Received: 14 March 2019 | Revised: 5 October 2020 | Accepted: 7 October 2020 | Published on: 2 November 2020

DOI: 10.1002/smj.3246

RESEARCH ARTICLE

STRATEGIC MANAGEMENT JOURNAL WILEY

Do university entrepreneurship programs promote entrepreneurship?

Charles E. Eesley[1] | **Yong Suk Lee**[2]

[1]Department of Management Science and Engineering, Stanford University, Stanford, California

[2]Freeman Spogli Institute for International Studies, Stanford University, Stanford, California

Correspondence
Charles E. Eesley, Department of Management Science and Engineering, Stanford University, Stanford, CA 94305.
Email: cee@stanford.edu

Abstract

Research summary: We examine how university entrepreneurship programs affect entrepreneurial activity using a unique entrepreneurship-focused survey of Stanford alumni. OLS regressions find a positive relationship between program participation and entrepreneurship activities. However, endogeneity hinders causal interpretation. We utilize the fact that the entrepreneurship programs were implemented at the school level. Using the introduction of each school's program as an instrument for program participation, we find that the Business School program has a negative to zero impact on entrepreneurship rates. Participation in the Engineering School program has no impact on entrepreneurship rates. However, the Business School initiative decreases startup failure and increases firm revenue. University entrepreneurship programs may not increase entrepreneurship rates, but help students better identify their potential as entrepreneurs and improve the quality of entrepreneurship.

Managerial summary: Recently, many universities have developed programs to promote entrepreneurship. However, relatively little is known about the impacts of such university initiatives. In this article, we examine the two major initiatives that were established in the mid-1990s—the Stanford Center for Entrepreneurial Studies at the Business School and the Stanford

Technology Ventures Program at the Engineering School. We find that the Business School program had a negative to zero impact on entrepreneurship rates and participation in the Engineering School program had no impact on entrepreneurship rates. However, the Business School initiative decreased startup failure and increased firm revenue. University entrepreneurship programs may not increase entrepreneurship rates, but help students better identify their potential as entrepreneurs and improve the startup performance.

KEYWORDS

ability, academic entrepreneurship, alumni, self-selection, universities

1 | INTRODUCTION

Although many universities have been embracing entrepreneurship-related courses and programs (Katz, 2003), the literature examining the impacts of such initiatives is still relatively sparse (Von Graevenitz, Harhoff, & Weber, 2010; Hsu, Roberts, & Eesley, 2007; Rothaermel, Agung, & Jiang, 2007). Recent studies have sought to assess entrepreneurship programs, for example, by examining a non-profit technical entrepreneurship training program and find positive effects primarily from those without prior entrepreneurship opportunities (Lyons & Zhang, 2018). However, other results are less promising, for instance using a randomized controlled trial to examine a large-scale government entrepreneurship training program finds no lasting effect on entrepreneurship and business performance (Fairlie, Karlan, & Zinman, 2015). Compulsory entrepreneurship courses at the university level appear to decrease student intention to start a business (Oosterbeek, Van Praag, & Ijsselstein, 2010), yet improve self-assessed entrepreneurial skills (Von Graevenitz et al., 2010). Examining general entrepreneurship education programs finds little impact in reducing the difference in entrepreneurship rates by ethnicity and nationality (Lee & Eesley, 2018). Similar work in international contexts is also ambivalent as examining alumni of China's Tsinghua University shows that while additional research funding for universities improves rates of high-tech entrepreneurship and awareness on the importance of patents, it has a negative impact on venture revenues (Eesley, Li, & Yang, 2016).

There are at least three limitations in the literature: (a) Research has focused on the impact on students' entrepreneurial orientation, but not their real-world startup careers after graduation; (b) It has not clearly articulated the mechanisms through which the great variation across such courses and programs may have their effects.[1] These gaps are important not only because of their practical benefits for informing educational choices but also for our fundamental understanding of the development of entrepreneurial skillsets in firms and society. If in-house training were a possibility, firms in need of entrepreneurial and innovation capabilities may not

[1]For instance, students could be learning about the fit between entrepreneurship and their personal preferences for risk, ambiguity, ambition, independence, money, prestige, or power.

need to rely on risky acquisitions to expand the set of potential entrepreneurial workers in the firm (Kim, 2019).

We first develop a conceptual framework that incorporates two opposite effects of entrepreneurship learning—the direct improvement of ability, and the correction of overestimated ability. We theorize the potential effects each channel could have on entrepreneurship rate and performance and examine which channels and hypotheses are consistent with the empirical results.[2] We examine the entrepreneurship consequences of Stanford University's two major entrepreneurship programs that were founded in the mid-1990s—the Stanford Technology Venture Program (STVP) at the Engineering School and the Center for Entrepreneurial Studies (CES) at the Business School. To address endogeneity, we use a difference-in-differences approach in an instrumental variable setting. In particular, we use the fact that the initiatives were implemented at the school level, that is, the Business School and the Engineering School, and that primarily students in each school were affected by their respective entrepreneurship programs.

Overall, the results imply that Business School entrepreneurship programs may decrease the entrepreneurship rate, but improve the quality of entrepreneurship in terms of survival and firm revenue. This article focuses on the average effects of entrepreneurship program introduction at the school level. Program differences could potentially be behind any observed differences. Delving into program differences, we descriptively examine one experiential learning program, that is, the Mayfield Fellows Program, offered through the STVP. By matching on observables and using control groups that are similarly motivated and have similar entrepreneurial interests, we find that the Mayfield Fellows Program is positively related to entrepreneurship.

The next section discusses how entrepreneurship training programs could affect human capital. Section 3 describes the Stanford University Entrepreneurship Initiatives. Section 4 lays out the alumni survey data, estimation, and identification strategy. Section 5 presents some descriptive patterns and the empirical results and Section 6 concludes with a discussion of results.

2 | STRATEGIC HUMAN CAPITAL AND ENTREPRENEURSHIP TRAINING

A core question in strategy is whether firms should develop capabilities internally or acquire them from external sources (Arora & Gambardella, 1994). Of particular importance is the decision on whether to develop innovation or entrepreneurial competencies in-house or to acquire them (Kim, 2019). Prior work finds that firms that take entrepreneurial actions are more likely to survive (Teece, Pisano, & Shuen, 1997) and that those individuals with prior experience in entrepreneurship are more likely to succeed (Eesley & Roberts, 2012; Paik, 2014). On the other hand, scholars have argued that expending resources on training in entrepreneurship is wasteful if it is a genetic trait (Nicolaou, Shane, Cherkas, Hunkins, & Spector, 2008). Given that proven entrepreneurial skills are relatively rare, costly, and hard to retain (Chatterji, 2009; Franco & Folsom, 2006; Kim, 2019), such labor market frictions suggest firms may be seeking ways to utilize in-house training (Arora, Belenzon, & Rios, 2014; Starr, Ganco, & Campbell, 2018).

[2]Our analytical approach was one of abduction (Heckman & Singer, 2017), where we continuously developed our hypotheses and analyzed the data based on novel empirical findings and comments from reviewers.

This insight that the accumulation of high quality, specialized human resources can drive competitive advantages for organizations is pervasive (Shaw, Park, & Kim, 2013) and led to a close integration of the streams on strategic human resource management and the resource-based view (Barney, 1991; Holcomb, Holmes Jr, & Connelly, 2009; Miller, Xu, & Mehrotra, 2015). Related work has examined the market value of firm investments in training (Riley, Michael, & Mahoney, 2017) and explored the interaction of human capital and diversification strategies (Kor & Leblebici, 2005). This work finds a link between firm investments in human capital, subsequent organizational learning, and firm performance or innovation (Datta & Iskandar-Datta, 2014; Hatch & Dyer, 2004). However, training for entrepreneurial skills is typically not the focus of corporate programs and the field still lacks theory and systematic evidence. If such training does magnify entrepreneurial ability (and it is not purely genetic or innate), it may be beneficial for firms. Yet, if it instead allows for more accurate signals of perceived ability, it may still be beneficial for students and employees, but possibly costly for firms.

While entrepreneurship education has proliferated, high quality research is still nascent (Cumming & Fischer, 2012; Vesper & Gartner, 1997). Some work shows a positive link between entrepreneurial education and attitudes or intentions toward entrepreneurship or entrepreneurial activity (Souitaris, Zerbinati, & Al-Laham, 2007). Entrepreneurship programs may encourage students increase their entrepreneurial self-efficacy (Gorman, Hanlon, & King, 1997), especially for those with weak ex ante intentions (Peterman & Kennedy, 2003). Von Graevenitz et al. (2010) find that while the average effects of an entrepreneurship course were negative on intentions, the effects were not uniform. As Von Graevenitz et al. (2010: p. 103) write, "While entrepreneurship education has been introduced and promoted in many countries and at many institutions of tertiary education, little is known at this point about the effect of these courses." There are a number of mechanisms through which entrepreneurship education may influence students. These can be roughly categorized into two broad areas: skill and social networks.

Social network effects on entrepreneurship will not be our focus as they have been explored extensively in prior literature (Azoulay, Liu, & Stuart, 2017). Social influence from workplace peers or from mentors has been found to increase not only rates of entrepreneurship (Nanda & Sørensen, 2010; Stuart & Ding, 2006), but also financings, (Roberts & Sterling, 2012) and in venture capital as well as in outcomes (Dahl & Sorenson, 2012; Rider, 2009). However, we observe what may be an important, but previously unnoticed distinction between the focus on development of networks that can be used at the time of starting a company relative to the few works on the role of network ties in providing skills at the time of the educational experience. The former type of ties (accessed at the time of startup) are critical for fostering entry and performance as they directly aid in getting feedback on opportunities and ideas, finding cofounders, fundraising, and in hiring early employees. The latter type (at the time of the educational experience) may be critical both for developing foundational skills as well as in evaluating the level of one's skills relative to what is necessary to succeed. We note the findings of Lerner and Malmendier (2013), that randomization to a cohort of peers with less successful former entrepreneurs, who returned to get an MBA appears to decrease rates of entrepreneurship (but increase the performance of the resulting pool of entrepreneurs). This effect is explained by the role of these ties in shedding light on skill levels. Entrepreneurship courses often rely on mentorship and this social influence mechanism has been found to increase rates of entrepreneurship, depending on the backgrounds of the mentors (Eesley & Wang, 2017). Skills also appear to be gained via an increase in network connections following an entrepreneurship program (Lyons & Zhang, 2018) as well as via broad, intensive, and paced consultation with mentors

(Hallen, Cohen, & Bingham, 2020). In this way, the skill-building effects may also be facilitated by the social networking mechanism.

Under the mechanism of skills, we can also further sub-divide the mechanisms into skill development and learning about one's own innate skill level as it relates to entrepreneurship. For most entrepreneurship education, the primary goal is skill development. Many entrepreneurship courses divide their content around (a) building opportunity discovery and evaluation skills and (b) the ability to execute on opportunities once discovered (including fundraising, team formation, sales, marketing, and distribution).[3] We can consider the potential effects of each of these two skill areas on the likelihood of founding and on the performance of ventures conditional on founding. The predictions for both of these skill types tend to go in the same direction (making them a challenge to disentangle with observational data). Both of these skills should tend to increase the average performance of ventures being founded. Opportunity evaluation skills should lead students to found more high-potential ventures with better performance, or to found fewer low-potential ventures. Execution skills should lead to better entrepreneurial performance. Correspondingly, the increased ability to recognize entrepreneurial opportunities as well as increased skill in entrepreneurial execution (which would increase expected performance) should both be expected to increase the likelihood of founding. This is due to the positive impact both types of skills have on increasing the returns to founding relative to wage-based employment.

Recent work has focused on the role of education in building entrepreneurial skills and ability (Chatterji, Delecourt, Hasan, & Koning, 2019; Lyons & Zhang, 2018; Kotha, Lin, Ohlsson-Corboz, & Vissa, 2019; Von Graevenitz et al., 2010). In contrast to the view that entrepreneurial skill levels are genetic and thus fixed (Nicolaou et al., 2008), most individuals have been documented to have high ability to learn many skills, (such as math) if provided with the right instructional style and content (e.g., Boaler, 2013; Sisk, Burgoyne, Sun, Butler, & Macnamara, 2018). However, in entrepreneurship, evidence on the role of skill building or on the type of skills has thus far been limited. Lyons and Zhang (2018) suggest that their findings are consistent with learning entrepreneurial abilities through social network contacts, which also increased the quality of firms created.[4] However, most studies have relied on self-reports of entrepreneurial ability which could be confounded by other differences.

We propose that entrepreneurship programs may perform two functions with differential predictions on rates and performance outcomes. One, they may allow participants to form a more accurate belief of their true individual entrepreneurial ability. Two, they may improve participants' entrepreneurial skills or ability. If ability increases with respect to opportunity identification, but not with regard to executing on opportunities, then we would expect to see an increase in rates of entrepreneurship. Performance may be likely to increase as well, even if execution ability is unchanged due to a greater likelihood of identifying high-quality opportunities. Correspondingly, if execution ability is increased (but not the ability to identify new opportunities), then we expect both rates of entrepreneurship and performance to improve. This result is because these students will be more likely to be recruited into founding teams with those who have identified opportunities and their improved ability to execute should increase performance in these ventures.

[3]With the exception perhaps of fundraising in the context of venture capital, many of these skills for execution may overlap with what is taught in other courses in a general management curriculum. This division of skills is blurred somewhat by common methodologies (e.g., the lean startup) which emphasize that some execution must occur in order for evaluation of the opportunity to occur.

[4]Their results suggest that preferences toward entrepreneurship or toward risk do not change, however, the self-reported ability to evaluate a startup increases. It remains unclear if this is related more towards evaluating opportunities or skills in evaluating the capability to execute on an opportunity.

Hypothesis (H1) . *To the extent that entrepreneurship training increases entrepreneurial skills, we expect to see increases in both entrepreneurship rates and performance.*

Recent work has pointed out the role of education in revealing relative ability levels or in providing informative signals about the abilities needed in entrepreneurship (Lerner & Malmendier, 2013). Entrepreneurs being overconfident about their relative ability could lead to neglecting the impact of competition, more entry of firms, and high failure rates (Artinger & Powell, 2016; Cain, Moore, & Haran, 2015; Cassar, 2010). However, if the information provided via entrepreneurship education is mainly a signal about how an individual's skill set fits with the requirements of entrepreneurship, then we would expect to see both a decrease in entrepreneurship rates and an increase in performance. Startup performance may increase as a result as those who might have otherwise tried a startup (with lower skills and thus, lower performance) have now been selected out from starting in the first place. An alternative mechanism that would also produce a pattern of lower entrepreneurship rates, but higher average performance would be if individuals were learning not to pursue less attractive or lower quality ideas. However, this mechanism can potentially be teased apart from learning about one's skillset by looking into how the effect varies among different subsets of the population, who may be more likely to overestimate their skills.

As a result, the likelihood of entrepreneurship differs depending on the extent of the two mechanisms of improved ability and improved perception of fit with ability.[5] Here we propose a theoretical framework that flexibly illustrates how the effect of university entrepreneurship education not only depends on the improvement of entrepreneurial ability through education, but also on the degree to which students overestimate and correct their entrepreneurial ability. In sum, with an increase in the accuracy of perception of entrepreneurship skills, we expect to see a differential effect on rates and performance of entrepreneurs.

Hypothesis (H2) . *To the extent that entrepreneurship training increases awareness of entrepreneurship skills needed relative to one's own skills, we expect to see a decrease in entrepreneurship rates, but an increase in performance.*

The above conceptual framework presents a flexible framework that incorporates the two opposite effects of learning—the direct improvement of ability, and the correction of overestimated ability. Table 1 summarizes the channels and the potential entrepreneurship-related outcomes.

3 | STANFORD UNIVERSITY ENTREPRENEURSHIP INITIATIVES

3.1 | The Center for Entrepreneurial Studies and the Stanford Technology Venture Program

Much of the academic research to date has focused on faculty entrepreneurs (Kenney, 2000; Kenney & Goe, 2004), or on firms established in the Bay Area (Baron & Hannan, 2005; Kenney,

[5]If multiple mechanisms are at work, as we can see above, the net effects could balance out to result in no net changes in the entrepreneurship rate. Further examining differences in performance and interactions to explore heterogeneous treatment effects may allow us to further disentangle more fine-grained mechanisms.

TABLE 1 Mechanisms and likely entrepreneurial outcomes of entrepreneurship education

Mechanisms by which entrepreneurship education can affect entrepreneurial outcomes			Likely entrepreneurial outcomes: Rate of entrepreneurship	Likely entrepreneurial outcomes: Startup performance
Skill	Skill development	Opportunity recognition	Increase	Increase
		Execution	Increase	Increase
	Learning about one's own innate skill		Decrease	Increase
Social network	Network while at school		Ambiguous	Ambiguous
	Network at time of starting company		Increase	Increase

2005). The stories of the founding of Hewlett–Packard and Google are two among many prominent examples of student and alumni founded firms (Eesley & Miller, 2018). Recent work suggests that relative to professorial entrepreneurship, the number of firms created via students and alumni is an order of magnitude larger (Åstebro, Bazzazian, & Braguinsky, 2012).

In recent decades, Stanford University further expanded and formalized its support for entrepreneurship and established two programs—the Center for Entrepreneurial Studies and the Stanford Technology Ventures Program. The Center for Entrepreneurial Studies (CES) was founded in 1996 at the Graduate School of Business to address the needs facing entrepreneurs and the entrepreneurial community. The program utilizes the expertise on campus and Silicon Valley to provide courses and networking opportunities, as well as support research. For students, the CES offers a variety of courses and experiential learning that touch upon all aspects of entrepreneurship. The courses cover topics ranging from management, finance, technology, law, education, design, and so on. However, the courses are primarily accessible to business school students only. Students have the opportunity to take experiential learning classes where they can learn the day-to-day activities of a start-up and test out new business concepts. The Stanford Technology Ventures Program (STVP) is the entrepreneurship center founded in 1995 at the Engineering School. Similarly, STVP offers courses and extracurricular programs to students as well as supporting research on high-technology entrepreneurship. In addition to offering entrepreneurship-related courses to engineering students, STVP houses several fellowship programs where students can obtain in-depth knowledge and first-hand experience of technology start-ups. However, the courses offered through STVP are more focused on technology ventures, and the range of courses offered by STVP is smaller compared to the CES. In the Supporting Information Appendix, we include results from qualitative interviews and historical documents showing that the motivation for the creation of the entrepreneurship programs was primarily educational in nature.

4 | DATA AND METHODS

The Stanford Innovation Survey covered all Stanford students regardless of entrepreneurship status. Since the surveyed alumni are not selected based on successful entry into entrepreneurship, unlike samples that focus on innovators or venture-backed founders, the results do not suffer from biases due to sampling on the dependent variable. Prior studies have found samples of alumni from research universities (MIT, Stanford, Harvard,

University of Toronto, and Chicago) useful in making theoretical contributions regarding how the broader social environment influences entrepreneurs (Dobrev & Barnett, 2005; Lazear, 2005; Burt, 2001, Roberts, 1991; Hsu et al., 2007; Roberts and Eesley, 2009; Roberts, Murray, & Kim, 2015).

The survey was conducted over a well-defined population of comparable individuals in multiple industries, and it was administered through official university channels and hence more trustworthy to the respondents. By surveying the entire population (all living alumni who graduated between the 1930s and 2010s), we were able to poll all alumni who could have found a firm. The 2011 survey generated 27,783 individual responses for a response rate of 19.5%. The response rates are similar across gender, departments, and graduation year. If we take graduates from 1933 to 1971, the response rate was 22% and graduates from 1972 to 2010, the response rate was 18%, indicating that older graduates were not less likely to respond. We do not detect significant differences in the main effects of gender and school (see Eesley & Miller, 2018 for more detailed benchmarking and response rate analyses). Out of the respondents, nearly 8,000 reported being entrepreneurs who founded any type of organization (for-profit or non-profit) and 4,290 said they had founded an incorporated business. The Stanford survey not only asks one's entrepreneurship status, but also whether one invested in start-ups as an angel investor or venture capitalist. Responses include data on 2,798 individuals who were early employees (16% of the alumni), 349 venture capital investors, and 2,572 angel investors. The survey also collected information on when each startup was created and whether it failed or exited through an IPO or was acquired by another firm. The survey asks about performance measures, that is, the revenue and number of employees in the most recent year the firm was alive. When available, these figures are verified by matching the firm names to the Dun and Bradstreet database. We examine the performance of each entrepreneur's first start-up when these measures are available.

The survey asks each respondent to indicate the degree to which they had participated in the CES or STVP—no participation, little participation, moderate participation, and heavy participation—and whether the respondent participated as a student or not. We define participation in either the CES or STVP as a dummy variable equal to one if the respondent indicated little, moderate, or heavy participation. We also examine the intensity of participation by constructing a participation variable that ranges from 1 to 4 depending on the degree of participation (1 = no participation, 4 = heavy participation). Other valuable information includes whether the respondent's parent, sibling, or friends had any entrepreneurship experience. The literature has found parental entrepreneurship status to be one of the strongest determinants of entrepreneurship in different countries and we include that as a control in our analysis. The survey also asks how optimistic the respondent is. In particular, it asks respondents to rate the degree to which one agrees with the statement: "Overall, I expect more good things to happen to me than bad." We use these variables and age, ethnicity, gender, and nationality variables to control for the underlying characteristics of the respondent. In the empirical analysis, we focus on students who graduated from Stanford on or after 1980 to minimize recall bias and on or before 2005 to provide time for entrepreneurship activity. Table 2 presents the summary statistics of the main variables.[6]

[6]Although there are advantages to using a survey to examine entrepreneurship, we acknowledge that there could be some drawbacks, since some respondents may not truthfully reveal their employment status and there could be recall errors.

TABLE 2 Summary statistics

Variable	Mean	*SD*	Min	Max	Obs
Panel A. Main sample					
Participate in Center for Entrepreneurial Studies	0.018	0.134	0	1	6,995
Participate in Stanford technology ventures program	0.031	0.174	0	1	6,943
Graduate School of Business student	0.115	0.319	0	1	6,995
Engineering school student	0.371	0.483	0	1	6,995
First year graduated from Stanford	1993.024	7.675716	1,980	2,005	6,995
Entrepreneurship—founded a new organization	0.297	0.457	0	1	6,995
Number of patents by founded company	2.605	27.609	0	2,000	6,285
Founded a non-profit	0.051	0.220	0	1	6,995
Founded an incorporated company	0.161	0.368	0	1	6,995
Founded an unincorporated company	0.148	0.355	0	1	6,995
Invest as an angel investor of venture capitalist	0.099	0.299	0	1	6,995
Been an early employee at an entrepreneurial firm	0.121	0.326	0	1	6,995
Stanford alumni association	0.659	0.474	0	1	6,836
Stanford alumni regional club	0.360	0.480	0	1	6,834
School specific alumni group	0.207	0.405	0	1	6,897
Use Stanford alumni network for funding	0.046	0.209	0	1	6,962
Use Stanford alumni network for cofounders	0.075	0.264	0	1	6,960
Use Stanford alumni network to find customers	0.058	0.234	0	1	6,955
Use Stanford alumni network to find partnerships	0.078	0.269	0	1	6,947
Use Stanford alumni network to find advisors	0.145	0.352	0	1	6,928
Panel B. first startup variables					
Years to first founding after graduation	10.317	6.881	0	31	2,101
Startup within first year of graduation	0.082	0.275	0	1	2,119
Startup within 5 years of graduation	0.283	0.450	0	1	2,119
Startup fails	0.257	0.437	0	1	2,119
Startup alive—no exit	0.596	0.491	0	1	2,119
Exit through IPO	0.019	0.136	0	1	2,119
Exit through acquisition	0.101	0.301	0	1	2,119
Ln(revenue) in 2011	10.105	5.491	0	27.73	1,399
Revenue above $100 K in 2011	0.546	0.498	0	1	876
Revenue above $500 K in 2011	0.330	0.470	0	1	876
Revenue above $1,000 K in 2011	0.264	0.441	0	1	876
Ln(number of employee) in 2011	1.800	1.471	0	9.55	1,880
Ln(total number of patent issued)	0.328	0.911	0	10.31	1,592

4.1 | Estimation and identification strategy

The base regression framework is the following:

$$y_{ijk} = \alpha + \beta Prog_{ijk} + \mathrm{X_{ijk}}\pi + \mu_j + \theta_k + \varepsilon_{ijk} \quad (1)$$

where y_{ijk} represents entrepreneurship rate or startup performance of Stanford University alumni i who attended school j and graduated in year k. $Prog_{\mathrm{ijk}}$ is a dummy variable indicating participation in either the CES or STVP. In some specifications, we include both program dummies. $\mathrm{X_{ijk}}$ is the vector of control variables that include the foreign dummy, gender dummy, parental entrepreneurship dummy, and the age fixed effects. Also included are a dummy variable for students who participate in both programs and a dummy variable for students who were Stanford undergraduates that became business school graduates at Stanford University. μ_j is the set of school fixed effects, that is, dummy variables indicating whether the student attended the business school, engineering school, medical school, and so on. We control for Stanford cohort-specific effects nonparametrically by including Stanford graduation year fixed effects θ_k. The main coefficient of interest is β, which captures the effect of the entrepreneurship programs on the outcome of interest. When the dependent variable is binary, we still estimate Equation (1) in a linear regression model to facilitate comparison with the 2SLS results. Estimation using a nonlinear probability model returns similar results.

We are interested in identifying the causal impact of the entrepreneurship program on entrepreneurship status and innovation. However, Equation (1) suffers from endogeneity. Students who were thinking of becoming an entrepreneur would likely have enrolled in the classes and programs offered by the University's entrepreneurship programs. To deal with endogeneity, we use a difference-in-differences approach in an instrumental variable setting. This approach is often used when a policy affects the treatment variable of interest, and thereby allows the researcher to identify the impact of the treatment on the outcome variable of interest.[7]

In our context, the difference-in-differences framework compares alumni who attended the Business (or Engineering) School before and after program introduction relative to alumni in other schools, which did not introduce entrepreneurship programs. Conceptually, the first stage of the instrumental variable strategy examines program participation in a difference-in-differences framework, and the reduced form of the instrumental variable strategy examines entrepreneurship rate (or startup performance) in the same difference-in-differences framework. The final instrumental variable estimate corresponds to the ratio of the estimated coefficients in the first stage and the reduced form.

In practice, we use 2SLS estimation where we instrument participation in the CES with the GSB dummy interacted with the dummy for cohorts who graduated Stanford in 1997 or after. Students who attended the GSB after the CES was established in 1996 could take entrepreneurship-related courses unlike their earlier cohorts or students from other schools. Other students in the university could only take GSB courses, if the instructor approved. However, as we show later, participation by students from other schools was minimal. Since school fixed effects and cohort fixed effects are included, the variation used to generate the plausibly exogenous variation in program participation is the difference in program participation of only

[7]For example, Duflo (2001) examines an elementary school construction policy that increased students' educational attainment using a difference-in-difference framework by comparing different regions before and after the school expansion policy. Those who attained additional schooling due to the school constructions had higher earnings later in life. Hence, the school construction policy indirectly contributed to higher earnings and she estimates the reduced form impact of the school construction policy on earnings using difference-in-differences. Ultimately, the returns to education can then be estimated by taking the ratio of the difference-in-differences estimate on earnings to the difference-in-differences estimate on years of schooling.

the GSB students before and after CES was introduced. An underlying assumption for identification is that students who graduated from the GSB after the program was introduced were no different than students who graduated before. If more entrepreneurial students started to attend the GSB because entrepreneurship programs became available, this identifying assumption would be violated. As such, the differences-in-differences identification strategy assumes that the business and comparison students are different in a relatively stable manner. We provide evidence that this was the case in the empirical analysis.

We perform the following 2SLS regression where the first stage is

$$Prog_{ijk} = \alpha + \beta GSB_j * Post1997_k + \gamma GSB_j * Time_{k \geq 1997} * Post1997_k + X_i\pi + \mu_j + \theta_k + \varepsilon_{ijk}$$

and the second stage is the same as Equation (1) but now with predicted program participation.[8]

$$y_{ijk} = \alpha + \delta \widehat{Prog}_{ijk} + X_i\pi + \mu_j + \theta_k + \varepsilon_{ijk}.$$

The $GSB_j * time_k * D_{k \geq 1997}$ term flexibly captures increasing student participation rates as the program becomes more established over the years. $Time_{k \geq 1997}$ is simply a linear time trend normalized at 1997. The estimation sample includes alumni who graduated from the GSB and the other schools, but not from the Engineering School.

In the robustness tests, we also use a more succinct version with $GSB_j * Post1997_k$ as the instrumental variable, as well as a version where we use the full set of interaction terms to flexibly capture the difference in program roll out over the years. In such specifications, the first stage is

$$Prog_{ijk} = \alpha + \sum\nolimits_k \beta^k GSB_j * Cohort_k + X_i\pi + \mu_j + \theta_k + \varepsilon_{ijk}.$$

When we examine the effect of the engineering school initiative we perform the same regressions but instead instrument participation in STVP with $ENG_j * Post1998_k$, the engineering school dummy interacted with the post-1998 dummy, and $ENG_j * Time_{k \geq 1998} * Post1998_k$. In this case, the estimation sample includes alumni who graduated from the Engineering School and the other schools, but not from the GSB. In other words, we are splitting the sample and examining business and engineering school students separately. The business students may be more different on average, especially, in terms of work experience and exposure and interest to entrepreneurship, to their comparison set relative to engineering students and its comparison set. The important assumption is that their characteristics remain stable before and after program introduction. We also run 2SLS regressions where we include both participation in CES and participation in STVP as the treatment variables of interest and use both sets of instrumental variables for the GSB and Engineering School. In this case, the estimation sample is not restricted by schools.

[8]The reduced form equation corresponds to $y_{ijk} = \alpha' + \beta' GSB_j * Post1997_k + \gamma' GSB_j * Time_{k \geq 1997} * Post1997_k + X_i\pi'' + \mu'_j + \theta'_k + \varepsilon'_{ijk}$, and the estimate of interest δ corresponds to the ratio of the reduced form effect to the first-stage effect, that is, β'/β.

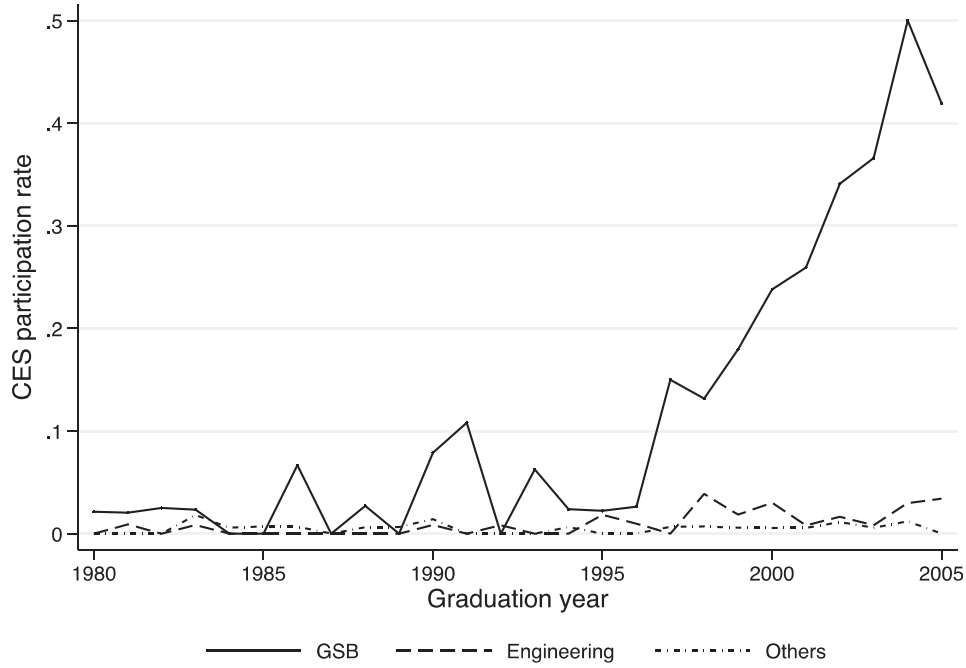

FIGURE 1 Center for Entrepreneurial Studies participation rate by graduation year

5 | EMPIRICAL RESULTS

5.1 | Descriptive patterns

Figure 1 illustrates the participation rate in CES by cohort among three different groups—those who graduated from the business school, engineering school, and the other schools are grouped in one category. The CES was introduced in the 1996–1997 academic year, and as expected, participation in the CES jumps with the 1997 graduating cohorts. The fact that participation is not zero among the earlier cohorts implies that those who graduated earlier could participate in the CES program not just when they were students.[9] What is noteworthy is that participation among students from other schools remains very low. This property of the CES lends itself as a good design to compare the effect of CES participation using a difference in differences framework. Figure 2 overlays the participation rate in STVP. Participation jumps for the engineering school students starting with the 1998 cohort. However, the increase in participation is substantially smaller in magnitude compared to the CES participation among business school students.

In Figure S1, we illustrate the entrepreneurship rate since the 1980s. The business school students in general have a higher entrepreneurship rate than those from the other schools. In Figure S2, we examine the log revenue in 2011 for surviving startups. Overall, the figures indicate that CES participation rose substantially among business school graduates after the mid-1990s, and revenue of first startup by business school graduates may have diverged from graduates from the other schools.

[9]Indeed, there are programs where alumni can participate in the CES. Given that many alumni remain in Silicon Valley for their careers, this is very likely.

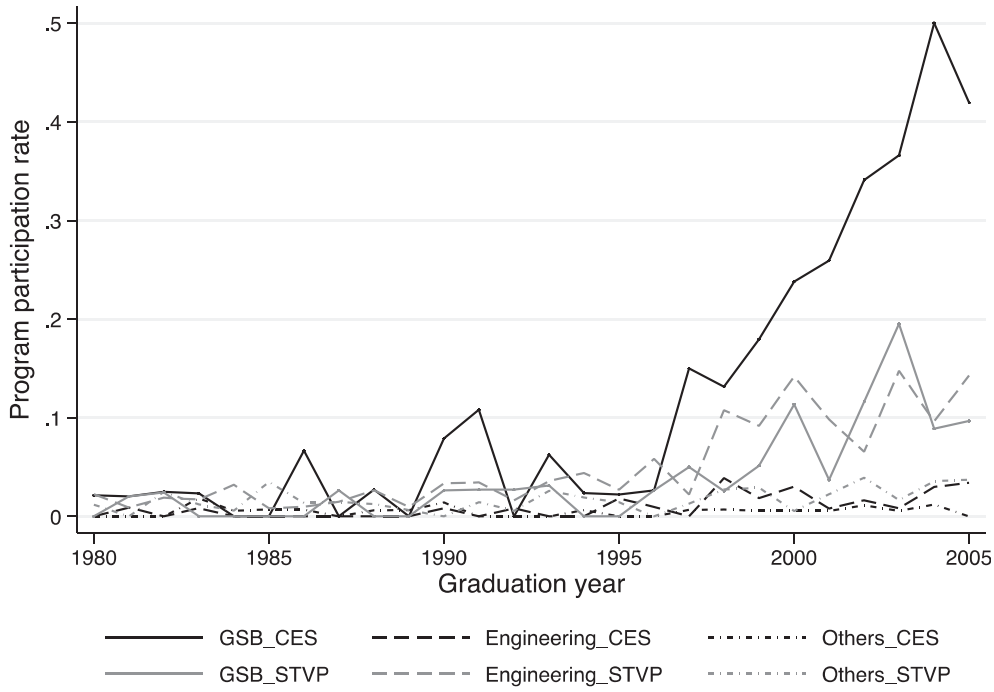

FIGURE 2 Center for Entrepreneurial Studies and Stanford Technology Venture Program participation rate

5.2 | Results on the rate of entrepreneurship

Table S1a–d to examine the relationship between program participation in CES or STVP and the various measures of entrepreneurship rate in an OLS framework.[10,11] The results show a positive relationship, however, the OLS estimates are likely biased upwards because of individual-level omitted variables. Students with high entrepreneurial ability and motivation are likely to participate in the entrepreneurship programs even among students in the same cohort in the same school. Our identification strategy aims to take advantage of the fact that students from the business schools were exposed to the entrepreneurship program after 1996 but students from the other schools were not able to participate in these programs (other than in rare cases where students petitioned to take classes). Stanford University's business school

[10]Column (1) examines entrepreneurship, defined as the founding of any new organization. CES and STVP participation are related to about a 13% and 10% higher entrepreneurship rate ($\beta = .13$, SE = 0.0516 and $\beta = .0966$, SE = 0.0323). However, we find no significant effect on the number of patents. In terms of the type of organization that is being found, the strongest effect is on incorporated companies. We also find that program participation in either program is positively associated with becoming an angel or VC investor. CES participation is strongly related to becoming an early employee of a startup as well. In Table S1d, we examine how the intensity of participation in the two entrepreneurship programs relate to entrepreneurship related outcomes. The intensity variable ranges from 1 to 4, where 1 indicates no participation and 4 heavy participation, and students who have more intense participation are positively and significantly associated with most of the entrepreneurial outcomes.

[11]The OLS regressions in Table S1 all control for ethnicity (white, black, Asian, Hispanic, and other), foreign citizenship, gender, and parental entrepreneurship status, and include cohort, school, and age fixed effects. We also control for the small number of students who participate in both programs and students who were Stanford University undergraduates and business school graduates.

admits only graduate students and aims to retain exclusivity even within campus by limiting cross-enrollment. We utilize a difference in differences framework to examine how take-up in the CES (and STVP) changed and then ultimately to entrepreneurship and innovation-related activities.

Figures 1 and 2 visually present how participation in the CES and STVP evolved across different schools. In Table S2, columns (1) and (2), we present estimates from a regression of CES participation on the business school graduate dummy interacted with the post-1997 dummy. The coefficient estimate is 0.255 (SE = 0.0273), indicating that on average 25.5% of the business school (GSB) students participated in the CES program after its introduction. However, as Figure 1 indicates, participation jumps up a bit initially and continues to increase over the years. This reflects both the growth of the program curriculum, increasing advertisement from the school, and student interest. Table S2 presents the first stage of the 2SLS regression strategy and the results confirm that there is a strong and significant first stage effect of program introduction on program participation. We use the variables in column (3) and (6) as the base specification for the instrumental variable strategy, but also use a simpler version of the instrumental variable, that is, school dummy interacted with the post dummy, and a more complex version, that is, school dummy interacted with year dummies, as robustness checks.

Table 3 presents the 2SLS results. In Panel A, we instrument CES participation with the business school interacted with the post-1997 dummy. Now we find a negative effect of CES program on entrepreneurship. Participation in CES results in a 35% reduction in the probability of entrepreneurship ($\beta = -.35$, SE = 0.161). The 2SLS estimates represent the local average treatment effect, that is, the impact of those who participate in the CES program only because it was available. Panel B indicates that the impact of STVP on entrepreneurship is positive but not significant. In Panel C, we examine the impact of CES and STVP in the same regression and use both sets of instrumental variables. The large negative result for CES remains for both the startup of incorporated and unincorporated firms, as well as future investor status or becoming an early employee in a startup. There is some evidence that participation in the STVP increases the probability of founding a non-profit. Overall, these results are inconsistent with H1 (which predicted increases in entrepreneurship rates), but more consistent with H2, where we predicted that if entrepreneurship training increases awareness of entrepreneurship skills needed relative to one's own skills, we expect to see a decrease in entrepreneurship rates.

The validity of our 2SLS estimates hinges upon the exclusion restriction that the introduction of entrepreneurship programs in the mid-1990s at the Business School or Engineering School did not affect entrepreneurial outcomes other than through its effect on program participation. One way to examine the validity of this assumption is to see whether student characteristics changed differentially before and after the programs were introduced in the relevant schools. In Table S3, we examine this for a set of observable individual characteristics. The results indicate that selection on these observable characteristics is unlikely to undermine the exclusion restriction.

To examine whether entrepreneurship education helps correct students' overestimation of their entrepreneurial ability, we examine whether the effects differ based on one's exposure to entrepreneurship within the family. Students with a parent who is an entrepreneur would be exposed to the life of an entrepreneur and either directly or indirectly learn and experience entrepreneurship. Such a student would have a better understanding of the scope of work and challenges involved with entrepreneurship and hence have a better approximation of her entrepreneurial ability and assessment of whether she is of the entrepreneurial type. Hence, we expect that students who do not have a parent as an entrepreneur are more likely to

TABLE 3 (a) Effect of CES, (b) effect of STVP, and (c) effect of entrepreneurship initiatives—2SLS estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Entrepreneurship	Number of patents	Found nonprofit	Found incorporated comp.	Found unincorporated comp.	Angel or VC investor	Early employee of startup
(a) Effect of CES							
Participate in CES	−0.350 (0.161)	13.23 (12.35)	−0.0514 (0.0745)	−0.337 (0.138)	−0.366 (0.133)	−0.233 (0.137)	−0.244 (0.137)
	.0295	*.284*	*.491*	*.0145*	*.00598*	*.0889*	*.0747*
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School, age, and graduation year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F statistic	37.85						
Observations	4,403	3,862	4,403	4,403	4,403	4,403	4,403
(b) Effect of STVP							
Participate in STVP	0.581 (0.398)	9.224 (20.47)	0.376 (0.195)	−0.179 (0.312)	−0.145 (0.299)	−0.468 (0.252)	−0.405 (0.297)
	.145	*.652*	*.0538*	*.567*	*.627*	*.0636*	*.173*
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School, age, and graduation year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F statistic	12.55						
Observations	6,187	5,592	6,187	6,187	6,187	6,187	6,187
(c) Effect of entrepreneurship initiatives							
Participate in CES	−0.416 (0.164)	8.953 (8.143)	−0.0726 (0.0742)	−0.345 (0.140)	−0.373 (0.132)	−0.173 (0.141)	−0.199 (0.141)
	.0114	*.272*	*.328*	*.0140*	*.00475*	*.221*	*.160*

TABLE 3 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Participate in STVP	0.637 (0.407)	11.23 (20.01)	0.410 (0.200)	−0.119 (0.319)	−0.145 (0.303)	−0.470 (0.259)	−0.374 (0.301)
	.117	*.575*	*.0409*	*.711*	*.632*	*.0696*	*.215*
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School, age, and graduation year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F statistic	6.33						
Observations	6,943	6,249	6,943	6,943	6,943	6,943	6,943

Note: Individual controls include dummy variables for ethnicity, foreign, gender, parental entrepreneurship status, students who were Stanford undergrad and Stanford MBAs, and students who participated in both the CES and STVP programs. Robust standard errors are reported in parentheses and *p* values are reported in italics.

overestimate their entrepreneurial ability, and thus more likely to adjust their beliefs when exposed to entrepreneurship education. We examine this in Table S4 Panel A. As columns (1) and (2) indicate the CES program has a negative effect on entrepreneurship rate for those who did not have a parent as an entrepreneur[12] ($\beta = -.463$, SE = 0.22). On the other hand, we do not find a negative effect, but rather a positive effect from the STVP program ($\beta = .81$, SE = 0.481). It could be that engineering students are less likely to overestimate their entrepreneurial ability compared to the business school students. This could be a general characterization between business majors and engineering majors, but also business school students, who have a few years of work experience but not necessarily entrepreneurship experience, may initially feel more confident about their own entrepreneurial prospects.[13]

Males are generally more overconfident and thus more likely to overestimate their entrepreneurial ability. Accordingly, they would be more likely to adjust their beliefs after receiving education. As predicted, the impact of the CES program on entrepreneurship rate is negative for males only ($\beta = -.397$, SE = 0.178). The impact of STVP on entrepreneurship is positive for both genders, but the estimates are not statistically different from zero.

Finally, in Panel D, we examine the effect of entrepreneurship education based on whether one had an entrepreneur friend. Having an entrepreneur friend or not may reflect on the characteristics of one's peer group as a youth. Those who have friends who eventually become an entrepreneur could have more knowledge about what it is like to become an entrepreneur through the conversations and interests shared among friends. The negative impact from the business school program only appears in the sample of students who do not have an entrepreneur friend. Those who had an eventual entrepreneur in her friendship group seems to have been less likely to overestimate their entrepreneurial ability, potentially through indirect exposure and learning about entrepreneurship. Overall, Table S4 supports our main argument that entrepreneurship education helps students to learn about their entrepreneurial capability.[14]

5.3 | Results on the characteristics and performance of startups

If entrepreneurship education enables students to better realize whether he or she is of the entrepreneurial type, one would expect to see better startup performance by those who eventually decide to become entrepreneurs. We next examine how the university entrepreneurship programs affect the characteristics and performance of the first startup after graduation. In particular, we examine the time to first startup, probability of failure, survival as a private entity, exit through an IPO or M&A, number of employees, revenue, and patenting. These results are

[12]Specifically, we ask whether one's parents, siblings, or friends had entrepreneurial experience before one founded one's first firm.

[13]Another possible interpretation of this pattern could be that engineering students must consider in advance more carefully their choice to take an entrepreneurship course, given the heavy course requirements in an engineering school curriculum.

[14]An alternative argument could be that entrepreneurship programs could teach students not to pursue poor or less attractive ideas. If this were the case, this would also result in reduction in the rate of entrepreneurship. However, as our heterogeneity analysis indicates, the negative impact on the rate of entrepreneurship is stronger among males and those without prior entrepreneurship exposure within the family, and it seems hard to explain this heterogeneity if the main channel was learning not to pursue less attractive ideas. On the other hand, male students or students without prior exposure to entrepreneurship may be more likely to over assess their entrepreneurial ability, and entrepreneurship courses could especially help these students to reassess their abilities.

conditional on entrepreneurship, and hence reflect the impact that the programs directly have on these outcomes as well as the selection effect induced by the programs, that is, the program may have induced potentially low entrepreneurial ability students to not pursue entrepreneurship. We first examine OLS results in Table S5. The CES program is associated with considerably larger revenue among firms that were alive by the time of the survey and about 1.8-year reduction in the timing to first startup. The STVP program is not systematically related to any of the firm characteristics or performance measures, other than weakly reducing the timing to startup by about 0.75 of a year. These results are more consistent with H2, which had predicted increases in performance, rather than H1, which predicted a decrease. Thus, the overall pattern of results (decrease in rates of entrepreneurship and increase in performance) appears more consistent with H2, which hypothesized on the impact of students gaining a signal of their entrepreneurial ability. We perform further analysis below to explore these ideas and the data in more detail.

The effects of an entrepreneurship program could likely be in both making individuals aware of their entrepreneurial ability and better equipping students with the instruments for succeeding as entrepreneurs. In Table S6, we examine the performance of startups by prior exposure to entrepreneurship. We find that the coefficient estimates related to the performance of startups, that is, failure rates, years to first startup, or revenue, are not statistically different between those with and without prior exposure to entrepreneurship based on parental and family entrepreneurship. This suggests that entrepreneurship education equips students with the tools needed to succeed as entrepreneurs even to those who have prior exposure to entrepreneurship.

In Table 4, we present the 2SLS estimates of the effects of entrepreneurship education on startup performance. First focusing on the CES effects, we find that participation in the CES decreases the probability of failure by 38.5% ($\beta = -.385$, SE = 0.192), increases the probability that a firm remains private and alive by 63.4% ($\beta = .634$, SE = 0.229), and reduces the probability that the firm will be acquired by 21% ($\beta = -.209$, SE = 0.1). Years to entrepreneurship decrease by about 11 years ($\beta = -11.42$, SE = 2.514). The likelihood of startup within a year or 5 years of graduation increases, and the likelihood of startup after 5 years decreases. Also, the log revenue of the startup in the year of survey increases substantially by 7.7 ($\beta = 7.69$, SE = 3.119). Using different cutoff measures, we find that the probability of achieving $100,000 revenue by 2011 increases significantly. On the other hand, other than a reduction in M&A of the startup and years to entrepreneurship, there is no statistically meaningful impact of STVP on firm performance. However, we note that the first stage of the 2SLS estimation is substantially weaker. These effects could be upper bounds on the estimate due to the high quality of the network, instruction, and reputation at Stanford and location in Silicon Valley. Also, students at this early stage in their careers may experience a relatively bigger boost relative to similar training provided to older, more experienced individuals who already have an extensive social network and industry experience.

In Table S7, we examine the robustness of the results to dropping participants in both programs, adding a control for optimism, to different instrumental variables, to using a narrower sample in the years around the reform, and to combinations of a program dummy interacted with post year dummies. Overall, the 2SLS results from Tables 3 and 4 imply that CES participation does not increase the rate of entrepreneurship and may actually decrease entrepreneurship. However, the negative or null impact on the entrepreneurship rate ultimately results in better performance of startups. Startups are more likely to stay alive and surviving startups tend to perform better.

TABLE 4 Impact on the characteristics and performance of first startup—2SLS estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Startup failure	Firm alive—no exit	IPO	M&A	Years to entrepreneurship	Entrepreneurship within 1 year of graduation	Entrepreneurship within 5 years of graduation	Entrepreneurship after 5 years since graduation	Ln(revenue) in 2011	Revenue in 2011 > 100 k	Revenue in 2011 > 500 k	Revenue in 2011 > 1,000 k	Ln(number of employee) on 2011	Ln(patents)
Participate in CES	−0.385 (0.192)	0.634 (0.229)	0.0527 (0.0562)	−0.209 (0.100)	−11.42 (2.514)	0.365 (0.161)	0.454 (0.204)	−0.682 (0.191)	7.690 (3.119)	0.693 (0.240)	0.406 (0.233)	0.226 (0.208)	0.878 (0.740)	0.127 (0.346)
	.0452	*.00570*	*.349*	*.0374*	*6.10e-06*	*.0231*	*.0263*	*.000377*	*.0141*	*.00410*	*.0824*	*.279*	*.236*	*.713*
First-stage F statistic	19.68													
Observations	1,290	1,290	1,290	1,290	1,290	1,290	1,290	1,290	526	527	527	527	733	1,144
Participate in STVP	0.271 (0.491)	0.481 (0.548)	−0.0705 (0.115)	−0.743 (0.377)	−25.10 (10.29)	0.218 (0.313)	0.632 (0.535)	−0.644 (0.536)	−4.023 (12.86)	−0.276 (1.153)	−0.100 (1.023)	−0.735 (1.033)	−1.719 (2.280)	0.190 (1.229)
	.581	*.381*	*.539*	*.0491*	*.0148*	*.486*	*.238*	*.229*	*.755*	*.811*	*.922*	*.477*	*.451*	*.877*
First-stage F statistic	3.9													
Observations	1,701	1,701	1,701	1,701	1,701	1,701	1,701	1,701	704	705	705	705	951	1,564
Participate in CES	−0.323 (0.179)	0.608 (0.204)	0.0538 (0.0549)	−0.209 (0.113)	−10.66 (2.912)	0.286 (0.148)	0.460 (0.205)	−0.639 (0.179)	6.232 (2.815)	0.401 (0.235)	0.263 (0.218)	0.213 (0.197)	1.372 (0.777)	0.287 (0.389)
	.0708	*.00296*	*.327*	*.0655*	*.000260*	*.0542*	*.0246*	*.000361*	*.0271*	*.0893*	*.229*	*.281*	*.0776*	*.461*
Participate in STVP	0.0543 (0.446)	0.553 (0.512)	−0.0540 (0.106)	−0.583 (0.299)	−24.64 (9.042)	0.158 (0.285)	0.542 (0.459)	−0.663 (0.472)	−1.569 (10.96)	0.0445 (0.988)	0.153 (0.891)	−0.407 (0.825)	−0.734 (1.866)	−0.00367 (1.107)
	.903	*.280*	*.609*	*.0511*	*.00649*	*.578*	*.238*	*.160*	*.886*	*.964*	*.864*	*.622*	*.694*	*.997*
First-stage F statistic	2.5													
Observations	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	860	861	861	861	1,168	1,908
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Founded year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Individual controls include dummy variables for ethnicity, foreign, gender, parental entrepreneurship status, students who were Stanford undergrad and Stanford MBAs, and students who participated in both the CES and STVP programs. Robust standard errors are reported in parentheses. Robust standard errors are reported in parentheses and *p* values are reported in italics.

We further explore which margins might be at work in increasing firm performance. We examine the information on financing, in particular, total financing up till the survey date and initial financing but find no significant results. These results are presented in Table S8. We also examine industry choice and networking activity. The 2SLS results in Table S9 indicate that CES participation increases startup of internet-related businesses, and some weak evidence that STVP increases startups in biomedicine. In Table S10, we find that CES participation significantly increases utilization of alumni networks via regional alumni clubs, and to find business partnerships. The evidence suggests that education informs students whether they are of the entrepreneurial type or not, but also provides tools and networking skills to succeed.

5.4 | Examination of a specific experiential learning program

The results up to now are the average effects of program introduction at the school level and may not adequately capture the effects of more targeted programs. Specific teachers, courses, or experiential learning programs may affect entrepreneurship differently compared to a high-level entrepreneurship initiative like the CES or STVP. Hence, we examine the effect of a more intensive and individualized entrepreneurship education program, that is, the Mayfield Fellows Program (MFP) offered through the STVP. The MFP is an intensive entrepreneurship work/study program for undergraduates and co-term students that provides leadership skills, practical entrepreneurial knowledge, and alumni mentoring opportunities.[15] Twelve fellows are selected each year from a variety of majors. As of 2018, there are a total of 268 MFP alumni including numerous successful company founders, as well as engineering and product management leaders at major firms.

Table S11 shows the results of logit regressions analyzing the likelihood of becoming an entrepreneur for participants in the MFP relative to different control groups, such as, Stanford engineering alumni who graduated in the top 5% of their class, and alumni who participated in other entrepreneurship courses or entrepreneurial activities during their time at Stanford. We find consistent results showing that MFP alumni are more likely to become entrepreneurs after graduating. In relation to our earlier findings on the CES and the STVP, the results here could be interpreted as indicating that general entrepreneurship education may be most impactful to individuals with a degree of work experience and who are somewhat into their professional careers—but that intensive entrepreneurship education may also be particularly impactful for younger students who are approaching graduation.[16]

One concern could be that MFP students are encouraged to start companies at a higher rate and then over-enthusiastically join the ranks of entrepreneurs even if they are not prepared, this should be expected to result in lower performance. On the other hand, if they are learning skills and gaining networks to improve their human capital and thus entering based on this improved expectation of success, then we would expect higher performance from their firms.

[15]Coterm is a special admissions process that allows students to matriculate into one of Stanford's master's degrees participating in the Coterminal Degrees Program. Coterm students are both undergraduate and graduate students at the same time for at least one quarter prior to undergraduate degree conferral.

[16]Alternatively, it may be that for engineering students, it is especially important to have the combination of mentorship and the internship component to working in a startup (i.e., the summer intern experience for MFP). For business school students, who already have more work experience and who may not come from an engineering background, general entrepreneurship education (without mentorship or internship experiences) may be sufficient since they have exposure to networks of coworkers/industry mentors and had industry experiences already.

The evidence suggests that the MFP alumni firms are at least comparable in fundraising performance and in terms of revenues and page views, they are likely outperforming, suggestive of the second mechanism of improved skills and networks, rather than over-enthusiastic entry. In particular, we collected additional data through exhaustive web-based searches, (including Crunchbase, LinkedIn, and Owler.com) on the performance of the companies started by MFP alumni, Terman Engineering Award alumni, and BASES (Business Association of Stanford Entrepreneurial Students; the largest undergraduate business student group on campus) alumni.[17] In terms of annual revenue, MFP alumni ventures earned an average of $73.1 million, whereas Terman award alumni had $1.08 million and BASES group alumni earned $1.5 million in revenue. These differences suggest that the MFP alumni ventures are earning significantly more revenue per venture capital dollar invested.[18] The data from SimilarWeb on website visits show a similar pattern of outperformance by MFP alumni.[19] These findings further corroborate the need for future research on specific entrepreneurship education programs. In combination with our earlier results, they show the variation in outcomes may be driven both by variation in the programs as well as in the students. The results suggest that such a tailored and engaging entrepreneurship education program may have a more positive effect.

6 | DISCUSSION AND CONCLUSION

There are a few streams of adjacent work that this research builds upon. First, much of the literature on academic entrepreneurship has focused on patenting, licensing and the role of the technology transfer office (Agrawal & Henderson, 2002; Mowery & Shane, 2002). Until recently, relatively less work has focused on the effectiveness of the university's role in educating students in entrepreneurship (Åstebro et al., 2012; Lerner & Malmendier, 2013). Recent work has examined influence from academic advisors and the university context and found evidence for both individual preferences and university context-based influence (e.g., the academic advisor) on the decision to become an entrepreneur (Azoulay et al., 2017; Roach & Sauermann, 2015). Entrepreneurship education programs and university entrepreneurship centers have proliferated over the past decade (Katz, 2003). Prior literature analyzing the impact of such programs, has been sparse, providing little in the way of quantitative assessments of their impact on students and alumni. Related work examining the social influence of classmates with entrepreneurial experience, venture competitions, compulsory entrepreneurship courses, and non-university entrepreneurship training programs show somewhat mixed results (Von Graevenitz et al., 2010; Lerner & Malmendier, 2013). Some of this work suggests that such programs may reduce entrepreneurship rates and have little impact on venture performance (Fairlie

[17]Although the numbers are small, this descriptive evidence is suggestive and should be interpreted with caution, however, it is important for understanding the results. In total, we found performance data on 61 companies founded by MFP alumni, 70 companies founded by BASES alumni, and 19 companies founded by Terman alumni.

[18]In a *t*-test of means, however, the differences do not reach the level of statistical significance, potentially due to the small sample size.

[19]Data on career and funding outcomes is mostly robust as well. MFP alumni ventures had raised an average of $24 million in venture capital funding in comparison to $51.4 million by Terman award alumni, and $22.9 million by BASES group alumni. These differences are not statistically significant. Finally, we gathered data (from LinkedIn) on the career histories of these groups of alumni. MFP alumni were more likely to hold CEO positions (18% were CEOs) relative to Terman award alumni (4% were CEOs) and BASES group alumni were more likely to be CEOs (29%) than MFP alumni.

et al., 2015; Howell, 2017). Other work provides evidence that entrepreneurship schooling or education does boost entrepreneurship rates and provide performance improvements for entrepreneurs (Gonzalez-Uribe & Leatherbee, 2017; Hallen et al., 2020; Lyons & Zhang, 2018). However, such pioneering work leaves open the question of whether such results are due to the educational content, structure of the programs, self-selection, small numbers, or whether more formalized entrepreneurship centers may exhibit a more positive impact on students and alumni.

Second, recent work suggests that the structure of accelerator programs may shape the benefits founders accrue in overcoming bounded rationality and learning the value of their ideas (Cohen, Bingham, & Hallen, 2018; Hallen et al., 2020), often leading them to close down their ventures more quickly (Yu, 2019). Qualitative evidence suggests that a particular type of learning mechanism in accelerators, coined as broad, intensive and paced consultation may be particularly effective (Hallen et al., 2020). Universities, non-profits, and governments all have different entrepreneurship programs and their objectives and structures are different. Even within universities, there are entrepreneurship courses, experiential learning programs, mentorship programs, and internship programs. The varying results from the different entrepreneurship programs highlight the importance of accounting for the institutional contexts when evaluating each program.

Third, related literature on the organizational context and sources of entrepreneurs focused on labor market frictions and the technical or managerial knowledge that employees accrue (Ganco, 2013). Much of this has centered on the so-called small firm effect, where those with experience in small firms appear more likely to become founders subsequently (Kacperczyk & Marx, 2016). Entrepreneurial opportunities among employees also appear to be associated with low pay-for-performance dispersion (Campbell, Ganco, Franco, & Agarwal, 2012) and by the dissolution of rival firms (Carnahan, 2017). Increasingly, scholars have used datasets of university alumni to examine issues related to career mobility (Bidwell & Mollick, 2015) and entrepreneurship (Kacperczyk, 2013). Scholars in this stream are interested in the future impact of entrepreneurial experience on the individual's future career trajectory (Campbell, 2013). Despite this growing stream, we know relatively little about the role of universities in preparing individuals for such career moves.[20]

Overall, the pattern of findings indicates that it is important to take into account variation in entrepreneurship training programs in course content, emphasis, and other dimensions. There are differences between the two programs, even within a single university that are important to note. The CES offers courses and programs that cater to business school students, most of whom have work experience, and are interested in entrepreneurship of all types (for-profit firms, not-for-profit organizations, social entrepreneurship, etc.) across all industries (retail, manufacturing, professional services, information technology, etc.). Accordingly, the course offerings cover a broad range of topics related to the general entrepreneurship experience. The STVP is designed to educate engineering students and emphasizes the entrepreneurial mindset, leadership, and problem-solving over outright company formation. Hence, the STVP could be leading to more impact on tech career progression rather than on startup activity, but we do

[20]There is literature that evaluates the impact of public efforts to promote entrepreneurship (Hsu, 2006; Lerner, 1999, 2002). Lee (2018) examines the effect of small business guaranteed loans, and Brander, Du and Hellmann (2015) examine the effect of public venture capital. These analyses overall point in the direction of little and uneven effects of public support for entrepreneurship. The paper proceeds following a "red-state" approach (Armanios, Eesley, Li, & Eisenhardt, 2017; Mitchell & Tsui, 2012). As such, this paper begins with a theoretical discussion of the relevant theories and formulate hypotheses.

not examine career progression in this article. Results could also differ due to underlying differences in business and engineering students. For instance, if business school students were more over-confident (as the evidence above suggests) or more receptive to certain types or formats of entrepreneurship education (i.e., case or project-based work), this could drive differences. Alternatively, if engineering students face a heavier course requirement load for their majors (or have more opportunities for internal venturing within established companies), this might generate more careful consideration or a different selection process into entrepreneurial coursework (and into founding new firms). Our findings suggest that general entrepreneurship education that targets a broader spectrum of startups, rather than one that solely focuses on technology startups, may be more effective in reducing the uncertainty in entrepreneurial ability or improving startup performance. Our results could also imply that Business School students overestimate their entrepreneurial ability more so than Engineering School students.

Our study is not without limitations that should be taken into account. In particular, as with all surveys, response bias is a vexing issue. Bias due to response rates could influence our estimates. However, in order to bias our estimates in the direction of making it more likely to find significance requires more than a simple story of general bias in response. It would require a story where alumni (from certain schools) became (around the time of the program introductions) more likely to respond to the survey if they were not entrepreneurs or were entrepreneurs but had higher performance. Such a story appears unlikely while remaining theoretically possible. Like all observational studies, we have concerns about unobserved heterogeneity which we must alleviate (albeit imperfectly) via our IV and DiD empirical strategies. Finally, since we utilize historical information on program introduction, we cannot directly measure changes in self-assessment of skills. We also leave for future research the challenging task of assessing the impact of different types of skills that may be taught. Future research may focus on training for opportunity recognition versus for entrepreneurial execution as well as interactions across social networks, skills and mindsets, social norms, or preferences as there may be complementary forces at work.

We cannot fully disprove that student characteristics, other than the variables that we observe in the data, of those who entered the business school or engineering school changed after the introduction of the entrepreneurship programs. There could have been selection on unobservable characteristics, and one could still be concerned that relatively more entrepreneurial students applied to Stanford after the entrepreneurship programs were introduced. If that were the case our estimates in Table 3 would likely be upward biased. But even with such possibility, we find negative to zero effects. Moreover, our qualitative analysis suggests that at least the main motivation behind the creation of Stanford University's entrepreneurship program was not to recruit more entrepreneurial students, but rather to institutionalize entrepreneurship education.

Whereas we focus on an educational institution that has a reputation for attracting students with preferences toward entrepreneurship, future work should focus on exploring heterogeneity in results conditional on preferences or social norms. Student preferences for entrepreneurial careers could be altered via entrepreneurship education, though this has rarely been explored in large samples. Prior work does not show or suggest a statistically significant change in risk preferences, social norms or attitudes towards entrepreneurship as a result of such training (Von Graevenitz et al., 2010; Lyons & Zhang, 2018; Oosterbeek et al., 2010). In another study of the Stanford student population, a randomized field experiment shows that entrepreneurial mentorship increases the likelihood of students becoming early employees (but not founders) after graduation (Eesley & Wang, 2017). Further, their findings show that the educational intervention (alongside parents' entrepreneurship status) was a stronger predictor of entrepreneurship than the students' entrepreneurial intentions prior to taking the course. In other

populations, social influence and more information on startup careers might change students' preferences towards (or away) from starting firms. Students may already know their preferences over primitives such as risk or independence and these may remain stable, but they may lack knowledge of how entrepreneurship fits (or not) relative to these preferences. Assuming those who self-select into such courses are skewed in distribution towards those who think it fits them, some students will come to realize entrepreneurship is not actually aligned with their preferences and opt-out. More informed self-selection based on preferences would impact the rate of entrepreneurship, but conditional on starting a firm, we would not expect to see significant changes in performance.[21] If instead, we would expect such courses to typically be encouraging of entrepreneurial preferences, we might expect to see an increase in entrepreneurship rates (in contrast to the findings here). However, if some students may change their preferences towards entrepreneurship yet lack skills for identifying promising opportunities or for executing, we expect that the performance of those ventures may be lower as a result. Again, this mechanism is inconsistent with our results here, but may be present in other samples or settings.

Entrepreneurship courses could also provide students to learn about opportunities and attain skills outside of entrepreneurship, and this may be the case especially for the business school programs which offer a variety of general management courses encompassing finance and law.[22] Another argument could be that entrepreneurship programs do not develop skills because the wrong content is being taught (or it may be less actionable for these individuals), or the right content is taught in the wrong way. As these arguments relate more to the field of education, we do not delve into these channels but acknowledge such a possibility for future work.

While we focus on the US, future work should also explore the effects of entrepreneurship education in different institutional environments. Prior work has long noted the positive effects of social norms and legitimacy toward entrepreneurship on rates of firm formation (Tolbert & Hiatt, 2010; Eberhart, Eesley, & Eisenhardt, 2017). Yet, this well-accepted story may also be oversimplified. Recent work that focuses on changes in university institutions to promote entrepreneurship has shown that if these normative and cognitive pillars of support are inconsistent with the broader regulatory environment, this can generate more entrepreneurship. However, these firms were demonstrated to have lower financial performance (Eesley et al., 2016). Thus, the optimal university-based interventions may vary with the institutional context. More effective interventions may also vary with the background of the student population. This is both consistent with our results here, as well as Lee and Eesley (2018) who find evidence that entrepreneurship education does little to address differences in entrepreneurship rates of alumni by ethnicity or national background. Traditional forms of entrepreneurship education may need to

[21]This is true under the assumption that changes in the assessed fit in skills and preferences for entrepreneurship have a sufficiently low correlation. If both self-assessments change simultaneously then disentangling them is challenging. Prior work that tested for changes in risk preferences, perceived social norms and attitudes toward entrepreneurship as a result of entrepreneurship education did not find statistically significant changes (Graevenitz et al., 2010). Changes in self-assessed skills have received more empirical support to date (Lyons & Zhang, 2018).

[22]Another possibility is that students not only learn about their own skills but also about post-graduation opportunities. This is a plausible explanation given that entrepreneurship programs sometimes offer not only entrepreneurship courses but also more general management courses. Through these other courses, students may learn about opportunities outside of the entrepreneurship realm and acquire skills that serve them well outside of the entrepreneurship market. However, whether this channel is strong enough to counter entrepreneurship related skill development is hard to tell, and may likely be a second-order effect.

be further questioned if they seek to address imbalances in access to entrepreneurial opportunities by race, gender, first-generation status, income level, or other characteristics.

Results based on this type of sample may generalize to other samples of selective-admission college-educated alumni. Yet, it is possible the effects we document here could be upper bounds on the estimated effects of entrepreneurship education due to the high quality of the network, instruction, and reputation at Stanford and the location in Silicon Valley. However, it is also possible that due to the fact that students who choose to attend Stanford University are likely to already have higher than average levels of entrepreneurial interest and intentions, the results from this sample could also represent a lower bound on the estimated effect size. If there is a saturation effect due to the large amount of information regarding entrepreneurship "in the air" due to the location in Silicon Valley and a large number of opportunities for interaction with students, alumni and faculty or staff who are entrepreneurial, then perhaps the additional effect of entrepreneurship education in this environment is reduced. If so, our coefficients could represent a lower bound on the size of the effect if the same instruction were offered at a different university or to students with less prior knowledge about entrepreneurship. While future research with different samples will be necessary to fully lift this fog in our understanding of such programs, our results shed light on the key dimensions of research designs to enable forward progress. Our study contributes to this discussion by arguing that a central element is to more clearly conceptualize the mechanisms involved as the observable outcomes are the net effect and depends on the size of the effects moving in opposite directions. For instance, to correctly interpret the results of a study in a different university (or corporate) setting that finds an increased rate of entrepreneurship, we need to understand whether that increase is due to greater skill development (perhaps resulting from a lower starting point in entrepreneurial knowledge outside of Silicon Valley) or whether it is due to over-enthusiastic entry (and thus lower average performance) due to social influence. In contrast, a finding in another university context of a decreased rate of entrepreneurship might be a replication of our finding of enhanced learning about one's own skills, or it could be due to a combination of learning about one's own skills and a lack of skill development in the curriculum. If future studies neglect to build in measures of the intervening mechanisms, then it is hard, if not impossible for the field to build cumulative knowledge on to what extent these results generalize.

In conclusion, if university students and alumni entrepreneurs are the next generations of potential entrepreneurs, such university entrepreneurship initiatives may play an important role in funneling the winds of creative destruction (Schumpeter, 1942).

ACKNOWLEDGEMENTS

We acknowledge funding from Sequoia Capital, the Kauffman Foundation, the Technical University of Munich Research Award, and the Richard Schulze Family Foundation. We appreciate feedback and comments from the editor and anonymous reviewers, the NBER Entrepreneurship Working Group, the NBER Asia Innovation Conference as well as seminar participants at INSEAD and the Technical University of Munich.

ORCID

Charles E. Eesley https://orcid.org/0000-0003-2348-1583

REFERENCES

Agrawal, A., & Henderson, R. (2002). Putting patents in context: Exploring knowledge transfer from MIT. *Management Science*, *48*(1), 44–60.

Armanios, D. E., Eesley, C. E., Li, J., & Eisenhardt, K. M. (2017). How entrepreneurs leverage institutional intermediaries in emerging economies to acquire public resources. *Strategic Management Journal*, *38*(7), 1373–1390.

Arora, A., Belenzon, S., & Rios, L. A. (2014). Make, buy, organize: The interplay between research, external knowledge, and firm structure. *Strategic Management Journal*, *35*(3), 317–337.

Arora, A., & Gambardella, A. (1994). The changing technology of technological change: general and abstract knowledge and the division of innovative labour. *Research Policy, 23*(5), 523–532.

Artinger, S., & Powell, T. C. (2016). Entrepreneurial failure: Statistical and psychological explanations. *Strategic Management Journal*, *37*(6), 1047–1064.

Åstebro, T., Bazzazian, N., & Braguinsky, S. (2012). Startups by recent university graduates and their faculty: Implications for university entrepreneurship policy. *Research Policy*, *41*(4), 663–677.

Azoulay, P., Liu, C. C., & Stuart, T. E. (2017). Social influence given (partially) deliberate matching: Career imprints in the creation of academic entrepreneurs. *American Journal of Sociology*, *122*(4), 1223–1271.

Baron, J. N., & Hannan, M. T. (2005). The economic sociology of organizational entrepreneurship: Lessons from the Stanford Project on Emerging Companies. *The Economic Sociology of Capitalism*, 168–203.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99–120.

Bidwell, M., & Mollick, E. (2015). Shifts and ladders: Comparing the role of internal and external mobility in managerial careers. *Organization Science*, *26*(6), 1629–1645.

Boaler, J. (2013). Ability and mathematics: The mindset revolution that is reshaping education. *Forum*, *55*(1), 143–152.

Brander, J. A., Du, Q., & Hellmann, T. (2015). The effects of government-sponsored venture capital: International evidence. *Review of Finance*, *19*(2), 571–618.

Burt, R. S. (2001). Attachment, decay, and social network. *Journal of Organizational Behavior, 22*(6), 619–643.

Cain, D. M., Moore, D. A., & Haran, U. (2015). Making sense of overconfidence in market entry. *Strategic Management Journal*, *36*(1), 1–18.

Campbell, B. A. (2013). Earnings effects of entrepreneurial experience: Evidence from the semiconductor industry. *Management Science*, *59*(2), 286–304.

Campbell, B. A., Ganco, M., Franco, A. M., & Agarwal, R. (2012). Who leaves, where to, and why worry? Employee mobility, entrepreneurship and effects on source firm performance. *Strategic Management Journal*, *33*(1), 65–87.

Carnahan, S. (2017). Blocked but not tackled: Who founds new firms when rivals dissolve? *Strategic Management Journal*, *38*(11), 2189–2212.

Cassar, G. (2010). Are individuals entering self-employment overly optimistic? An empirical test of plans and projections on nascent entrepreneur expectations. *Strategic Management Journal*, *31*(8), 822–840.

Chatterji, A. K. (2009). Spawned with a silver spoon? Entrepreneurial performance and innovation in the medical device industry. *Strategic Management Journal, 30*(2), 185–206.

Chatterji, A., Delecourt, S., Hasan, S., & Koning, R. (2019). When does advice impact startup performance? *Strategic Management Journal*, *40*(3), 331–356.

Cohen, S. L., Bingham, C. B., & Hallen, B. L. (2018). The role of accelerator designs in mitigating bounded rationality in new ventures. *Administrative Science Quarterly*, *47*, 92–124. https://doi.org/10.1177/0001839218782131

Cumming, D. J., & Fischer, E. (2012). Publicly funded business advisory services and entrepreneurial outcomes. *Research Policy, 41*(2), 467–481. Vancouver.

Dahl, M. S., & Sorenson, O. (2012). Home sweet home: Entre- preneurs' location choices and the performance of their ventures. *Management Science*, *58*(6), 1059–1071.

Datta, S., & Iskandar-Datta, M. (2014). Upper-echelon executive human capital and compensation: Generalist vs specialist skills. *Strategic Management Journal*, *35*(12), 1853–1866.

Dobrev, S. D., & Barnett, W. P. (2005). Organizational roles and transition to entrepreneurship. *Academy of Management Journal, 48*(3), 433–449.

Duflo, E. (2001). Schooling and labor market consequences of school construction in Indonesia: Evidence from an unusual policy experiment schooling and labor market consequences of school construction in Indonesia: Evidence from an unusual policy experiment. *American Economic Review*, *91*(4), 795–813.

Eberhart, R. N., Eesley, C. E., & Eisenhardt, K. M. (2017). Failure is an option: Institutional change, entrepreneurial risk, and new firm growth. *Organization Science*, *28*(1), 93–112.

Eesley, C., Li, J. B., & Yang, D. (2016). Does institutional change in universities influence high-tech entrepreneurship?: Evidence from China's project 985. *Organization Science*, *27*(2), 446–461.

Eesley, C., & Wang, Y. (2017). Social influence in career choice: Evidence from a randomized field experiment on entrepreneurial mentorship. *Research Policy*, *46*(3), 636–650.

Eesley, C. E., & Miller, W. F. (2018). Impact: Stanford University's economic impact via innovation and entrepreneurship. *Foundations and Trends in Entrepreneurship*, *14*(2), 130–278.

Eesley, C. E., & Roberts, E. B. (2012). Are you experienced or are you talented?: When does innate talent versus experience explain entrepreneurial performance? *Strategic Entrepreneurship Journal*, *6*(3), 207–219.

Fairlie, R. W., Karlan, D., & Zinman, J. (2015). Behind the GATE experiment: Evidence on effects of and rationales for subsidized entrepreneurship training. *American Economic Journal: Economic Policy*, *7*(2), 125–161.

Franco, A. M., & Filson, D. (2006). Spin-outs: knowledge diffusion through employee mobility. *The RAND Journal of Economics, 37*(4), 841–860.

Ganco, M. (2013). Cutting the Gordian knot: The effect of knowledge complexity on employee mobility and entrepreneurship. *Strategic Management Journal*, *34*(6), 666–686.

Gonzalez-Uribe, J., & Leatherbee, M. (2017). The effects of business accelerators on venture performance: Evidence from start-up Chile. *The Review of Financial Studies*, *31*(4), 1566–1603.

Gorman, G., Hanlon, D., & King, W. (1997). Some research perspectives on entrepreneurship education, enterprise education and education for small business management: A ten-year literature review. *International Small Business Journal*, *15*(3), 56–77.

Hallen, B. L., Cohen, S. L., & Bingham, C. B. (2020). Do accelerators work? If so, how? *Organization Science*, *31*(2), 378–414.

Hatch, N. W., & Dyer, J. H. (2004). Human capital and learning as a source of sustainable competitive advantage. *Strategic Management Journal*, *25*(12), 1155–1178.

Heckman, J., & Singer, M. (2017). Abducting economics. *American Economic Review*, *107*(5), 298–302.

Holcomb, T. R., Holmes, R. M., Jr., & Connelly, B. L. (2009). Making the most of what you have: Managerial ability as a source of resource value creation. *Strategic Management Journal*, *30*(5), 457–485.

Howell S. (2017). Are New Venture Competitions Useful? NBER Working Paper 23874.

Hsu, D. (2006). Venture capitalists and cooperative start-up commercialization strategy. *Management Science*, *52*(2), 204–219.

Hsu, D., Roberts, E. B., & Eesley, C. (2007). Entrepreneurs from technology-based universities: Evidence from MIT. *Research Policy*, *36*, 768–788.

Kacperczyk, A. J. (2013). Social influence and entrepreneurship: The effect of university peers on entrepreneurial entry. *Organization Science*, *24*(3), 664–683.

Kacperczyk, A. J., & Marx, M. (2016). Revisiting the small-firm effect on entrepreneurship: Evidence from firm dissolutions. *Organization Science*, *27*(4), 893–910.

Katz, J. A. (2003). The chronology and intellectual trajectory of American entrepreneurship education: 1876–1999. *Journal of Business Venturing*, *18*(2), 283–300.

Kenney, M. (2000). *Understanding Silicon Valley: The anatomy of an entrepreneurial region*. Stanford, CA: Stanford University Press.

Kenney, M., & Goe, W. R. (2004). The role of social embeddedness in professorial entrepreneurship: A comparison of electrical engineering and computer science at UC Berkeley and Stanford. *Research Policy*, *33*(5), 691–707.

Kenney, M., & Patton, D. (2005). Entrepreneurial geographies: Support networks in three high-technology industries. Economic Geography, 81(2), 201–228.

Kim, J. D. (2019). Predictable Exodus: Startup Acquisitions and Employee Departures. Available at SSRN: https://ssrn.com/abstract=3252784 or https://doi.org/10.2139/ssrn.3252784

Kor, Y. Y., & Leblebici, H. (2005). How do interdependencies among human-capital deployment, development, and diversification strategies affect firms' financial performance? *Strategic Management Journal*, *26*(10), 967–985.

Kotha, R., Lin, Y., Ohlsson-Corboz, A.V., & Vissa, B. (2019). Does management training help entrepreneurs grow new ventures? Field experimental evidence from Singapore. INSEAD Working Paper.

Lazear, E. P. (2005). Entrepreneurship. *Journal of Labor Economics*, *23*, 649–680.

Lee, Y. S. (2018). Government guaranteed small business loans and regional growth. *Journal of Business Venturing*, *33*(1), 70–83.

Lee, Y. S., & Eesley, C. (2018). The persistence of entrepreneurship and innovative immigrants. *Research Policy*, *47*(6), 1032–1044.

Lerner, J. (1999). The government as venture capitalist: The long-run effects of the SBIR program. *Journal of Business*, *72*, 285–318.

Lerner, J. (2002). When bureaucrats meet entrepreneurs: The Design of Successful 'public venture capital' programs. *Economic Journal*, *112*(477), 73–84.

Lerner, J., & Malmendier, U. (2013). With a little help from my (random) friends: Success and failure in post-business school entrepreneurship. *Review of Financial Studies*, *26*(10), 2411–2452.

Lyons, E., & Zhang, L. (2018). Who does (not) benefit from entrepreneurship programs? *Strategic Management Journal*, *39*(1), 85–112.

Miller, D., Xu, X., & Mehrotra, V. (2015). When is human capital a valuable resource? The performance effects of ivy league selection among celebrated CEOs. *Strategic Management Journal*, *36*(6), 930–944.

Mitchell, W., & Tsui, A. S. (2012). *Research in emerging economy contexts: Selected Articles from MOR and three SMS journals (GSJ, SEJ, and SMJ)*. Hoboken, NJ: Wiley-Blackwell.

Mowery, D. C., & Shane, S. (2002). Introduction to the special issue on university entrepreneurship and technology transfer. *Management Science*, *48*(1), v–ix.

Nanda, R., & Sørensen, J. B. (2010). Workplace peers and entrepreneurship. *Management Science*, *56*(7), 1116–1126.

Nicolaou, N., Shane, S., Cherkas, L., Hunkins, J., & Spector, T. (2008). Is the tendency to engage in entrepreneurship genetic? *Management Science*, *54*(1), 167–179.

Oosterbeek, H., Van Praag, M., & Ijsselstein, A. (2010). The impact of entrepreneurship education on entrepreneurship skills and motivation. *European Economic Review*, *54*(3), 442–454.

Paik, Y. (2014). Serial entrepreneurs and venture survival: Evidence from US venture-capital-financed semiconductor firms. *Strategic Entrepreneurship Journal, 8*(3), 254–268.

Peterman, N. E., & Kennedy, J. (2003). Enterprise education: Influencing students' perceptions of entrepreneurship. *Entrepreneurship Theory and Practice*, *28*(2), 129–144.

Rider, C. I. (2009). Constraints on the control benefits of brokerage: A study of placement agents in US venture capital fundraising. *Administrative Science Quarterly*, *54*(4), 575–601.

Riley, S. M., Michael, S. C., & Mahoney, J. T. (2017). Human capital matters: Market valuation of firm investments in training and the role of complementary assets. *Strategic Management Journal*, *38*(9), 1895–1914.

Roach, M., & Sauermann, H. (2015). Founder or joiner? The role of preferences and context in shaping different entrepreneurial interests. *Management Science*, *61*(9), 2160–2184.

Roberts, B., Murray, F., & Kim, J. D. (2015). *Entrepreneurship and innovation at MIT: Continuing global growth and impact (December 15, 2015)*. Cambridge MA: Massachusetts Institute of Technology Available at SSRN: https://ssrn.com/abstract=2772695

Roberts, E. B. (1991). Entrepreneurs in high technology: Lessons from MIT and beyond. Oxford University Press.

Roberts, E. B., & Eesley, C. E. (2009). Entrepreneurial Impact: The Role of MIT. Kauffman Foundation.

Roberts, P. W., & Sterling, A. D. (2012). Network progeny? Prefounding social ties and the success of new entrants. *Management Science*, *58*(7), 1292–1304.

Rothaermel, F. T., Agung, S. D., & Jiang, L. (2007). University entrepreneurship: A taxonomy of the literature. *Industrial and Corporate Change*, *16*(4), 691–791.

Schumpeter, J. (1942). *Capitalism, Socialism and Democracy*. New York: Harper & Row.

Shaw, J. D., Park, T. Y., & Kim, E. (2013). A resource-based perspective on human capital losses, HRM investments, and organizational performance. *Strategic Management Journal*, *34*(5), 572–589.

Sisk, V. F., Burgoyne, A. P., Sun, J., Butler, J. L., & Macnamara, B. N. (2018). To what extent and under which circumstances are growth mind-sets important to academic achievement? Two meta-analyses. *Psychological Science*, *29*(4), 549–571.

Souitaris, V., Zerbinati, S., & Al-Laham, A. (2007). Do entrepreneurship programmes raise entrepreneurial intention of science and engineering students? The effect of learning, inspiration and resources. *Journal of Business Venturing*, *22*(4), 566–591.

Starr, E., Ganco, M., & Campbell, B. A. (2018). Strategic human capital management in the context of cross-industry and within-industry mobility frictions. *Strategic Management Journal*, *39*(8), 2,226–2,254.

Stuart, T. E., & Ding, W. W. (2006). When do scientists become entrepreneurs? The social structural antecedents of commercial activity in the academic life sciences. *American Journal of Sociology, 112*(1), 97–144.

Teece, D.J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management journal, 18*(7), 509–533.

Tolbert, P. S., & Hiatt, S. R. (2010). The shape of things to come: Institutions, entrepreneurs, and the case of hedge funds. In W. D. Sine & R. J. David (Eds.), *Institutions and Entrepreneurship (Research in the Sociology of Work, Vol. 21)*. Bingley: Emerald Group Publishing Limited.

Vesper, K. H., & Gartner, W. B. (1997). Measuring progress in entrepreneurship education. *Journal of Business Venturing*, *12*(5), 403–421.

Von Graevenitz, G., Harhoff, D., & Weber, R. (2010). The effects of entrepreneurship education. *Journal of Economic Behavior & Organization*, *76*, 90–112.

Yu, S. (2019). How do accelerators impact the performance of high-technology ventures? *Management Science*, *66*(2), 530–552.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Eesley CE, Lee YS. Do university entrepreneurship programs promote entrepreneurship? *Strat Mgmt J*. 2021;42:833–861. https://doi.org/10.1002/smj.3246