” | Working with people, Connecting with others                                                       | 0.84        |
| Agentic goals            | Participants responded on a 5-point Likert scale (1 = not at all, 5 = extremely) to a list of goals following the stem “How important is each of the following to you at work?” | Achievement, Status                                                                             | 0.80        |
| Managerial path          | “When I think about my career trajectory, I am or have taken a managerial path” with a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) | Single item                                                                                       |             |

| Controls                 |                                                                                                              |                                                                                                   |             |
|--------------------------|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------|
| Engineering identification| Participants responded on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) to the following: “How much do you agree or disagree with the following?” | Engineering is important to my self-image, I do not identify with the engineering profession (reverse coded) | 0.82        |
| Professional tenure      | Measured as the number of years in the engineering profession. Participants were asked, “For how many years have you been a practicing engineer?” | Single item                                                                                       |             |
| Desire for advancement   | Participants were asked whether “Desire for increased pay was linked to my career path choice in engineering;” dummy coded, 1 = yes | Single item                                                                                       |             |
| Supervisor encouragement  | Participants were asked whether “Supervisor encouragement was linked to my career path choice in engineering;” dummy coded, 1 = yes | Single item                                                                                       |             |
| Individualistic organizational culture | Using the stem “How would you characterize your organization’s culture?,” participants responded on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) | Rewards and recognition in my organization are based on individual achievement, The emphasis is on achieving personal objectives | 0.76        |
is associated with being in managerial roles in engineering (Tremblay et al., 2002), we included a dummy coded item that asked participants to indicate “yes” or “no” to whether “Desire for increased pay” was linked to their career path choice in engineering. Similarly, based on evidence that women are mentored into managerial roles in engineering (Cardador, 2017), we included a single dummy coded item which asked participants to indicate “yes” or “no” to whether “Supervisor encouragement” was linked to their career path choice in engineering. Finally, although the organizational climate has not been linked to engineers’ career path decisions, extensive research shows that individualistic and masculine organizational climates pose challenges to women’s experiences of belongingness and fit within engineering (Fouad et al., 2012), thus we controlled for individualistic organizational culture with three items (Chatman et al., 1998). Using the stem “How would you characterize your organization’s culture?,” participants responded on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) to the following sample items: “Rewards and recognition in my organization are based on individual achievement,” and “The emphasis is on achieving personal objectives” (α = .67).

4 | RESULTS

We first examined means, standard deviations, and bivariate correlations (symbolized with “r”) for all study variables. The managerial path was positively related to being a woman (r = .23), and being a woman was positively related to social interests (r = .15). Being a woman was also negatively related to engineering identification (r = −.13). However, no gender differences were shown for communal goals among the engineers in our sample (r = .05). Additionally, having high social interests (r = .16), enterprising interests (r = .40), and agentic goals (r = .32) were correlated with managerial path. The managerial path was unrelated to communal goals (r = .11). Of the study controls, engineering identification (r = .15), desire for increased pay (r = .26), and supervisor encouragement (r = .26), were all significantly and positively associated with positioning on the managerial path. Table 2 shows these relationships and other descriptive statistics.

We evaluated the relationships between interests, goal strivings, and managerial paths using hierarchical regression analysis. We first entered the control variables and gender into the regression model. Results showed a significant positive relationship between identification with engineering and managerial path (β = .26, p = .001), supervisor encouragement and managerial path (β = .20, p = .001), and gender and managerial path (β = .22, p = .001), but no significant relationship between professional tenure and managerial path (β = .00, p = .96) or between individualistic culture and managerial path (β = −.07, p = .27). Refer to Table 3, Model 1.

We next entered the social interests and communal goals variables into the model. Neither showed significant relationships with managerial path with the control other variables in the model (social interests: β = .12, p = .09; communal goals: β = .05, p = .23).

### Table 2: Means, standard deviations (SD), and bivariate correlations for all variables

| Variable                                | Mean | SD  | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |
|-----------------------------------------|------|-----|------|------|------|------|------|------|------|------|------|------|
| 1. Professional tenure                  | 9.92 | 9.15| –     |      |      |      |      |      |      |      |      |      |
| 2. Engineering identification           | 4.05 | 0.65| 0.07 | –     |      |      |      |      |      |      |      |      |
| 3. Individualistic organizational culture| 3.25 | 0.77| 0.04 | 0.10 | –     |      |      |      |      |      |      |      |
| 4. Desire for more pay                  | 0.28 | 0.45| −0.10| −0.05| 0.08 | –     |      |      |      |      |      |      |
| 5. Supervisor encouragement             | 0.21 | 0.41| 0.01 | 0.05 | −0.01| 0.14*| –     |      |      |      |      |      |
| 6. Gender                               | 0.40 | 0.49| −0.00| −0.13*| −0.06| −0.02| 0.05 | –     |      |      |      |      |
| 7. Social interests                     | 3.02 | 0.68| 0.06 | −0.16*| 0.09 | 0.02 | 0.12 | 0.15*| –     |      |      |      |
| 8. Enterprising interests               | 2.93 | 0.69| −0.17**| −0.02| 0.07 | 0.19**| 0.15*| 0.02 | 0.37**| –     |      |      |
| 9. Communal goals                       | 3.53 | 0.60| −0.05*| 0.08 | 0.13*| −0.01| 0.14*| 0.05 | 0.42**| 0.03 | –     |      |
| 10. Agentic goals                       | 3.71 | 0.44| −0.11| 0.34**| 0.23**| 0.21**| 0.13*| 0.05 | 0.29**| 0.22**| –     |      |
| 11. Managerial path                     | 3.27 | 1.24| −0.00| 0.15*| −0.01| 0.26**| 0.26**| 0.23**| 0.16*| 0.40**| 0.11 | 0.32**|

Note: N = 243–273. Gender was coded 1 = women, 0 = men; Desire for more pay and supervisor encouragement were dummy coded 1 = yes, 0 = no; Professional tenure was coded in years.

*p < .05; **p < .01.
communal goals: $\beta = .03, p = .67$). Thus, the prediction that social interests and communal goals would be associated with engineers’ positioning on the managerial path was not supported. Moreover, the effect of gender on the managerial path was consistent ($\beta = .21$ vs. $\beta = .22$) when social interests and communal goals were in the model, suggesting that being a woman was related to the managerial path above and beyond having social interests and communal goals. Refer to Table 3, Model 2.

We next examined whether gender would have a moderating effect on the relationships between social interests and communal goals, respectively, and the managerial path. We tested the interaction by first entering the mean-centered predictors and then entering the gender × social interests and gender × communal goals product terms into the regression model. Results showed no statistically significant gender × social interests ($\beta = .07, p = .46$) or gender × communal goals ($\beta = .03, p = .71$) interactions. Refer to Table 3, Model 3. Together, the results showed no gender differences in the effect of social interests and communal goals on being on a managerial path.

Finally, we tested the effect of enterprising interests and agentic goals on the managerial path, above and beyond controls, gender, social interests, and communal goals. We found a positive relationship between managerial path and enterprising interests ($\beta = .34, p = .001$), and between agentic goals and managerial path ($\beta = .15, p = .03$). Additionally, with enterprising interests and agentic goals in the model, the positive relationship between gender and managerial path remained significant ($\beta = .21, p = .001$; refer to Table 2, Model 4). For robustness, we tested the gender × enterprising interests and gender × agentic goals interactions as exploratory analyses. Neither of these interactions were significant ($\beta = -.06, p = .45$ and $\beta = .03, p = .73$, respectively). Refer to Figure 2 for a statistical model with coefficients for all relationships tested.

### 5 | DISCUSSION

An existing stereotype, informed by a perceived technical/social dualism in engineering, describes managerial roles in engineering as more “social” and associated with feminine expressiveness (Faulkner, 2007). Although researchers and
practitioners alike agree that the technical/social dualism fails to capture the reality of professional engineering practice, persistent gender stereotyping has tempted the conclusion that women engineers may occupy managerial roles in engineering because of their greater tendency to endorse social and communal interests and goals. We examined the evidence for this perception by exploring the extent to which social interests and communal goals predicted engineers’ positioning in managerial roles and whether there were gender differences in these relationships (Research Question 1). We reasoned that if social interests and communal goals were associated with being in managerial roles for engineers, the gender effect found in prior research (Cardador, 2017; Cardador & Hill, 2018), and this study, should be partially explained by including social preferences in the model. However, controlling for factors previously linked to occupying managerial roles in engineering, our results showed that social interests and communal goals did not predict being in a managerial role, and gender remained a significant predictor of managerial roles when accounting for these factors.

To test whether social tendencies matter more for women in association with managerial roles in engineering, we examined the moderating effect of gender on the relationships between social interests and communal goals, respectively, and being in managerial roles. The moderation tests showed no gender differences. However, we found that considering all interest types and goal strivings together, enterprising interests and agentic goals predicted being in a managerial role in engineering for both men and women.

Together, our results provide evidence that individual differences in social tendencies do not explain gender differences with respect to being in managerial roles but that enterprising and agentic interests do explain engineers’ positioning in managerial roles regardless of gender. These results debunk the notion that women are in managerial roles because of their social tendencies.

5.1 | Theoretical implications

These findings have theoretical implications for research on gender stereotyping in engineering. It has long been established that pervasive gender stereotyping exists in engineering such that men are perceived to be more technical and women more social and that “roles like management are perceived as just social, not technical” (Faulkner, 2007, p. 348; also refer to Cech, 2013 and Faulkner, 2000). Our findings refute these stereotypes associated with the technical/social dualism by showing that engineers are not more likely to occupy managerial roles when they have social tendencies, nor are there gender differences in this likelihood. While women in our sample did report higher levels of social interests than men, they did not report more communal goal striving as compared to men. These patterns suggest that researchers would do well to more precisely define and measure what it means to be “social” in engineering and to explore gender differences in the distinct ways that social tendencies can be expressed. For example, in our sample,
while women were more likely to endorse interests in helping and guiding others, both genders were equally likely to endorse the goals of working with and connecting with others. This suggests that men and women engineers may have socially oriented tendencies and preferences but express them in both similar and unique ways. Future research is needed to test for gender differences among engineers in additional social tendencies (e.g., social–emotional–behavioral skills; Soto et al., 2022), as well as the potential implications of these tendencies for engineers’ career development.

Our research also has theoretical implications for the literature on intraoccupational gender segregation in engineering. Prior research has shown that women engineers are crowded into roles in engineering that are perceived to be more socially oriented roles, such as project management, administration, and jobs that require communication with employees and clients and/or teaching (Cardador, 2017; Cardador & Hill, 2018; Cech, 2013; Faulkner, 2000). Our study aligns with this prior research, such that being a woman was predictive of being on a managerial path, above and beyond all other predictors in the models run (refer to Table 3). However, social interests and communal goals did not explain gender differences in occupying managerial roles. If social interests and communal goal endorsement do not explain gender differences in engineers’ pursuit of managerial roles, why might women crowd into these roles? One reason is likely to be that because women are stereotyped to be more social and communal and because management and supervisory roles are perceived to be associated with more social tendencies, women are encouraged to pursue less technical roles. In line with this idea, Cardador (2017) showed how women engineers are mentored into managerial roles because they are perceived by their own managers and supervisors as possessing greater social and communal interest than men engineers. Her study showed that there were clear gender differences in how engineers were tasked in project groups, with women—especially junior women—frequently assigned tasks that set them up to take on less technical and more managerial functions in the future. Cardador (2017) describes how gendered task assigning sets women engineers up to develop and be noticed for their proficiency at tasks requiring communicating and organizing (i.e., people skills), and subsequently, to be groomed for managerial roles. This prior research, combined with our results, suggests that it may not be women engineers’ unique interests and goals that set them up for taking managerial paths in engineering, but rather others’ presumptions about their interests and goals and concomitant assumptions about their fit for these roles.

Another explanation for women engineers’ selection into managerial roles could be to escape the identity and stereotype threat associated with the awareness that they are persistently perceived as less technically competent than men in technical environments (Logel et al., 2009). Extensive research documents the societal level gender biases that span most professional and occupational domains (Ridgeway & Erickson, 2000) and consistently the systemic bias and discrimination that women experience in engineering (e.g., Fouad et al., 2011). Moving into managerial roles may help women avoid the exclusion and marginalization they persistently face due to microaggressions, harassment, and unconscious bias (McIlwee & Robinson, 1992; Tonso, 2007) because they are less judged primarily for their technical competence in a managerial capacity. Future studies might examine identity and stereotype threats, as well as hostile organizational climate, as factors related to women engineers’ career path decisions.

Turning to our results pertaining to enterprising interests and agentic goals, we explored the extent to which both were associated with positioning in managerial roles, above and beyond social interests and communal goals (Research Question 2). We found that considering all interest types and goal strivings together, enterprising interests and agentic goals predicted being in a managerial role in engineering for both men and women. Furthermore, consistent with prior research in nonengineering samples (Diekman & Steinberg, 2013; Proyer & Häusler, 2007; Su et al., 2009), we found that the men and women engineers in our sample did not differ in their endorsement of enterprising interests or agentic goals. To our knowledge, this is the first study to examine these relationships in an engineering sample, and our findings suggest that engineers, like individuals in other professions (Chan et al., 2000; Eagly & Carli, 2007; Koenig et al., 2011), seem to be in managerial roles when they possess strong enterprising and agentic tendencies, perhaps because managerial roles provide opportunities for activities such as leading, directing, and persuading, as well as an outlet for ambition and work efficiency. The stronger effect of enterprising interests and agentic goals (vs. social interests and communal goals) on positioning in managerial roles suggests that the stereotype that those who occupy managerial roles in engineering are more socially oriented is not accurate according to our data. Reframing managerial roles in engineering as associated with leadership characteristics, such as ambition, attaining organizational goals, directing, and efficiency (i.e., those associated with enterprising interests and agentic goals), might go further in communicating the value of these roles in engineering firms than referring to these roles as “social.” It may also do more to communicate that managerial roles in engineering are linked to capabilities that affect work efficiencies and the bottom line of engineering firms. Both may, in turn, reduce the gender stereotyping associated with engineering skills and
competencies. Our findings introduce new avenues for future research into the personal preferences, goals, and capabilities that predict engineers’ pursuit of and success in distinct roles within the engineering profession.

On a related point, our findings refute a problematic gender bias associated with engineering management roles. Specifically, women in managerial roles are seen as “being social” and men in managerial roles are seen as “being leaders.” Our data may help refute this stereotype by suggesting instead that both men and women are in leadership roles, not when they have socially oriented tendencies, but when they have tendencies toward leadership and influence.

Finally, in line with prior research, analysis of the effect of our control variables showed that above and beyond interests and goals, desire for more pay and supervisor encouragement were related to engineers being on a managerial path (Cardador, 2017; Tremblay et al., 2002). However, contrary to prior research showing that engineering identification is highest among those in technical versus managerial career paths (Tremblay et al., 2002), we found a positive association between managerial path and engineering identification. In light of these consistencies and inconsistencies with past findings, future studies should continue to examine the factors—preferences, attitudes, contextual factors, opportunities, and threats—that affect professional engineers’ pursuit of technical versus managerial career paths in engineering, as well as potential boundary conditions to these factors.

5.2 Educational implications

The findings from this research carry educational implications for engineering curriculum, instruction, mentoring, and advising. First, related to our findings that challenge gender stereotypical notions about women’s positioning in managerial roles in engineering, part of engineering curricula could be explicitly devoted to explaining and refuting the technical/social dualism in engineering education through bias training (Rudman et al., 2001). Another option is to provide a full course or develop activities across courses (Mejia et al., 2018) devoted to helping students learn about stereotypes in engineering and how to dismantle them.

Second, and related to efforts aimed at changing stereotypes about separate roles in engineering, educators should strive to offer more assignments that combine technical and social skill development, such as assignments that require teamwork, presenting findings, and/or communicating with others. While engineering educators have long acknowledged the importance of teaching professional skills in addition to technical skills (Ford & Riley, 2003; Retnanto et al., 2019; Sageev & Romanowski, 2001), many students have limited opportunity to acquire these skills prior to entering the workforce (e.g., Long, 1997; Martin et al., 2005). Providing a curriculum that teaches all students to develop strong social, as well as technical skills might contribute to social skills being perceived as less gendered, and thus lessening the stereotype that social skills in engineering are associated with women. In a similar vein, educators should ensure that they are recognizing women students for their technical, as well as social skill, and men students for their social, as well as technical skill to reduce the degree to which these skills continue to be unnecessarily gendered in engineering.

Third, engineering advisors might consider providing more opportunities for engineering students to learn more about career paths in the engineering industry. Many students are uncertain or unaware of career paths in industry and could benefit from additional information during their education (Hewner & Guzdial, 2011). Our findings suggest that combining student exposure to knowledge about different career paths with efforts to help students better understand their own interests and goal strivings could be a fruitful strategy for helping students make informed decisions about career paths in the industry. For example, through exposure to various engineering roles (e.g., from guest speakers in courses and student organizations or by offering a stand-alone career development course), students could learn more about career paths in engineering and the types of work tasks they involve. This would help them determine how their own personal interests and goals align (or do not) with the various career paths in engineering.

Fourth, our finding that enterprising interests and agentic goal strivings were associated with being in managerial roles has implications for student instructors, mentors, and advisors. Engineering students interested in the industry might be counseled to learn more about the managerial path in engineering, particularly when they possess a strong interest in activities such as leading, organizing others, directing, influencing others, and improving work efficiencies. These tendencies can be observed during project teamwork or through student behavior in student clubs (e.g., robotics), for example. Student career advisors can also make available certain assessment tools (e.g., the RIASEC interest inventory, which contains the enterprising interest scale; Holland, 1997) to help students better understand whether their interests align with those associated with a managerial career path in engineering.
5.3 | Limitations and future research

This study has some limitations that suggest opportunities for future research. First, our cross-sectional design did not allow us to make causal claims. Thus, other explanations for the relationships observed may be plausible. For example, it may be that being in a managerial role increases enterprising interests and endorsement of agentic goals. Accordingly, future studies should adopt a longitudinal approach to better test the causality of relationships found here. Additionally, qualitative and mixed methods approaches should be considered in order to gain more nuanced insights into how vocational interests and goal strivings are operationalized in practice as engineers make decisions about their career pathways across both technical and managerial trajectories over time.

Second, our reliance on self-report measures is a potentially limiting feature common to field studies involving attitudinal or psychologically based constructs (Podsakoff et al., 2003). Although we used recommended practices to mitigate common method bias (Podsakoff et al., 2003)—for example, the employment of validated measures and scale items that were clear, simple, specific, and concise—future research could equate self-report measures of career path with organization-provided job titles.

Third, although we were able to improve the external validity of our research by sampling engineers from multiple organizations and subfields, we were not able to examine the effect of organization, engineering subfield, or industry on the pattern of results established here due to the small numbers of participants in any single organization, subfield, or industry. Thus, it may be that the connections between vocational interests and goal strivings, as well as gender differences in these connections, vary in some engineering firms, subfields, and industries. Accordingly, future studies should build on the findings presented here to test potential organization-, field-, and industry-level boundary conditions to the pattern of results found.

Fourth, given prior research showing that managerial roles may be perceived as less gender authentic for men (Faulkner, 2007), it may be that men underreport the extent to which they occupy the managerial (vs. technical) path in engineering, even when they are objectively performing managerial tasks. Thus, future research should strive to collect job title information rather than self-assessments of career paths. In a similar vein, given prior research that there are more men in management positions in engineering firms and that women are likely to be crowded into lower-level management positions (Faulkner, 2000, 2007), future research should attempt to measure different types of managerial roles associated with a managerial career path to develop an understanding of whether and how social tendencies are linked to different types of managerial roles in engineering.

Sixth, given our interest in the link between interests and goal strivings and managerial career paths among practicing engineers, our sample included only practicing engineers. Sampling practicing engineers introduces the possibility of range restriction, which might influence the findings. For example, women in our sample may score lower on social interests and communal goal strivings than women who have left the profession (however, note that Fouad and colleagues found no differences in social interests between women engineers who stayed or exited the profession; 2016). Another possibility is that, given the connection with managerial roles and greater intention to turnover for women (Cardador & Hill, 2018), and evidence that many women who leave engineering move into management (Fouad et al., 2011), the women in our sample may be in managerial career paths in lower numbers than those who have left. Consistent with this idea, Fouad et al., 2012 showed that the management rank of women working in engineering is about 45%, while the management rank of working women who have left engineering is approximately 75%. Accordingly, future research might benefit from examining the interests, goal strivings, and pre-exit career path decisions of engineers who have opted out of the engineering workforce.

Finally, some limitations with respect to sample demographics are worth noting. As the selection of gender was offered to participants as a binary choice, we did not capture the experience of nonbinary individuals. Additionally, as we did not measure additional demographic variables beyond gender (e.g., race), we were not able to determine the potential effect, if any, of demographic intersectionality. Future research would benefit from addressing these limitations.

6 | CONCLUSION

We found no support for social interests and communal goal strivings as predictors of positioning in managerial roles, nor did we find gender differences in these relationships. Moreover, while the women engineers in our sample scored higher on social interests, we found no gender differences in communal goals. We did find that enterprising interests and agentic goals were associated with positioning in managerial roles but again observed no gender differences in
these relationships, nor in engineers’ propensity to be enterprising and agentic. Our findings, taken together, challenge the notion that women engineers are in managerial roles because they have stronger social and communal tendencies and suggest instead that positioning in managerial roles is associated with being enterprising and agentic, desiring more pay, being encouraged by supervisors to pursue these roles, and having stronger identification with engineering. Consistent with prior research (Cardador, 2017; Cardador & Hill, 2018), being a woman was positively associated with being in a managerial role in our sample.

Our research offers insights that suggest novel directions for future research. First, men and women engineers were similar in the endorsement of communal goals suggesting that the women in our sample were not more socially oriented than the men. While women engineers have been stereotyped to have more socially oriented interests, goals, and skills than their men counterparts, our findings suggest that nuanced investigations are needed to relate to what it means to have social tendencies in the engineering profession and whether/how these tendencies map onto different career paths. Second, women were more likely to report taking managerial career paths, but this relationship was not explained by gender differences in interests or goals. This suggests that more research is needed to determine why and when women engineers pursue managerial paths. Moreover, given that a glass ceiling exists in engineering, as elsewhere, additional studies are needed to understand how the managerial paths that women hold are different from those held by men. Third, engineers in our sample were more likely to be in managerial roles when they reported being more enterprising and agentic. In other words, when they possessed more leadership interests and tendencies. This finding challenges the stereotype of managerial roles in engineering as more social and suggests that occupying these roles in engineering, as in other industries, is associated with preferences for directing and influencing others and accomplishing organizational goals. More research is needed to determine whether and how individual differences in engineers’ interests, goals, skills, and values are associated with their career path decisions within the profession. Our findings, taken together, challenge pervasive stereotypes about gender differences in suitability for distinct roles in engineering and provide the foundation for fruitful additional research to understand gender differences, as well as similarities in career path outcomes.

Our research also carries with it educational implications related to engineering curricula, instruction, mentoring, and advising. Training, courses, and course activities could all be devoted to helping students learn about stereotypes in engineering and how to lessen them. Incorporating professional skill development activities into technical classes and providing students with the opportunity to develop strong social as well as technical skills might contribute to these skills being less gendered. Providing more opportunities for engineering students to learn more about the career paths in the engineering industry may help students better understand how these paths map onto their own interests and goals. In particular, engineering students drawn to the industry might be mentored and advised to learn more about the managerial path in engineering, particularly when they possess a strong interest in activities such as leading, directing, influencing, and improving work efficiencies.

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REFERENCES
Abele, A. E., & Wojciszke, B. (2014). Communal and agentic content in social cognition: A dual perspective model. In J. M. Olson & M. P. Zanna (Eds.), Advances in experimental social psychology (Vol. 50, pp. 195–255). Academic Press. https://doi.org/10.1016/B978-0-12-800284-1.00004-7
Bartol, K. M. (1979). Professionalism as a predictor of organizational commitment, role stress, and turnover: A multidimensional approach. Academy of Management Journal, 22(4), 815–821. https://doi.org/10.5465/255817
Cardador, M. T. (2017). Promoted up but also out? The unintended consequences of increasing women’s representation in managerial roles in engineering. Organization Science, 28(4), 597–617. https://doi.org/10.1287/orsc.2017.1132
Cardador, M. T., Damian, R. I., & Wiegand, J. P. (2021). Does more mean less?: Interest surplus and the gender gap in STEM careers. Journal of Career Assessment, 29(1), 76–97. https://doi.org/10.1177/1069072720930658
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