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Entrepreneurial intent of engineering and business undergraduate students

Shannon K. Gilmartin[1] | Marissa E. Thompson[2] | Emily Morton[2] | Qu Jin[3] | Helen L. Chen[4] | Anne Colby[2] | Sheri D. Sheppard[4]

[1]Stanford VMware Women's Leadership Innovation Lab, Stanford University Stanford, California

[2]Graduate School of Education, Stanford University, Stanford, California

[3]Earnin, Palo Alto, California

[4]Department of Mechanical Engineering Stanford University, Stanford, California

Correspondence
Shannon K. Gilmartin, Stanford VMware Women's Leadership Innovation Lab, Stanford University, 589 Capistrano Way Stanford, CA, 94305.
Email: shannong@stanford.edu

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Abstract

Background: In recent years, technological innovation and entrepreneurship have been emphasized in engineering education. There is a need to better understand which individual- and contextual-level factors are related to engineering students' entrepreneurial intentions.

Purpose/Hypothesis: This study explores individual and contextual predictors of entrepreneurial intent among undergraduate women and men in engineering and business majors. Entrepreneurial intent is defined as the personal importance that students ascribe to starting a new business or organization.

Design/Method: The participants included 518 engineering and 471 business undergraduates from 51 U.S. colleges and universities. We examined relationships first by discipline and then by gender in each discipline using regression models with interaction terms.

Results: Innovation orientation and participation in entrepreneurship activities tied to intent more strongly for engineering students than for business students; in contrast, being at a research institution and selection of novel goals tied to intent more strongly for business students than for their engineering peers. Among engineering students only, being able to switch gears and apply alternative means for reaching one's goal in the face of setbacks was positively related with women's entrepreneurial intent but not with men's.

Conclusions: Entrepreneurial intent is a function of individual-level characteristics and academic and social contexts, with some degree of discipline-specific effects. Diversifying the community of aspiring engineering entrepreneurs is a critical issue that merits attention by the engineering education community.

KEYWORDS
cross-field comparison, entrepreneurship, gender, program design, regression

1 | INTRODUCTION

Engineering is often regarded as a driver of innovative technological advancements that fuel economic growth. In recent years, entrepreneurship education in engineering has been promoted as a means to augment the field's ties to innovation, as well as support

students' strategic thinking and creative problem-solving abilities as they graduate and enter the global workforce (Byers, Seelig, Sheppard, & Weilerstein, 2013). Increasingly, postsecondary institutions are building comprehensive learning environments for engineering innovation and entrepreneurial skill development involving entrepreneurship-focused courses; engineering core courses that have entrepreneurship elements in them; and engineering entrepreneurship centers, programs, and incubators (Gilmartin, Shartrand, Chen, Estrada, & Sheppard, 2016; Green, Smith, & Warner, 2012; Schar, Sheppard, Brunhaver, Cuson, & Grau, 2014).

Because models for these courses and programs may come from business schools (Colby, Ehrlich, Sullivan, & Dolle, 2011; Mars & Metcalfe, 2009), considering how engineering and business students have similar or different entrepreneurial interests can be illuminative, if not necessary, for program design. However, it is not enough to examine disciplinary differences. Consideration of how students' identities and positions within larger societal contexts play into entrepreneurship interests is critical as well in order to investigate the applicability of traditional entrepreneurship curricula to engineering students across a broad range of backgrounds.

Gender is one example. Gender is both a marker of identity and an "institutionalized *system* of social practices for constituting males and females as different in socially significant ways and organizing inequality in terms of those differences" (Ridgeway, 2001, p. 637; see also Ridgeway & Smith-Lovin, 1999). At the system level, entrepreneurship is a "male-typed" activity given its association with stereotypically masculine characteristics like risk-taking, competitiveness, leadership ability, and business sense (Thébaud, 2015). It is also characterized by a predominance of men. In the United States, for example, the rate of entrepreneurial activity among women is generally lower than the rate among men (Global Entrepreneurship Monitor, 2017); women entrepreneurs receive less venture funding than do their male counterparts and are underrepresented in most financial institutions awarding this funding (Kanze, Huang, Conley, & Higgins, 2017, 2018). These data raise several pertinent questions: How does gender matter to undergraduate students' formulation of entrepreneurial intent? How much do gendered (male-advantaging) dimensions of entrepreneurship vary by different educational contexts? What is the net implication of gendered entrepreneurial pathways for entrepreneurship program design across all fields of study? By studying how women's and men's interests unfold differentially within the context of their disciplines and broader social systems, we can gain new insight into gendered entrepreneurship patterns and the conditional effects of educational experiences (i.e., differential impact of the same learning environment). Program design in engineering stands to benefit from these expanded views.

Yet few studies have looked into individual characteristics and environmental or structural factors that may affect engineering students' entrepreneurial career interests, much less at how these factors compare between engineering and business students or between women and men by discipline. The current research helps to fill this gap. In this study, we focus on entrepreneurial intent as a measure of students' entrepreneurial interests, given that it is predictive of entrepreneurial behaviors in the future (Ajzen, 2002; Krueger & Carsrud, 1993). Entrepreneurial intent is defined as a "state of mind that directs attention, experience, and action toward a business concept, [setting] the form and direction of organizations at their inception" (Bird, 1988, p. 442). Drawing from Geldhof, Weiner, Agans, Mueller, and Lerner (2014), we operationalize intent as the personal importance that students ascribe to starting a new business or organization in their lives at any time. Personal importance is conceived as a potentially more stable indicator of long-term engagement with entrepreneurship than is a time-specific measure of one intended action, such as self-rated likelihood of starting a new organization at a future point.

2 | RESEARCH QUESTIONS

The purpose of this research is to compare factors that shape engineering and business students' entrepreneurial intent, and explore how gender may interact with these factors for students from both disciplines. The research is guided by the following three questions:

RQ1: Which individual and contextual factors are related to the entrepreneurial intent of engineering and business undergraduate students?
RQ2: How do these relationships differ for engineering and business undergraduate students?
RQ3: How do these relationships differ for women and men in engineering and business majors?

3 | LITERATURE REVIEW

3.1 | Conceptual framework

Relational Developmental Systems Theory (RDST) is our organizing framework for examining entrepreneurial intentions. According to RDST, individual and contextual characteristics reciprocally influence one another and together influence the

development of a person's goals and behaviors (Damon & Lerner, 2008; Lerner, Agans, DeSouza, & Gasca, 2013). The dynamic interaction between the individual and their context(s) is conceived as a developmental regulation; multivariate analysis using linear modeling techniques can serve as a proxy for such regulation, which is considered the foundational unit of analysis in RDST research (Geldhof, Weiner, et al., 2014).

RDST can be considered a meta-theory for describing human development (Overton, 2010, 2013). It also has been applied to specific questions about the development of entrepreneurial intent among young adults. For example, Geldhof, Weiner, et al. (2014) argue that entrepreneurial activities and behaviors require individuals to regulate interactions between their characteristics and contexts, and that entrepreneurship is an adaptive developmental regulation because it carries benefit to the individual and to society as a whole. Entrepreneurship, moreover, is a dynamic state realized through ongoing interaction of multiple social and individual factors rather than a fixed state that is the sum of individual traits (Geldhof, Porter, et al., 2014).

An RDST framework grounds our model-building and testing by specifying the domains that help to explain phenomena and why they are interrelated. With RDST, we identify three categories of factors that may be related to students' entrepreneurial intent: personal characteristics, including students' attitudes and self-concepts; contextual variables, including students' major field of study and the types of activities they are involved in; and background characteristics, such as students' race/ethnicity, socioeconomic status, and gender. Background characteristics occupy a distinct space in this mapping insofar as we see these characteristics exerting influence as both individual attributes and contextual frames; for example, gender is both an individual characteristic and a social context, or system, that conditions and organizes people's evaluations and behaviors. The degree to which social contexts more broadly (social status, cultural beliefs, structural locations) are embedded in what we consider to be background characteristics is a rich sociological perspective to layer onto RDST, one that we begin to develop in this paper and look toward future work for amplification. (See Ridgeway (2001, 2011), Correll and Ridgeway (2003), and Thébaud (2015) for theoretical approaches that can deepen consideration of how RDST's "adaptive regulations" may be, in practice, differentially accessible to high versus low status groups in a given context, leading some but not others to enjoy a benefit of the doubt in an entrepreneurial landscape.)

3.2 | Previous research on personal characteristics, contextual variables, and background characteristics relating to entrepreneurial intent

Whether in concert with or separately from an RDST framework, prior research has looked at the relationships among many personal, contextual, and background factors and entrepreneurial intent among college-age and adult populations. Below, we summarize previous work in each of the three categories. Where previous work was limited on the relationship between a variable and entrepreneurial intent per se, we expanded our review to also consider predictors of entrepreneurial self-efficacy, entrepreneurship-related interests, and entrepreneurial behaviors and outcomes, such as being self-employed. Self-employment is not the only or even best measure of entrepreneurial behavior or entrepreneurship-related outcomes, but it is a commonly used one. See Thébaud (2016) for a discussion of the strengths of and limitations to this measure.

Personal characteristics such as intentional self-regulation, which highlights the importance of goal-directed behaviors in promoting adaptive developmental regulations, play an important role in the formation of entrepreneurial intent (Damon & Lerner, 2008). Intentional self-regulation, or "agentic control over one's own development" (Geldhof, Weiner, et al., 2014, p. 83; Gestsdóttir & Lerner, 2008), is specifically manifested as goal selection, optimization of the conditions under which one can realize their goals, and goal compensation, or seeking out alternative means of reaching these goals when the first strategy does not yield results (Geldhof, Weiner, et al., 2014). These self-regulatory actions are shown to be critical to academic achievement and individual development generally in a well-developed body of psychological and educational research (e.g., Lerner et al., 2011). Geldhof, Weiner, et al. (2014) propose that self-regulation is fundamentally catalytic to not only entrepreneurial intent but also the achievement of entrepreneurial success.

Other predictors of entrepreneurial intentions include positive attitudes toward risk and independence (Douglas & Shepherd, 2002) and proactive behaviors (Crant, 1996). Self-efficacy, or the strength of one's belief in their ability to complete tasks and goals (Bandura, 1977, 1997), may mediate the development of entrepreneurial intentions (e.g., Zhao, Seibert, & Hills, 2005). Using meta-analysis methods, Zhao et al. (Zhao & Seibert, 2006; Zhao, Seibert, & Lumpkin, 2010) reported that select Big Five personality characteristics, especially conscientiousness, openness, and emotional stability, were moderately correlated with entrepreneurial career choice.

Critically, many of these characteristics are often studied in neutral terms, that is, with minimal or no attention to cultural beliefs and socioeconomic resources that influence one's ability to be positively evaluated as an agentic risk-taker, for instance. Questions about cultural bias in the personal characteristics perceived as especially beneficial to or reflective of entrepreneurial action and success are raised in such studies as Thomas and Mueller (2000), Ahl (2006), Thébaud (2015), Malmstrom,

Johansson, and Wincent (2017), and Wheadon and Duval-Couetil (2017). RDST is a powerful if not underutilized theoretical framework for exploring the variable expression of personal characteristics within and because of cultural context (and biases therein).

Additional contexts such as family, social networks, and educational environments can shape not only career choice but also entrepreneurial intent. Echoing Carr and Sequeira's (2007) finding that family business exposure predicted an individual's entrepreneurial intent, Engle, Schlaegel, and Delanoe (2011) showed that the presence of an entrepreneurial parent was a significant predictor of entrepreneurial intent in a multinational study of university students, with some variation by country (and especially in a small group of countries that included the United States). In this study, cultural dimensions as clustered by region, such as regional scores on measures of gender egalitarianism, were related to entrepreneurial intent as well, indicating that context, whether locally proximate to an individual or measured at the level of societal organization, can act on individual entrepreneurial pathways.

For college students, contexts such as field of study and previous experience in entrepreneurship activities, courses, and programs can be related to entrepreneurial intent (Duval-Couetil, Reed-Rhoads, & Haghighi, 2012; Jin et al., 2016; Nabi, Holden, & Walmsley, 2010; Souitaris, Zerbinati, & Al-Laham, 2007). Although institution- and region-level entrepreneurial ecosystems may be formative to the development of students' intent, causal or even temporal links between the features of different ecosystems and student intentions are less studied, much as research on the impact of entrepreneurship education is limited (Huang-Saad, Morton, & Libarkin, 2018).

Turning to background characteristics, studies suggest that underrepresented racial/ethnic minorities (URMs) in the United States have higher entrepreneurial intent than do other race/ethnicity groups. For example, Rodriguez, Chen, Sheppard, Leifer, and Jin (2015) found that URM engineering alumni were more likely to be interested in being entrepreneurs compared with non-URM engineering alumni. Similarly, Wilson, Marlino, and Kickul (2004) found that African American and Hispanic girls had higher levels of interest in becoming entrepreneurs than did White/Caucasian girls (but these differences were not reported among boys). However, in considering the translation of intent to behavior and using self-employment as one such behavioral measure, the self-employment rate is lower for URM groups than for Whites, with rates of incorporated self-employment highest among Asian and White groups relative to Black/African American and Hispanic/Latino/a groups (Hipple & Hammond, 2016). This disconnect between intent and later behaviors may reflect differential and unequal access to financial assets, credit, and other forms of entrepreneurship capital by racial/ethnic group in the United States (Fairlie & Robb, 2010). Recent reports indicate that self-employment among URM women is markedly increasing, although women business owners in every racial/ethnic group have lower revenues/receipts than do their male peers, in connection with their high rates of sole proprietorship/having small firms (Fetsch, 2015).

Socioeconomic status (SES), a background characteristic that is tightly coupled with the family contexts described above, also may link to entrepreneurial intent and action. Levine and Rubinstein (2017), in an analysis of national (U.S.) longitudinal data, find that those who are self-employed in incorporated firms come from higher-income backgrounds and tend to be White, male and well educated, relative to salaried workers and those self-employed in unincorporated firms. Although research is limited on the role of SES in the development of intent from an early age, Schoon and Duckworth (2012) find that family SES and having a father who is self-employed (a correlate of SES) conditionally matter to both intent and outcomes. For instance, family SES has an indirect positive effect on entrepreneurship outcomes via positively influencing young people's social skills that predict entrepreneurship in adulthood. The measure of entrepreneurial intention in this study is one of personal importance of working for oneself at age 16, and the outcome measure of entrepreneurship is self-employment at age 34.

Gender, like race/ethnicity and SES, operates in and as context. Although an increasing percentage of women overall have pursued entrepreneurial careers since the 1990s (Lowrey, 2006), women are still less involved in entrepreneurial activities than are men (Global Entrepreneurship Monitor, 2017). Women entrepreneurs are asked more questions from would-be funders about potential business losses, while men entrepreneurs are asked more questions about potential business gains, a difference that has significant consequence for gender disparity in fundraising outcomes (Kanze et al., 2018). In a foundational study of gender, entrepreneurship, and innovation, Thébaud (2015) describes how male-advantaging gender status beliefs (e.g., believing that men are more competent in male-typed domains conceived as requiring high levels of risk tolerance, business sense, aggressiveness, and competition) manifest in lower ratings of women entrepreneurs compared with men entrepreneurs; in addition, the perceived innovativeness of a business model has stronger and positive effects on evaluations of women's entrepreneurial ability compared with men's (perhaps compensating for cultural perceptions of women's competence deficits). Gender biases in evaluation of entrepreneurs can be extended to uncertain macroeconomic conditions; for example, as small-business lending fell in the years immediately following the 2008 recession, women-led firms had greater difficulty

securing funding than did men-led firms even though there is little evidence suggesting women are unable to repay loans at rates any different from those among men (Thébaud & Sharkey, 2016).

The development of entrepreneurial intent and its translation into career outcomes may accordingly vary by gender. For example, family resources are important to both women's and men's entrepreneurial outcomes, but family SES may be more important to women's entrepreneurial pathways, and having an entrepreneurial (self-employed) father may be more important to men's (Schoon & Duckworth, 2012). In light of research suggesting that women have lower entrepreneurial self-efficacy than do men (Wilson, Kickul, & Marlino, 2007), BarNir, Watson, and Hutchins (2011) find that role models may have a stronger influence on women's entrepreneurial self-efficacy compared with men's and that entrepreneurial self-efficacy mediates the effect of role-modeling on intention more strongly for women than for men.

Not all studies of gender and entrepreneurship employ statistical models with interaction terms to examine how the effect of a particular environment or characteristic depends on gender, net other potentially confounding characteristics, limiting insights into gendered patterns of entrepreneurship intentions and behaviors. Gender, moreover, operates intersectionally and interdependently with other aspects of students' identities in larger systems of socioeconomic, cultural, and political privilege and power. Wilson et al.'s (2004) study is distinctive in its focus on the relationship between entrepreneurial interests and both race/ethnicity and gender among young people; in their work, some gender gaps in entrepreneurship-related motivations varied by racial/ethnic group.

3.3 | Modeling entrepreneurial intent

Whereas many studies rely on bivariate analyses to understand entrepreneurial intent, others have tested multivariate models of intent and compared the relative importance of multiple predictors in a single model. Geldhof, Weiner, et al.'s (2014) study of intent through a relational systems lens falls into this latter category. Here, structural equation models (run for women and men separately) tested relationships between intent and eight self-regulation constructs, innovation orientation, and having an entrepreneurial parent in a sample of upward of 3,000 undergraduate students across all fields of study at a single time-point. Self-regulation constructs such as novel goal selection and optimizing goals through individual initiative positively predicted intent, as did innovation orientation. Optimizing goals through persistence and diligence had a net negative effect on intent. The only contextual measure in Geldhof et al.'s analysis, having an entrepreneurial parent, was positively albeit weakly related to students' intent. Gender (not specified as an individual or contextual level factor) did not moderate results, although gender differences were observed on mean scores of several constructs, including intent itself.

Few studies have statistically modeled the entrepreneurial intent of engineering students specifically. Lüthje and Franke (2003) used structural equation modeling to investigate how engineering students' entrepreneurial intent related to individual risk-taking propensity and internal locus of control, and perceived contextual barriers and supports. Though each of these measures was directly or indirectly linked with students' intent (based on a single-institution sample), the findings were not disaggregated by gender, and there were no comparison groups of students from other disciplines.

Building on this work, the current research will provide a much-needed comparative perspective on the development of entrepreneurial intent among undergraduate women and men in engineering. By selecting a range of measures not typically tested in engineering education research and constructing parallel, multivariate models of intent for engineering students and business students, we can assess the extent to which engineering undergraduates are similar to (or different from) their peers when it comes to entrepreneurship and what this might mean for program design. This study extends previous and largely bivariate research by the authors (Jin et al., 2016; Jin, Gilmartin, Sheppard, & Chen, 2015) and multivariate analysis on a larger, aggregate sample by Geldhof, Weiner, et al. (2014) in that engineering and business students' intent is analyzed as a function of multiple interdependent factors selected on the basis of theoretical (RDST) framing; such factors are assessed in terms of relative strength of relationship to intent; and the conditional effects of characteristics and contexts (by field of study and gender) are investigated. Intent itself is conceived in terms of personal relevance and importance to one's life goals, versus plans to engage in one specific action. Although the study does not employ longitudinal data, our definition of intent, and conceptions of entrepreneurship more broadly, presume a dynamic and socially contingent process through which women and men in engineering and business (differentially) come to see entrepreneurial pathways as important, possible, and viable.

4 | METHODS

This study draws from national survey data collected through the Young Entrepreneurs Study (YES) to address our three research questions. YES is a longitudinal, mixed-methods study designed to understand the relationships among personal

characteristics, contexts, and the development of entrepreneurship in young adults, testing core tenets of an RDST framework (i.e., what RDST theorists might refer to as co-action of individuals and their contexts in the realization of developmental milestones and goals; Geldhof, Porter, et al., 2014, Geldhof, Weiner, et al., 2014). The multi-item YES survey includes three waves of data collected from students registered at universities and colleges centered in three regions of United States: New England, the Midwest, and the West Coast. For the first wave of data collection in 2012, YES researchers emailed instructors at schools in the target regions with a request to distribute the survey to students in their classes. Students were given course credits or were entered into a drawing for iPads as survey response incentives. Two pilot studies were conducted prior to the first wave of data collection to explore and confirm the factor structure of the scales (Geldhof, Weiner, et al., 2014; Weiner, Geldhof, & Lerner, 2011).

4.1 | Sample characteristics

Data for our study draw from the first survey wave. Based on the larger sample of 3,461 YES survey respondents across all academic disciplines, our sample includes all 518 engineering and 471 business undergraduate respondents who were enrolled at 51 U.S. universities and colleges. The number of engineering and business participants varied from school to school; the largest number was 100 (10% of all participants) and among the smallest was 15 (2% of all participants). Our selection of engineering and business majors builds on histories of developing entrepreneurship learning environments in each field (Gilmartin et al., 2016; Standish-Kuon & Rice, 2002); this said, the specific programmatic features of entrepreneurship education at each of the 51 institutions were not collected as part of YES.

Consistent with research on gender differences in survey response rates (e.g., Martikainen, Laaksonen, Piha, & Lallukka, 2007), women are overrepresented in the YES sample, especially among engineering students. Forty-two percent of engineering respondents and 51% of business respondents self-identified as women (see Table 1), compared with 20% and 47% of engineering and business bachelor's degree earners, respectively, nationally (U.S. Department of Education, 2015).

Approximately 82% of engineering respondents and 88% of business respondents were born in the United States. Drawing from the National Science Foundation's (NSF) definition of underrepresented racial/ethnic minorities (URM) in U.S. science, mathematics, engineering, and technology fields (Guenther & Didion, 2014), URM students (i.e., students from Black/African American, Hispanic/Latino/a, American Indian/Alaska Native, and Native Hawaiian/Pacific Islander backgrounds) make up 13% of engineering students and 11% of business students in the sample (Table 1). These percentages compare with 13% and 22% of the national population of engineering and business bachelor's degree-earners, respectively (U.S. Department of Education, 2015). The average age of respondents was 20.7 ($SD = 1.4$) in the engineering sample and 21.2 ($SD = 1.4$) in the business sample.

4.2 | Variables

4.2.1 | Dependent variable

Entrepreneurial Intent is the dependent variable in the regression models constructed for this study. This variable was operationalized as a scale using the following four survey items that measure the personal importance of starting/developing a new business or organization at any time in the future: (a) Start my own business, (b) Develop my own business, (c) Start a new organization, and (d) Change the way a business or organization runs. Each individual item was measured on a five-point Likert scale with responses ranging from "1" (not at all important) to "5" (extremely important). Responses across these four items were averaged to calculate the final score. The Cronbach's alpha value for this scale in the study sample was 0.89 (Nunnally & Bernstein, 1994).

A normality check confirmed that the dependent variable was approximately normally distributed. This variable is identical to the dependent variable in Geldhof, Weiner, et al.'s (2014) analyses. The items in Entrepreneurial Intent were part of a larger set of YES survey items labeled "Life Goals," such as "Have a strong relationship with my family" and "Be regularly involved in volunteer activities."

4.2.2 | Independent variables

Consistent with literature reviewed above, independent variables for our regression models were selected and grouped into three categories: personal characteristics, contextual variables, and background characteristics. The 10 personal characteristic variables tested in our regression models were a subset of the 31 scales/subscales in the YES survey. All 10 scales/subscales

TABLE 1 Description of categorical variables for engineering and business students

	Engineering		Business	
	n	%	*n*	%
Total	518	100	471	100
Background characteristics				
Gender				
Male	297	58	231	49
Female	216	42	239	51
URM Status				
URM	66	13	53	11
Non-URM	448	87	416	89
Mother's Highest Education Level				
Did not finish high school	17	4	23	5
Graduated from high school	50	10	62	14
Some college	80	17	131	29
4-year degree	180	37	160	36
Graduate degree	154	32	69	16
Contextual variables				
Entrepreneurship-Oriented Major				
Yes	283	55	199	42
No	235	45	272	58
Research Institution				
Yes	483	93	222	47
No	35	7	249	53
Entrepreneurial Parent				
Yes	203	43	212	47
No	272	57	236	53

Note: All percentages in this table are valid percentages (missing data are excluded).

met sufficient standards of reliability in the study sample, with Cronbach's alpha values equal to or greater than 0.70 (Nunnally & Bernstein, 1994), except for one borderline subscale at 0.69 (but deemed sufficient for our work). Measures of intentional self-regulation composed the majority of these variables, given their importance to the development of entrepreneurial intent (Damon & Lerner, 2008; Geldhof, Porter, et al., 2014; Geldhof, Weiner, et al., 2014); these included scales for Goal Selection, Goal Optimization, Goal Compensation, and Loss Based Selection (see Table 2). In addition, based on simple correlations between Entrepreneurial Intent and the YES variables (see Jin et al., 2015), we also included select measures correlated with intent but outside of the self-regulation domain: Innovation Orientation, Career Value (Challenge and Social), and Sense of Self—Movers and Shakers (see Table 2). (Of these latter four variables, only Innovation Orientation was tested in Geldhof, Weiner, et al., 2014's models. See Geldhof, Porter, et al., 2014 for details about subsequent model elaboration, in which Financial Risk Tolerance and having a mentor were added to the equations, and qualitative data were integrated into the analysis. Patterns related to these two new variables were not conclusive.) The ranges, means, and standard deviations of the personal characteristic measures are summarized in Table 3.

The four contextual variables included in our analyses are having an entrepreneurship-oriented major, institutional type, involvement in entrepreneurial activities, and having an entrepreneurial parent. Being in an entrepreneurship-oriented major is considered a contextual variable as it is an indicator of academic environment. It was operationalized based on a single career-goal question in YES that allowed for the identification of how many students in a given major were focused on starting an organization versus all other options (which consisted of joining an existing organization, being an artist, being involved in politics, and other). Using this logic and building on Jin et al.'s (2016) analysis of major-by-major ratios between starters and joiners, industrial, civil, mechanical, and computer engineering majors were categorized as entrepreneurship-oriented majors within engineering (relative to all other engineering fields in the sample), and business administration, international business,

TABLE 2 Descriptions of the scales measuring the 10 personal characteristic variables

Dimensions of Intentional Self-Regulation (response scales for all self-regulation survey items range from 1 = almost never to 5 = almost always)

Goal Selection includes two subscales: *Novel* (three items; α = 0.78) and *Challenge* (three items; α = 0.88). Selection of novel goals represents a preference for selecting goals others have not considered or that fulfill an unmet need. An example item from Goal Selection—Novel is "I like to pursue projects that others have not thought about pursuing." Selection of challenging goals represents a preference for selecting challenging goals, projects, and tasks. An example item from Goal Selection—Challenge is "I prefer to take on challenging projects."

Goal Optimization includes two subscales: *Self Starter* (three items; α = 0.80) and *Persistence* (three items; α = 0.70). Goal Optimization—Self Starter represents the ability to self-motivate goal optimization (Geldhof, Weiner, et al., 2014). An example item from the subscale of Self Starter is "I take initiative when something needs to get done." Optimization through persistence represents diligence and efficiency in goal attainment. An example item from the subscale of Persistence is "I work diligently to complete my tasks."

Goal Compensation (six items; α = 0.91) represents the ability to switch gears and apply alternative means for reaching a goal when faced with setbacks or failures. An example item from the scale of Goal Compensation is "When one approach fails, I try different ways to reach my goals."

Loss Based Goal Selection (four items; α = 0.71) represents the ability to adaptively switch goals in the face of insurmountable failure. An example item is "I keep an eye out for other opportunities I can pursue in case a project fails."

Other personal characteristic measures

Innovation Orientation (six items; α = 0.84) asks participants to rate the extent to which they engage in a list of innovation-related behaviors. Example items are "Search out new technologies, processes, techniques, and/or product ideas" and "Develop adequate plans and schedules for the implementation of new ideas." The items were measured on a five-point Likert scale with responses ranging from 1 (almost never) to 5 (almost always).

Career Values are defined as the importance attached to different career rewards, and are closely related to career choice (Johnson, 2002). The scale of Career Values was adapted from the Job Value Scales (Johnson, 2001, 2005). Two career value subscales were included in this study: *Challenge* (six items; α = 0.72) and *Social* (two items; α = 0.69). An example from the subscale of Challenge is "A career where you can see the payoff of what you create." An example from the subscale of Social is "A career that is worthwhile to society." Items in each scale were measured on a five-point Likert scale with responses ranging from 1 (not important) to 5 (extremely important).

Sense of Self measures characteristics that are relevant to participants' sense of who they are as a person. An example item from the subscale of *Movers and Shakers* (nine items; α = 0.76) is "Willing to stand up for what I believe is right." The items were measured on a five-point Likert scale with responses ranging from 1 (not at all central to my sense of self) to 5 (very central to my sense of self).

Note: Respondents' scores on each scale represent averages across constituent items.

TABLE 3 Range, mean, and standard deviation of approximate interval scaled variables

		Engineering		Business	
Variables	**Range**	***M***	***SD***	***M***	***SD***
Dependent variable					
Entrepreneurial Intent	1–5	2.93	1.06	3.54	1.00
Independent variables					
Personal characteristics					
Goal Selection—Novel	1–5	3.79	0.70	3.80	0.74
Goal Selection—Challenge	1–5	3.93	0.71	3.89	0.71
Goal Optimization—Self Starter	1–5	3.83	0.72	4.07	0.71
Goal Optimization—Persistence	1–5	4.08	0.60	4.12	0.62
Goal Compensation	1–5	4.11	0.58	4.13	0.62
Loss Based Selection	1–5	3.21	0.66	3.26	0.68
Innovation Orientation	1–5	3.35	0.72	3.50	0.76
Career Value—Social	1–5	3.95	0.86	3.97	0.82
Career Value—Challenge	1–5	3.92	0.55	3.96	0.59
Sense of Self—Movers and Shakers	1–5	3.42	0.60	3.62	0.60
Contextual variables					
Entrepreneurship Activities	0–4	0.63	0.43	0.80	0.45

management, and entrepreneurship majors were entrepreneurship-oriented majors within business (relative to all other business fields in the sample).

Institutional type was operationalized as attending a research institution versus attending all other institutions, where institutional classifications were based on the 2010 Carnegie Classification scheme (Carnegie Foundation, 2011). We included this measure as an exploratory variable, given that institutional type was salient in previous work on engineering students' career plans (e.g., Sheppard, Antonio, Brunhaver, & Gilmartin, 2014). A research institution (relative to all others) might have more extensive facilities for students to explore technology-based innovation and entrepreneurship ideas. On the other hand, faculty at nonresearch institutions might be more encouraging of undergraduates developing their innovative and entrepreneurial ideas.

Entrepreneurship Activities was operationalized as the average number of times participants had ever been involved in seven entrepreneurship-related activities when they took the YES survey: (a) Starting a club, (b) Organizing people around a cause, (c) Devising ways to make money, (d) Designing a new product or service, (e) Developing a business plan, (f) Starting a business, and (g) Buying or selling a company. The five response options ranged from "0" to "4 or more." The survey did not include additional measures of entrepreneurial activities.

Finally, having an entrepreneurial parent was identified through two survey questions that ask whether respondents' parents (Parent 1 and Parent 2, respectively) had ever started a business. We assigned a value of "1" to the variable if either of two parents had ever started a business and a value of "0" to the variable if neither had ever started a business. The four contextual variables are summarized in Tables 1 and 3.

Our three variables classified as background characteristics are Gender, URM Status, and Mother's Highest Education Level. Respondents' gender was coded as "Male" or "Female" according to a binary question on the YES survey. The URM variable was coded on the basis of respondents' self-reported racial/ethnic background, such that students marking "Black or African American," "Hispanic/Latino," "Pacific Islander," and/or "Native-American/Alaska Native" were coded as URM, and students marking "White, Caucasian, Anglo, European American; not Hispanic," "Asian, or Asian American, including Chinese, Japanese, and others," "Asian Indian/(Asian) Indian-American," and "Arab-American" were coded as non-URM (labels for each category are those presented verbatim on the survey; our coding follows NSF groupings defined earlier). Students who marked multiple backgrounds that included at least one underrepresented racial/ethnic background were classified as URM; other "Multiethnic" or "Other" responses were classified as non-URM. For the small number of respondents ($n = 6$) who provided uninterpretable text descriptions of their race/ethnicity, their URM Status was coded as missing.

Because parents' education levels can be used to indicate students' SES and mother's education level has a stronger correlation with SES than does father's education level (Donaldson, Lichtenstein, & Sheppard, 2008; Schoon & Duckworth, 2012), in this study we used students' self-reported mother's highest education level as a proxy for SES. Mother's Highest Education Level was coded into five categories from "1" (Did not finish high school) to "5" (Graduate degree). In the case that a respondent did not name a mother (whether adoptive, biological, step, etc.) as a primary parental figure, the mother's education variable was considered missing for the purpose of this analysis. Table 1 summarizes percentages associated with the background variables for engineering and business students.

4.2.3 | Candidate independent variables not included

The YES survey includes other measures that have been shown to be important in youth development, such as Self-Efficacy Optimism and Hopeful Future Expectations. These variables were not tested in the regression models for this study because they had smaller correlations with our measure of entrepreneurial intent (Jin et al., 2015) and/or had not been tested in Geldhof, Weiner, et al. (2014).

4.3 | Data analysis

The percentage of missing values on each variable ranged from 0–7%. Mean replacement was the selected missing data strategy for all variables on which there was < 1% missingness. Listwise deletion was the selected missing data strategy for four variables (Gender, URM Status, Mother's Highest Education Level, and Entrepreneurial Parent), where the percentages of missing values were higher (1% on Gender and URM Status, 6–7% on Mother's Highest Education Level and Entrepreneurial Parent). Statistical analyses conducted in STATA 15 indicated that these data were missing completely at random (MCAR), which substantiated our choice to use listwise deletion.

To answer the first research question about predictors of entrepreneurial intent in the aggregate sample, an ordinary least squares (OLS) linear regression model with all independent variables was built and tested among engineering and business students combined. For this model, variance inflation factors (VIFs) for the independent variables suggested that there was

little multicollinearity in the model (Kutner, Nachtsheim, Neter, & Li, 2005). All independent variables were tested as categorical or approximate interval scaled variables as noted in Tables 1 and 3 (mother's education was tested twice, first as a categorical variable and then as an approximate interval variable, with little difference in the results; findings for this variable are reported using the approximate interval measure).

To answer the second research question about differences between engineering and business students, three OLS regression models were built: (a) A model with all independent variables among engineering students only, (b) A model with all independent variables among business students only, and (c) A model with all independent variables along with their interaction terms with discipline of study among engineering and business students. The purpose of the third model was to test the difference in the parameter estimates between the two disciplines.

To answer the third research question about relationships between gender and intent, all independent variables along with their interaction terms with gender were tested in separate regression models for engineering and business students, respectively.

Each model with interaction terms was run twice: first with main effects uncentered and second with main effects centered to ensure that multicollinearity between main and interaction effects had no material effects on the model, which it did not (see Allison, 2012). To facilitate comparability of coefficients across the models, we report the models with uncentered terms.

5 | RESULTS

RQ1: Individual and contextual factors related to entrepreneurial intent

Table 4 summarizes the regression analysis results for the model of intent among all engineering and business students. The model was significant ($F[18, 877] = 36.13$, $p < 0.001$) and explained 41% of the total variance in the dependent variable. Business students were significantly more likely to have entrepreneurial intent than were engineering students.

Among the background characteristic variables, men were more likely than women to have higher levels of entrepreneurial intent, and higher levels of education among mothers linked to lower levels of intent among students. URM and non-URM students had statistically comparable levels of intent, holding all other variables in the model constant.

Among personal characteristics, Entrepreneurial Intent was significantly and positively related to Goal Optimization—Self Starter (standardized coefficient Beta, or $\beta = 0.07$), Innovation Orientation ($\beta = 0.22$), and Career Value—Challenge ($\beta = 0.15$). Based on Beta coefficients, Innovation Orientation is the strongest predictor among the personal characteristics variables, followed by Career Value—Challenge. Goal Optimization—Persistence, which measures respondents' propensity toward realizing goals through diligence and efficiency, was a significant negative predictor ($\beta = -0.11$) of Entrepreneurial Intent.

All four contextual variables were significant predictors of intent. Controlling for discipline, students from entrepreneurship-oriented majors were (perhaps unsurprisingly) more likely to have entrepreneurial intent ($\beta = 0.10$). Also, students attending a research institution ($\beta = 0.09$), students having greater involvement in entrepreneurial activities ($\beta = 0.12$), and students having an entrepreneurial parent ($\beta = 0.09$) showed higher levels of entrepreneurial intent than did their peers. Among these four contextual variables, Entrepreneurial Activities is the strongest predictor of intent.

RQ2: Differences by discipline

To compare factors that may influence entrepreneurial intent in engineering versus business, three linear regression models were generated. The first two models did not include interaction terms and the third model included interaction terms with discipline of study. Table 5 summarizes the results for the two models without interaction terms, with the left panel showing results for engineering students and the right panel showing results for business students. The engineering student model ($F[17, 444] = 17.34$, $p < 0.001$) and the business student model ($F[17, 416] = 17.43$, $p < 0.001$) reached statistical significance, explaining 38% and 39% of the total variance, respectively. Thus, our variables do not describe intent in one discipline better than they do in another. The collective explanatory power is the same.

For both engineering and business students, there were four common significant factors: Gender: Female, Innovation Orientation, Career Value—Challenge, and Entrepreneurship-Oriented Major. All except Gender: Female were positively related to intent.

The separate models in Table 5 also show distinct predictors for engineering and business majors. For business students but not for engineering students, Mother's Highest Education Level was a negative predictor of Entrepreneurial Intent, whereas Goal Selection—Novel was a positive predictor of intent, as was being at a research institution. For engineering students but not for business students, two contextual factors, having an entrepreneurial parent and Entrepreneurship Activities, were

TABLE 4 Linear regression results for engineering and business students (listwise $n = 896$), with Entrepreneurial Intent as the dependent variable

	Unstandardized coefficients		Standardized coefficients	
	B	***SE***	**Beta (β)**	***Sig.***
(Constant)	−0.32	0.31		
Discipline of Study: Business	0.57	0.07	0.26	***
Background characteristics				
Gender: Female	−0.28	0.06	−0.13	***
URM Status: URM	0.14	0.09	0.04	
Mother's Highest Education Level	−0.07	0.03	−0.07	**
Personal characteristics				
Goal Selection—Novel	0.11	0.06	0.07	
Goal Selection—Challenge	0.05	0.06	0.03	
Goal Optimization—Self Starter	0.10	0.05	0.07	*
Goal Optimization—Persistence	−0.20	0.06	−0.11	**
Goal Compensation	0.02	0.06	0.01	
Loss Based Selection	0.07	0.04	0.04	
Innovation Orientation	0.32	0.05	0.22	***
Career Value—Social	0.01	0.04	0.01	
Career Value—Challenge	0.29	0.06	0.15	***
Sense of Self—Movers and Shakers	0.10	0.06	0.06	
Contextual variables				
Entrepreneurship-Oriented Major	0.21	0.06	0.10	***
Research Institution	0.20	0.07	0.09	**
Entrepreneurship Activities	0.30	0.07	0.12	***
Entrepreneurial Parent	0.20	0.06	0.09	***
F-statistics	$F(18, 877) = 36.13$, $p < 0.001$			
R^2	0.43			
Adjusted R^2	0.41			

Note: Personal characteristics scales are described in Table 2.
$^{*}p < 0.05$. $^{**}p < 0.01$. $^{***}p < 0.001$.

positive predictors of Entrepreneurial Intent, and Goal Optimization—Persistence was a negative predictor of intent. Geldhof, Weiner, et al.'s (2014) parallel finding that Goal Optimization—Persistence was a negative predictor of intent among an aggregate sample of college students (despite, as the authors note, having a positive simple correlation) is accordingly expanded and qualified in the results from this study. For business students, a positive simple correlation between persistence and intent ($r = 0.17$, $p < 0.001$) is explained by other measures of self-regulation (with persistence having a nonsignificant negative parameter coefficient in the final model), while for engineering students, a nonsignificant correlational relationship between persistence and intent ($r = 0.06$, $p > 0.05$) becomes stronger, significant, and negative, holding other measures constant. Persistence in completing tasks and realizing goals (see Table 2) may operate, or read, differently for engineering majors and business majors, a point we return to in the Discussion section.

In the next step, a linear regression model with interaction terms was constructed to test if the differences in the importance of the factors (i.e., difference in parameter estimates) are significant or not for the two disciplines. The model with interaction terms ($F[35, 856] = 20.18$, $p < 0.001$) was significant and explained 43% of the total variance of Entrepreneurial Intent. Table 6 summarizes the results for engineering (top panel) and interaction terms for each variable with business (bottom panel).

Looking at the interaction terms in Table 6, Goal Selection—Novel and Research Institution had stronger positive relationships with Entrepreneurial Intent for business students than for engineering students, while Innovation Orientation and

TABLE 5 Linear regression results for engineering (listwise $n = 462$) and business (listwise $n = 434$) students separately, with Entrepreneurial Intent as the dependent variable

Engineering					Business			
	Standardized coefficients	Unstandardized coefficients			Unstandardized coefficients		Standardized coefficients	
Sig.	Beta (β)	*SE*	*B*		*B*	*SE*	Beta (β)	Sig.
		0.47	0.10	(Constant)	0.05	0.40		
				Background characteristics				
***	−0.16	0.08	−0.34	Gender: Female	−0.27	0.08	−0.13	**
	0.04	0.12	0.12	URM Status: URM	0.18	0.13	0.06	
	−0.03	0.04	−0.03	Mother's Highest Education Level	−0.10	0.04	−0.11	**
				Personal characteristics				
	−0.04	0.09	−0.06	Goal Selection—Novel	0.25	0.08	0.18	**
	0.04	0.08	0.06	Goal Selection—Challenge	0.07	0.08	0.05	
	0.04	0.07	0.06	Goal Optimization—Self Starter	0.14	0.07	0.10	
**	−0.16	0.08	−0.29	Goal Optimization—Persistence	−0.09	0.08	−0.05	
	0.02	0.09	0.04	Goal Compensation	−0.04	0.08	−0.03	
	0.07	0.06	0.12	Loss Based Selection	0.02	0.06	0.01	
***	0.29	0.07	0.42	Innovation Orientation	0.21	0.07	0.16	**
	0.03	0.06	0.04	Career Value—Social	0.00	0.06	0.00	
**	0.15	0.09	0.30	Career Value—Challenge	0.31	0.09	0.18	***
	0.06	0.09	0.11	Sense of Self—Movers and Shakers	0.09	0.09	0.05	
				Contextual variables				
*	0.09	0.08	0.18	Entrepreneurship-Oriented Major	0.22	0.08	0.11	**
	−0.05	0.16	−0.19	Research Institution	0.30	0.08	0.15	***
***	0.21	0.11	0.53	Entrepreneurship Activities	0.08	0.10	0.04	
**	0.11	0.08	0.25	Entrepreneurial Parent	0.15	0.08	0.08	
	$F(17, 444) = 17.34, p < 0.001$			*F*-statistics	$F(17,416) = 17.43, p < 0.001$			
	0.40			R^2	0.42			
	0.38			Adjusted R^2	0.39			

$^{*}p < 0.05$. $^{**}p < 0.01$. $^{***}p < 0.001$.

Entrepreneurship Activities had stronger positive relationships for engineering students than for business students. Notably, the percentage of engineering students who were from nonresearch institutions was very small (only 7%), while approximately one-half of business students were from nonresearch institutions. Limited variability among engineering students might help to explain why there was a relatively weak relationship between this variable and Entrepreneurial Intent for these students.

We want to highlight here that a nonsignificant interaction term in Table 6 does not indicate that the factor was a significant predictor for both disciplines (in Table 5). For example, the interaction term between discipline and Mother's Highest Education Level was not significant in Table 6. The nonsignificant interaction term suggests only that the difference in the parameter estimates between the two disciplines was not statistically significant at $p < 0.05$. Recall that this variable was a significant negative predictor in the model of business students' intent but not in the model of engineering students' intent. Thus, we can still consider mother's education to play a stronger role relative to other variables in the model for business students. Similarly, a significant interaction term in Table 6 does not suggest that the factor was significant for one discipline but not for the other. For example, the interaction term between Discipline of Study: Business and Innovation Orientation was significant in Table 6, and Innovation Orientation was a significant predictor for both disciplines in Table 5. Innovation Orientation appears to affect intent in both disciplines, and, comparatively speaking, the net effect is stronger in engineering compared with business.

TABLE 6 Results for the linear regression model of Entrepreneurial Intent with interaction terms for Discipline of Study (listwise $n = 896$)

			Unstandardized coefficients		Standardized coefficients	
			B	*SE*	Beta (β)	*Sig.*
Engineering students						
(Constant)			0.10	0.46		
Background characteristics						
Gender: Female			−0.34	0.08	−0.16	***
URM Status: URM			0.12	0.12	0.04	
Mother's Highest Education Level			−0.03	0.04	−0.03	
Personal characteristics						
Goal Selection—Novel			−0.06	0.08	−0.04	
Goal Selection—Challenge			0.06	0.08	0.04	
Goal Optimization—Self Starter			0.06	0.07	0.04	
Goal Optimization—Persistence			−0.29	0.08	−0.16	***
Goal Compensation			0.04	0.08	0.02	
Loss Based Selection			0.12	0.06	0.07	
Innovation Orientation			0.42	0.07	0.29	***
Career Value—Social			0.04	0.05	0.03	
Career Value—Challenge			0.30	0.09	0.16	**
Sense of Self—Movers and Shakers			0.11	0.09	0.06	
Contextual variables						
Entrepreneurship-Oriented Major			0.18	0.08	0.09	*
Research Institution			−0.19	0.15	−0.08	
Entrepreneurship Activities			0.53	0.10	0.21	***
Entrepreneurial Parent			0.25	0.08	0.11	**
Difference between two disciplines	*Sig. For Eng.*	*Sig. For Bus.*				
Discipline of Study: Business			−0.08	0.62	−0.04	
Background characteristics						
Gender: Female × discipline	***	**	0.08	0.12	0.03	
URM Status: URM × discipline			0.06	0.18	0.01	
Mother's Highest Education Level × discipline		**	−0.08	0.05	−0.13	
Personal characteristics						
Goal Selection—Novel × discipline		**	0.30	0.12	0.55	**
Goal Selection—Challenge × discipline			0.01	0.12	0.02	
Goal Optimization—Self Starter× discipline			0.09	0.10	0.17	
Goal Optimization—Persistence × discipline	**		0.20	0.12	0.40	
Goal Compensation × discipline			−0.08	0.12	−0.16	
Loss Based Selection × discipline			−0.10	0.09	−0.16	
Innovation Orientation × discipline	***	**	−0.21	0.11	−0.36	*
Career Value—Social × discipline			−0.05	0.08	−0.09	
Career Value—Challenge × discipline	**	***	0.01	0.13	0.02	
Sense of Self—Movers and Shakers × discipline			−0.01	0.12	−0.02	

(Continues)

TABLE 6 (Continued)

			Unstandardized coefficients		Standardized coefficients	
			B	***SE***	**Beta (β)**	***Sig.***
Contextual variables						
Entrepreneurship-Oriented Major × discipline	*	**	0.04	0.11	0.02	
Research Institution × discipline		***	0.48	0.17	0.19	**
Entrepreneurship Activities × discipline	***		−0.44	0.15	−0.20	**
Entrepreneurial Parent × discipline	**		−0.09	0.12	−0.03	
F-statistics	$F(35, 856) = 20.18$, $p < 0.001$					
R^2	0.45					
Adjusted R^2	0.43					

$^{*}p < 0.05$. $^{**}p < 0.01$. $^{***}p < 0.001$.

RQ3: Gender differences within discipline

To explore gender differences in these relationships, we built two regression models separately for engineering and business students. Interaction terms with gender were added to the two models after controlling for main effects of all independent variables. For business students, no interaction term (including those between Gender: Female and URM Status and Gender: Female and Mother's Highest Education Level) was statistically significant. The story is largely the same for engineering students, except for one variable: Goal Compensation (for the main effect: unstandardized $B = -0.18$, $p = 0.12$; for the interaction term: unstandardized $B = 0.51$, $p = 0.004$). The coefficient for the interaction term suggests that goal compensation, or the ability to switch gears and be flexible in the face of setbacks, has a stronger and positive relationship with entrepreneurial intent for engineering women compared with engineering men, net other factors.

6 | DISCUSSION

Although entrepreneurship education opportunities for engineers are expanding in higher education, often modeled after such opportunities in business schools, less is known about the characteristics of engineering students who have entrepreneurial interests. Results of this study suggest that the development of entrepreneurial intent is gendered and discipline-sensitive. What are implications of such variation for entrepreneurship education program design and practice, as well as theoretical elaboration of RDST?

6.1 | Design by discipline

In aggregate, our findings do not support taking wholly different approaches to entrepreneurship education in engineering versus business disciplines. Not only are our findings based on a small sample of business and engineering students (see Limitations), but the role of many attitudinal constructs in this study was the same for business and engineering majors. In fact, cutting through different disciplinary norms to arrive at common ground could be essential to scaling entrepreneurship education opportunities in higher education. Nonetheless, engineering and business students may not be identical in what drives them toward entrepreneurship, sparking new ideas for program curricula.

For example, higher rates of what might be called innovative behaviors were strongly related to women's and men's entrepreneurial intent in both fields. However, students' innovation orientation was even more predictive of intent in engineering than in business. Perhaps for engineers, (technological) innovation is among the more charted pathways toward entrepreneurship (and vice versa), whereas for business students, entrepreneurial pathways are forged in many different ways. In terms of programming, entrepreneurship educators in engineering might integrate more innovation-related topics (e.g., idea generation, creativity, and how to mobilize others around new ideas) into existing courses, programs, and extracurricular activities to draw a wider group of students into considering entrepreneurship.

It is also possible that for business students, innovation orientation is more closely coupled with aspects of self-regulation that predict intent, whereas for engineering students, innovation orientation is a more stand-alone set of behaviors. Put differently,

engineering entrepreneurship programs might consider how to strengthen the relationships between innovation orientation and self-regulation concepts known to matter to goal attainment more generally. But which types of self-regulation concepts exist and in which ways would they be discussed? Here we note the net negative relationship between optimizing goals through persistence and entrepreneurial intent among engineering students. Geldhof, Weiner, et al. (2014) postulates that "too much" of a goal-striving characteristic such as persistence may be negatively associated with intentions after controlling for other self-regulation measures, insofar as it could reflect not knowing when to "cut one's losses" and move to a viable alternative (p. 89). We also wonder if lower average scores on the three items that constitute the persistence scale ("I work diligently to complete my tasks" as well as "I devote as much time and energy as needed to complete a task" and "I find ways to use my resources most efficiently") are in some ways compatible with a would-be engineering entrepreneur, that is, if there is a degree of "un-diligence" or rule-breaking thought to be needed in engineering given that entrepreneurship is not part of a traditional engineering curriculum or set of learning goals. The nonsignificant interaction term with discipline limits our ability to read too deeply into engineering-specific effects, but the finding does call attention to the opportunity for entrepreneurship program leaders to engage with their students about the role of persistence in entrepreneurial pathways. How and when might engineering students think about "cutting their losses?" When might a rule-breaking persona prove complicated in entrepreneurial work? And who can be an engineering rule-breaker to begin with—what types of cultural and economic privileges does this persona assume?

Entrepreneurship Activities was a significant predictor of entrepreneurial intent for engineering students but not for business students. Overall, engineering students may have lower levels of exposure to such activities that conceivably promote entrepreneurial know-how, relative to their business peers (see Table 3 and Jin et al., 2015). Therefore, these activities could be particularly effective in sparking engineering students' entrepreneurial interests (Duval-Couetil et al., 2012; Souitaris et al., 2007). Entrepreneurship program design in engineering might be more intentional in connecting students to entrepreneurial opportunities across and beyond campus as a result, even more so than one might expect in a business program setting. Entrepreneurship educators in business, in turn, might build on the importance of novel business ideas as they broaden their programming, given that the self-regulation measure Goal Selection—Novel (e.g., "I like to pursue projects that others have not thought about pursuing") was more tightly associated with business students' intent relative to their engineering peers.

6.2 | Entrepreneurship in context

Entrepreneurship is not only field-specific to some degree but also tied to people's locations in social systems. Previous literature shows that evaluation of entrepreneurs, access to capital for entrepreneurs, and rates of success for entrepreneurs systematically vary for different social groups. In our study, women in engineering and business majors reported lower entrepreneurial intent than did men in the same majors, net self-regulation characteristics and contextual experiences such as being in an entrepreneurship-oriented major or participating in entrepreneurship activities. The largely nonsignificant interaction terms with gender suggest that the entrepreneurship-related experiences, attitudes, and contexts measured in the YES survey influence men's and women's intent in similar ways (qualifying our earlier work in which we suggested that we expect to see more conditional effects by gender, see Jin et al., 2016, but consistent with Geldhof, Weiner, et al.'s, 2014 aggregate findings). Together, these results indicate that the particular educational and family contexts under study neither explain nor correct for baseline gender differences favoring men and underscore the need for experimental models that test cultural beliefs about gender and entrepreneurship.

We do observe that goal compensation, or being able to switch gears and apply alternative means for reaching a goal when faced with setbacks or failures, is positively related to entrepreneurial intent for women but not for men in engineering only. One interpretation is that entrepreneurship carries risk particularly for women in engineering, who are underrepresented in both domains. Understanding how to troubleshoot and switch gears in the face of obstacles, setbacks, and biases may become, therefore, all the more important to engineering women who seek to pursue entrepreneurial paths. Our finding, while singular in this study, is reminiscent of Thébaud's (2015) work suggesting that business models proposed by women are held to innovativeness standards not expected of men.

URM and non-URM women and men had comparable levels of intent in our statistical models, in both disciplines. Mother's education, which serves as a proxy for students' SES, was a significant negative predictor of entrepreneurial intent for business students, in contrast to research on entrepreneurial behavior indicating that individuals from higher SES family backgrounds are more likely to be self-employed in an incorporated firm versus being a salaried employee (Levine & Rubinstein, 2017). One possible interpretation, resonant with racial/ethnic differences in entrepreneurship outcomes in the United States, is that lower SES students may have higher entrepreneurial intent but more limited access to resources that could help them to start their own firms (see Schoon & Duckworth, 2012). It is not yet clear why mother's education has a stronger net

effect in the business-only model (and why having an entrepreneurial parent has a stronger net effect in the engineering-only model); conservatively, family contexts count for both groups of students.

Programmatically, we would argue that given what is known about the nexus of entrepreneurship, gender, race/ethnicity, and SES, whether based on our or other studies, program design in engineering *and* business would be well served by recognizing the force of social context in shaping historical and current patterns of entrepreneurial intent and behavior. Curriculum focused on how social position, identity, and systems influence entrepreneurship belongs in all manners of entrepreneurship education settings, if these settings wish to substantively expand entrepreneurial pathways and create or catalyze something fundamentally new. In such settings, biases embedded in entrepreneurship models, processes, and evaluation/reward mechanisms would be investigated and discussed intentionally and transparently by students and faculty. Students themselves could team together to envision how structures could change (e.g., case studies that feature more diverse entrepreneurs, anonymized pitch events, standardized criteria against which to evaluate business proposals). Students from diverse backgrounds would participate in designing the program itself, and sponsoring departments or units would prioritize the recruitment and hiring of more diverse entrepreneurship faculty and mentors (considering that some engineering entrepreneurship programs have zero women instructors teaching courses, see Gilmartin et al., 2016). To ignore the force of context in conditioning or shaping entrepreneurship, or not question educational levers that reinforce societal bias around who can be an entrepreneur, risks sameness in who among engineering students goes on to venture, create, and found, a prospect deeply inconsistent with the notion of entrepreneurship as a vehicle for innovation and economic growth.

6.3 | Thinking about theory

Our study demonstrates that RDST is not only appropriate for understanding intent among engineering students (we cite our R-square values as quantitative evidence) but also generative, leading to new questions for the framework itself and questions for engineering educators. In this work, we build on Geldhof, Weiner, et al. (2014) and suggest that background characteristics such as gender are not only individual-level characteristics but also contexts conditioning behaviors, evaluations, and choices. The effects of these contexts, moreover, can depend on other contexts (such as field of study) and manifest in differentials around self-regulation concepts like goal compensation. Goal compensation works differently for different groups in positioning people for future entrepreneurial action, precisely because of social inequalities built into what it takes to achieve one's goals. Future research that situates RDST in sociological understandings of cultural beliefs, status, and power, and/or in critical feminist and race theories would be an exciting extension.

We also note the importance of measuring context on multiple levels, from microinteractions that might be associated with having an entrepreneurial parent or doing entrepreneurship activities to macropatterns in the broader culture and economy; missing one level could shortchange the full understanding of co-action and human development. For example, had we included an additional measure of cultural beliefs about the characteristics of a successful entrepreneur across different institutional and field or (especially) experimental settings, it is possible that we would see variation in the gender gap. Layering RDST frames can deepen insights into the dimensionality of human development.

7 | LIMITATIONS AND FUTURE STUDY

As noted earlier, we cannot assume that entrepreneurial intent, even when measured as personal importance of starting a new organization, is perfectly predictive of some action classified as entrepreneurship, such as founding a company or being self-employed. Only comprehensive longitudinal data could establish more conclusive insights about the relationships among individual and contextual characteristics and entrepreneurial outcomes. However, entrepreneurial intent is an appropriate outcome to consider among a sample of undergraduate students, many of whom have not started a venture or founded a firm.

Longitudinal data are also optimal for analyses that are based on relational developmental systems frameworks. While we have tried to interpret our findings as if the constructs represent dynamic interactions with some net consequence for an (unfolding) outcome, we are not in a position in this study, with cross-sectional data, to make causal statements above and beyond what theory suggests is related (we cannot, moreover, tease apart self-selection into a major versus the effect of a major field of study itself). We note that the larger YES project is mixed methods and longitudinal; we urge future quantitative and qualitative analysis that investigates how intentions change over time and why, much less how those intentions translate into action.

Our sample was not designed to be nationally representative. Among respondents, women were overrepresented and URM students were underrepresented compared with the U.S. bachelor's degree-earning population in engineering and business. In

addition, only 7% of engineering respondents were from nonresearch institutions, while approximately 18% of engineering students are enrolled at nonresearch institutions nationally (ASEE, 2013). Future studies could design a sampling frame to better represent the national undergraduate population and universe of schools, and/or use weighting adjustments to better approximate this population. These steps would improve the generalizability of our findings and allow for a more comprehensive investigation of school-level effects on intentions, with statistical techniques to account for possible clustering by context. As an exploratory check on our own work, we ran our regressions using a specification with robust standard errors clustered by school (keeping in mind that YES was designed neither to represent a national sample of institutions nor to explore school-level effects). Findings largely replicate those presented here.

The set of independent variables tested in this work is incomplete. Students' class standing or academic year (e.g., first-year student), which could be associated with intent, was not collected on the YES instrument, nor was citizenship status (although parents' and respondents' "countries of birth" were). Future research can and should test these background characteristics, taking into account how markers of the individual that are ostensibly in the "background" may be among the strongest contextual forces shaping behavior. We note the limitations to our measurement of gender, in terms of its binary categorization and use of terms that imply biological sex, not gender. Throughout this manuscript, we interpret responses to this question as a measure of one's identity and location within the gender system (Ridgeway, 2001). We look to research conducted by Magliozzi, Saperstein, and Westbrook (2016) for guidelines on how to better measure gender on future instruments, as well as to Fernandez et al. (2016) for an overview of better demographic measurement generally on surveys.

We also stress that while one set of analyses in this paper examines the intersection of gender and race/ethnicity, and gender and SES (i.e., the interaction terms in the RQ3 models), much more can be done to investigate gender, race, and class, as well as other markers of identity and context, intersectionally. For instance, an entire next set of research questions could focus on models of entrepreneurial intent among women and men from different racial/ethnic groups and interpret findings through a critical lens that understands difference as a function of relative social position and power unique to each racial/ethnic/gender group. Relatedly, we call for future engineering entrepreneurship research that critically examines dominant channels through which venture funding is raised and investigates cognitive biases around the evaluation of viable business ideas. This line of research would build on findings of Thébaud (2015) and Kanze et al. (2018) and focus specifically on engineering contexts to demonstrate biases and opportunities for intervention.

This research could feed back into entrepreneurship education programs as such programs widen their scope to consider development of individual intent and action in context, and equip students with ideas, frames, and tools to realize change in an entrepreneurial ecosystem. While we are focused on programs in engineering and business fields in this paper, we recognize that such programs often enroll students from a much broader range of fields, and programs are being developed in many departmental homes outside of engineering and business. We look forward to future research that explores how entrepreneurship learning unfolds for diverse students in other disciplinary cultures and systems.

8 | CONCLUSIONS

Few previous studies explore factors that may shape entrepreneurial intent of engineering students and how these factors compare with those among their business peers. We address this gap by testing individual and contextual factors in multivariate regression models of entrepreneurial intent among engineering and business undergraduate women and men.

Examining our models run separately for engineering and business majors, we observe that intent cannot be decoupled from students' individual characteristics or the academic and social contexts associated with those characteristics. And while business and engineering students are not radically different in terms of what matters to intent, some factors are discipline-sensitive, such as having goals that emphasize the new and novel, having an innovation orientation, attending a research institution, and participating in entrepreneurship activities. Put differently, entrepreneurship education models in business are adaptable to engineering environments (and vice versa), even with the possibility of customization to address engineering students' (perhaps more limited) involvement in entrepreneurship activities and the possibility that entrepreneurship is particularly engaging to engineering students who have a strong bent toward innovation.

Men have higher entrepreneurial intent than do women among both engineering and business students. Being able to switch gears and apply alternative means for reaching a goal is positively associated with entrepreneurial intent for engineering women but not for engineering men. Finding ways to support diverse students in their pursuit of entrepreneurial pathways—for example, by recruiting and hiring entrepreneurship faculty and mentors from underrepresented social groups, engaging engineering students with diverse social identities and experiences in program design, critically

examining local channels through which venture funding is raised to ensure wide and equitable accessibility, and investigating cognitive biases around the evaluation of viable business ideas—is an essential next step for entrepreneurship education in engineering.

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AUTHOR BIOGRAPHIES

Shannon K. Gilmartin is a Senior Research Scholar at the Stanford VMware Women's Leadership Innovation Lab and an Adjunct Professor in the Department of Mechanical Engineering at Stanford University; shannong@stanford.edu

Marissa E. Thompson is a PhD Candidate at the Graduate School of Education at Stanford University, where she is a Stanford Graduate Fellow in Science and Engineering and an Institute of Education Sciences Graduate Research Fellow; marissathompson@stanford.edu

Emily Morton is a PhD Candidate and Institute of Education Sciences Graduate Research Fellow at the Graduate School of Education at Stanford University; emorton@stanford.edu

Qu Jin is a Senior Data Scientist at Earnin, Palo Alto, CA; jinq03@gmail.com

Helen L. Chen is a Research Scientist in the Designing Education Lab in the Department of Mechanical Engineering at Stanford University; hlchen@stanford.edu

Anne Colby is an Adjunct Professor at the Stanford Center for Research on Adolescence in the Stanford Graduate School of Education; acolby1@stanford.edu

Sheri D. Sheppard is the Richard Weiland Professor of Mechanical Engineering and The Bass University Fellow in Undergraduate Education at Stanford University; sheppard@stanford.edu

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