

Entrepreneurial Adaptation and Social Networks: Evidence from a Randomized Experiment on a MOOC Platform

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Abstract:

We examine the performance of early-stage entrepreneurs before and after randomly showing them different approaches to finding an advisory social network tie, and we find important interactions between the type of social tie and the entrepreneur's strategic process. To our knowledge, this is the first randomized, controlled field trial of both social networks and strategic process in the literature. In particular, the results show that adding a diverse network tie alone is less effective than combining a diverse tie with a specific strategic approach. In isolation, a planning strategic process is more effective than just adding a diverse mentor tie. Contrary to the finding that entrepreneurs often change their business model and strategic direction frequently, we find that instructing entrepreneurs to have a strong, persistent vision for their startup often results in better performance in the early stages. In contrast to prior work that shows that entrepreneurs often begin their ventures with a cohesive, closed network high in trust then transition later to a more diverse network, we find that early stage ventures appear to be better off with more diverse social ties in the beginning, particularly if a more adaptive approach is adopted for the venture's strategy. The results suggest that social networks should not be altered for entrepreneurs and managers (as many recent policies attempt to do) without also taking the strategy formulation process into consideration.

I tell this story to illustrate the truth of the statement I heard long ago in the Army: Plans are worthless, but planning is everything. – Dwight Eisenhower

Introduction

The accelerated pace of a major structural change in the US economy and beyond has elevated the importance of entrepreneurship. As a result, universities and policymakers around the world seek to foster entrepreneurship as a way to increase job creation and economic growth. One of the most salient factors that have a significant effect on entrepreneurial outcomes is the social networks of the founders (Ingram and Roberts 2000, Lerner and Malmendier 2013, Nanda and Sørensen 2010). Consequently, many universities, governments and industry participants have started programs that aim to influence social networks, especially advisory network ties as a key component in increasing entrepreneurship (Eesley and Miller 2012). In recent years, mentorship programs in science parks, accelerators, entrepreneurship education initiatives (Von Graevenitz et al. 2010) and government-sponsored small business programs have proliferated in both the US and abroad (Bruneel et al. 2012).¹ Accelerator and incubator programs outside of universities, such as YCombinator, TechStars and the Founder Institute have also grown; and mentorship has become an important component of these programs. Often, these programs pitch to potential entrepreneurs that in exchange for their equity stake, they gain the benefits of accessing a network of industry experts and a mentor to help navigate the uncertain and complex environment of starting a venture. In the US, the JOBS Act and Startup America has allocated \$400M dollars for mentorship and funding.² In addition, the National Science Foundation (NSF) has recently launched an \$18M program to pair select engineers and scientists who win SBIR³ grants with mentors. This program teaches these participants a more adaptive process for startup creation.⁴ Alongside these government and industry-led initiatives, universities have created courses and programs that feature mentorship components (Fayolle 2000, Fayolle et al. 2006,

¹ The SBA, in partnership with the Department of Energy and Advanced Research Projects Agency-Energy (ARPA-E), is funding four business accelerators. These accelerators will provide intensive mentorship from seasoned entrepreneurs to a selection of the most promising new companies. This pilot program is the first step in the development of a large, distributed network of entrepreneurs, mentors, and accelerators. The Department of Veterans Affairs (VA), in partnership with SBA and the Department of Labor, will establish two of the first integrated business accelerators, where early-stage Veteran-owned businesses are mentored by experienced entrepreneurs and trained to develop the skills needed to build successful businesses.

² <http://s.co/press-release/april20commitments>

³ SBIR: Small Business Innovation Research, <http://www.sbir.gov/>

⁴ https://www.nsf.gov/news/special_reports/i-corps/

Kuratko 2005). Recent studies have estimated significant economic impact from university-based entrepreneurship (Harhoff 1999, Roberts and Eesley 2011, Shane 2004). Anecdotally, we have also observed that along with adding mentorship, many of these programs have moved away from having participants create extensive business plans, in favor of a more flexible, adaptive approach to strategy formulation (Blank 2013).

While these new programs may be a good way to foster entrepreneurship, we know little about how to successfully alter the social networks of aspiring entrepreneurs (e.g., network ties such as mentors and advisors). Moreover we know even less about the entrepreneurial process, such as whether a flexible and adaptive process is beneficial. This is in part because it is difficult to observe the entrepreneurial process; and even when it is observable in some rare cases, disentangling various confounding factors that could simultaneously affect outcomes remains a challenge. For example, it may be observed that having a mentor is correlated with a superior outcome, yet it remains unclear whether the mentor's guidance was responsible for the success of the venture or if it is simply that a good business idea tends to attract a mentor. Without finding an exogenous source in the pairing between a new advisory network tie and an entrepreneur, it is difficult to disentangle these complex and often endogenous relationships. Furthermore, even if we find evidence that the social network of the founder can affect entrepreneurial success, it is difficult to determine how it facilitates the process precisely because we cannot observe it. As the result, we cannot explain the mixed findings in literature on whether certain social network ties affect entrepreneurial performance (Lerner and Malmendier 2013, Stuart and Ding 2006). In particular, if the venture strategy that an entrepreneur adopts could mediate the effect of network ties, observing this process could help explain the heterogeneous performance effect of social networks. Thus, our goal is to not only understand whether certain network ties affect performance but also to understand how the entrepreneurial processes mediate the effect.

To understand how social networks of the founder affect entrepreneurial outcome, we focus on a salient characteristic of social networks that has received a tremendous amount of attention in the literature: having a structurally diverse network, also called brokerage or structural holes. Literature has shown that a diverse network of connections that spans structural holes can provide advantageous access to information that in turn improves various performance outcomes including entrepreneurial success (Burt 1992, Granovetter 1973). A primary advantage

of having high network diversity is access to novel information through facilitating the flow of information and bridging otherwise unconnected groups. Such effects should be applicable to entrepreneurship because the requirements for information are likely to be high for starting a venture. With the fast pace of change in starting an entrepreneurial venture, receiving information faster than others can substantially improve the opportunities for the entrepreneur to capture its value. However, the impact of having a structurally diverse network or high network diversity may depend on the venture strategy or more specifically, how the entrepreneur chooses to use the information. Planning and adaptive logics are two main approaches that guide the strategic process in forming a venture. The former focuses on the entrepreneur's ability to plan and execute a strategy; and the latter focuses on the entrepreneur's flexibility to take advantage of new information and opportunities. While information about the business environment is likely to be helpful for both types of strategic processes, the adaptive logics strategy is inherently more suited to take advantage of new information. When an entrepreneur using adaptive logics receives a novel bit of information, she is more likely to use the information even when it may not conform to the original vision of the venture. However, an entrepreneur using the planning logic is more likely to discard the information if it would potentially detract from her original vision. Thus, an entrepreneur choosing an adaptive process could benefit more from having a structurally diverse network because it can provide a variety of novel information. For the same reason, having a structurally diverse network may not benefit an entrepreneur who chooses the planning approach.

An examination of the potential interaction between network characteristics and venture strategy would be nearly impossible without observing the details of entrepreneurial process and introducing randomized interventions. The massive open, online course (MOOC) setting overcomes these challenges in that it allows us to use a pre-test, post-test randomized controlled trial to test and observe various strategic processes and mentor ties. This setting provides an unprecedented opportunity to understand how social network and venture strategies relate to each other in generating entrepreneurial outcomes. The revolution in MOOCs is parallel to the revolution in digital and social media. It allows us to observe the entrepreneurial process with a finer grain of precision, and to detect the micro-mechanisms behind entrepreneurship that were nearly impossible to observe before. These experiments are more general than traditional lab studies or tracking a small group of MBA students in the Northeastern US (for example),

because the subjects in MOOCs classes are sampled from all over the world. More importantly, MOOCs are verifiable as the experiments could be repeated quickly and at scale.

In order to understand the interplay between network structures and venture strategy, we randomly introduce different versions of the same assignments: we specify different venture strategies as well as the advantage of certain network characteristics. By prompting students to adopt either planning or adaptive logics as well as prompting them to find a mentor that could improve their overall network diversity, we show that the venture strategy an entrepreneur chooses can substantially moderate the effect of having a structurally diverse network. We find that having a mentor who could increase the network diversity for the founder results in an ambiguous effect on the quality of the entrepreneur's final startup presentation. This is because the effect is heterogeneous depending on the venture strategy. When the entrepreneur chooses the adaptive logics approach, having a mentor with diverse social ties can significantly improve the entrepreneurship outcomes; whereas the planning logics approach has no effect on the outcomes. Overall, these results suggest the importance of introducing venture strategies into understanding the effect of social networks on entrepreneurial outcomes. An understanding of their interactive nature can have a profound effect on entrepreneurial success as well as on how we mentor future entrepreneurs.

Our analyses are unique in several ways. First, through MOOCs, it is the first time we are able to observe the detailed entrepreneurial process across a diverse population of entrepreneurs. Through the introduction of different strategies of pursuing a venture, we can observe the use of these strategies and network relationships and how they affect performance. Second, by using randomized experiments, the usual endogeneity concerns, such as selection or omitted variable biases, are less likely to hamper the validity of our analysis, thereby enabling us to make causal inferences. Furthermore, our results also demonstrate the power of MOOCs to advance the studies of information technologies, entrepreneurship, and general social science. A change of a few lines in an assignment can produce a statistically significant change in large sample of population. This could only be achieved through a MOOCs platform that can easily gather thousands of potential subjects. Combined with the ability to conduct randomized experiments, MOOCs can serve as an ideal platform to understand and address many difficult problems faced in social science.

Social Networks and Entrepreneurship Outcomes

We know from prior social network literature that networks shape entrepreneurial entry (Stuart and Ding 2006) as well as performance (Dahl and Sorenson 2012, Roberts and Sterling 2012). This earlier work has examined vertical ties to prior employers as either pipes for information (Chatterji 2009) or prisms to reflect status (Burton et al. 2002, Gulati and Higgins 2003, Stuart et al. 1999). Some scholars have examined the influence of horizontal ties to peers and other managers (Ingram and Roberts 2000, Lerner and Malmendier 2013, Nanda and Sørensen 2010) or family members such as entrepreneurial parents (Sørensen 2007). Using observational data, prior work has examined the exposure to entrepreneurship via parents or coworkers, indicating that it increases entrepreneurial behavior (Nanda and Sørensen 2010, Sørensen 2007, Stuart and Ding 2006). However, the exact mechanism is still unclear. Matching with peers is a highly endogenous process, and it could be that more entrepreneurial individuals tend to associate with one another. In fact, more careful research designs appear to show opposite effects (Lerner and Malmendier 2013). A recent study using a quasi-experimental design found that MBA students randomized to class sections with former entrepreneurs were *less* likely to start businesses after graduation (Lerner and Malmendier 2013). However, this study uses a highly selected sample from a prestigious MBA program and thus it may not be generalizable to the larger population of entrepreneurs.

Some scholars have also argued that in addition to the direct ties, the network structure or the triadic connections of the founder can play an important role in entrepreneurial success (Burt 2004). The triadic structure could explain the variance in the return to having the same dyadic ties. Prior work has focused on a type of triadic structure that has shown to be correlated with various types of work benefits. Specifically, individuals with high network diversity or the ability to bridge structural holes can provide information benefits obtained through facilitating the flow of information from otherwise unconnected groups (Burt 1992, Burt 1997, Cross and Cummings 2004, Lin 2002, Lin 2008, Wu 2013, Wu et al. 2009). For instance, individuals in research and development jobs who maintain diverse contacts beyond the firm have higher productivity relative to peers (Reagans and Zuckerman 2001). Bankers who can bridge across multiple structural holes are also associated with superior performance and promotions. Recent work has quantified the various information benefits derived from having network diversity. These benefits are shown to directly improve work productivity as well as improving career

paths (Aral and Van Alstyne 2011, Wu 2013). Thus, individuals with high network diversity are in a unique position to receive novel information and use them to their advantage. Based on the network diversity/structural hole literature, adding the same tie could have different effect on entrepreneurial outcomes depending on how much of the founder's network diversity could increase from the new tie. When a mentor comes from a different social network space, she can provide novel and non-redundant information, which can be especially helpful in information-intensive environments, such as starting a venture. By introducing necessary network connections, mentors can help the entrepreneur to strategically use new information in her favor. They might make introductions, provide strategic guidance, or even introduce investors, early adopters or potential cofounders.

On the other hand, some have argued that there are benefits to have a social network tie in the same cohesive network as the entrepreneurs themselves. The trust and absorptive capacity (Cohen and Levinthal 1990) enabled through cohesive networks can better facilitate collaborations. For example, some studies show that a social network with fewer structural holes is better for building trust and facilitate collaborations (Coleman 1988). Contrary to finding diverse ties, finding a network tie in a cohesive network may actually be better for early stage ventures. A cohesive network could better provide social status and prominence needed for obtaining funding. Social status, conferred through network ties with customers and investors, has been shown to improve entrepreneurial performance including fundraising (Burton et al. 2002, Roberts and Sterling 2012). Direct and indirect ties influence the selection of ventures to fund (Shane and Cable 2002) because these ties provide important informational signals about the quality of the entrepreneur and her project (Nicolaou and Birley 2003, Shane and Stuart 2002). However, to transfer status and prominence requires that the network be more cohesive such that resource providers know the status level and strength of the relevant tie. Studies generally assume that network ties provide information about opportunities and skills (Saxenian 2000, Sorenson and Audia 2000), or create trust and a signal of quality to third parties and other resource providers (Burton et al. 2002, Stuart et al. 1999). Yet, in such observational studies, the exact mechanism and nature of the social interaction is often unobservable.

Based on the existing empirical evidence, it is unclear which of the two mentorship ties is best for improving entrepreneurial outcomes, especially in the early stages. In fact, these ties

may both be beneficial but under different conditions. For example, diverse information and resources may only be critical to entrepreneurial success if an entrepreneur chooses to use them and believes these resources are strategic to her venture. A mentor that can introduce a more structurally diverse network would then be extremely beneficial to the founder. However, if information is not on the critical path, a mentor with the same cohesive network may be more beneficial. The ease of collaboration and the status transfer enabled through a cohesive network could be very helpful as the mentor in the same cohesive network is more likely to understand the vision and help the entrepreneur realize it. One particular factor that can aid in understanding the importance of information is the strategic process used in the venture.

Planning vs. Adaptive Logics in Entrepreneurship

Recent literature in strategy outlines two main approaches that guide the strategic process: [1] planning logic and [2] adaptive logic. These differ in the emphasis on prediction and control over the environment. The planning logic model emphasizes prediction and planning based on the positioning model of firm strategy (Porter 1980). In this high prediction and high control model, the entrepreneur is assumed to have a strong ability to predict the future direction of the market and has a high level of control to position the venture in order to take advantage of that future. The entrepreneur gathers information, creates a vision and plan, and then executes on that plan. Creation of this vision may begin with analyzing the market, including growth rates, opportunities and new market segments. Strategy making then proceeds to develop products and services to fill the identified unaddressed needs of consumers. Finally, go-to-market strategies are planned, resources are gathered, and execution is tracked. Delmar and Shane (2003) provide empirical evidence supporting this logic and show that business planning facilitates the development and survival of ventures.

Strategy in more uncertain environments has been argued to be based less on planning and positioning and more on a flexible, discovery-driven process (Baker and Nelson 2005, Blank 2013, Brown and Eisenhardt 1997, McGrath 2010). Diverse streams of strategy and entrepreneurship literature broadly propose a similar view of a more adaptive, flexible mode of strategy under the labels of discovery-driven planning (McGrath 2010), dynamic capabilities (Eisenhardt and Martin 2000, Teece 2007), improvisation, bricolage (Baker and Nelson 2005), and effectuation (Sarasvathy 2001). This is an adaptive logic model. The underlying idea is that

long-term competitive advantage is rare for firms and a series of short-term competitive advantages recreated over time may be more feasible (Chen et al. 2010). Drawing on insights from this literature, in uncertain environments ventures should not plan and position in the early stages; instead entrepreneurs must be more adaptive to feedback (Blank 2013). Instead of a planning logic which emphasizes vision and planning, this alternative model is based on adaptive control logic, which emphasizes a flexible and adaptable approach (Wiltbank et al. 2006). The entrepreneur is assumed to have a high degree of control but limited predictive ability. The entrepreneur does not create an unwavering vision, but rather he begins with the resources available and remains open to adapting rather than adhering to a vision and plan. If a stakeholder is willing to offer resources to co-create and advance the project, the entrepreneur may take advantage of the opportunity and move in a different direction.

Interactive Nature of Network Diversity and Strategic Decision-making

We draw on the insight from planning and adaptive logics to contribute to the literature on the mechanisms of how social network ties affect performance. Prior work has shown that network structure matters. However, it is important to understand this effect in relation to the type of strategic process that is undertaken by the individual. The planning logic and adaptive logic of strategic decision-making and entrepreneurship are likely to have important implications and place different demands on the individual's social network. The optimal advisory network ties may differ according to the entrepreneur's strategic process. Thus, while access to mentors with diverse network ties is useful, its effect on entrepreneurial outcomes may depend on the founder's propensity to choose a planning logic or adaptive strategic process. We expect that an adaptive strategy will only work well with a mentor who can expand an entrepreneur's network diversity whereas the same mentor may not benefit an entrepreneur who uses a planning strategy. The intermediate mechanism is the need to formulate a plan and willingness to change the plan. An entrepreneur who uses the adaptive process is receptive to extra mentoring that can help create the plan. Through co-creating a vision with the mentor, an adaptive entrepreneur is more likely to utilize the information and expertise provided by the mentor and adjusts her business model accordingly. In the fast-paced and uncertain landscape of starting a new venture, information is critical for entrepreneurs to seize new opportunities and gain competitive advantage. However, the information is only useful when the entrepreneur is receptive and

willing to act on it. Adaptive logics prompt the entrepreneur to be more receptive and find ways to better utilize the mentor's new information and resources. Bringing information into the venture, the mentor is also more likely to influence the entrepreneurial process and feel like he has a greater stake in the venture.

On the other hand, under a planning logic, the entrepreneur is less likely to modify his vision because of his strong belief in it. When a mentor brings in diverse perspectives, the entrepreneur may reject them if they fail to conform to the vision. The novel and non-redundant information offered by a mentor with high network diversity is thus less useful to the entrepreneur. The entrepreneur may benefit more from a similar-minded mentor who is likely to understand the vision and can help the entrepreneur to realize it. A mentor in the same cohesive network with frequent and strong ties is useful as frequent interactions enable the mentor and the entrepreneur to effectively communicate and operationalize the vision. In addition, the cohesive network facilitates building trust and transferring status signals that could help an entrepreneur to achieve goals in the planning strategy. While these features could also help an entrepreneur who use an adaptive strategic process, the entrepreneur could still benefit more from a mentor with high network diversity because of the unique and novel information offered by the mentor. In the rapid-pace environment of starting a venture, information can bring significant competitive advantage to entrepreneurs who need it and are willing to use it.

Thus, we expect that adaptive, flexible strategic processes will be enhanced by mentors with diverse network ties due to the information benefits; whereas a persistent and planning-based strategic process may not. Online entrepreneurship education offers a unique research design and setting to tests these theories because the process of entrepreneurship is difficult to test in other ways. Through class assignments on finding mentors, we randomize the way that students are taught to find a mentor and test the outcomes for student entrepreneurs in the course. Through this experiment, we can also examine whether it is possible to alter social networks that could provide entrepreneurs with performance advantages in the earliest stages of venture formation.

Setting

Our setting is an entrepreneurial class taught on NovoEd.com, a large massive online open courses (MOOC) platform primarily designed to foster entrepreneurial education. We

conducted a randomized field experiment using an entrepreneurship class taught as a MOOC. Since MOOCs can potentially reach thousands of students, it is an ideal setting for experimentations to understand how one becomes an entrepreneur. The advantages of using MOOCs to collect data are that it allows a randomized experiment that is easily repeatable and verifiable because the software infrastructure does not need to be built specifically for the experiment. Unlike using MBA students or undergraduate students from a particular university, we can get much closer to a uniformly distributed sample of the world's potential entrepreneurs. The students on the platform speak sixty-one different languages and come from more than 100 different countries as well as from a wide range of ages and education levels.

Specifically, our randomized experimental design focuses on manipulating the course content. This is the first randomized, controlled field experiment on advisory social network ties and strategic processes (that we are aware of). We created several versions of the same assignment that aims to help students find mentors. Comparing the student outcomes before and after the mentoring assignment can help us understand not only the micro-processes of how a person becomes an entrepreneur but also lessons on how to enable entrepreneurs to become more successful.

The massive open, online class (MOOC) on technology entrepreneurship was conducted in the fall of 2013. Enrollment was open for free to anyone via the Internet platform, NovoEd. Knowledge of the course spread through social media and also through distribution lists of previous online courses offered by the university and by the platform. Students were advised that they need not have an entrepreneurial idea to begin the course and were also encouraged to sign up with a team or individually. Using a similar process for recruiting students, mentors are also recruited to sign up for the class. Once registered, each student and mentor creates a profile page that includes biographical and work experience information.

The platform allows for students and mentors to search for and message one another using keywords and other profile information. The class consists of a series of video lectures alongside seven assignments, which culminate in a final project, the opportunity analysis project. The class covers the early stages of entrepreneurship and strategy formulation, including forming a team, finding an opportunity, creating a business model canvas as well as a prototype/beta version, and evaluating that opportunity based on qualitative and quantitative market analysis and customer interviews. The final project summarizes in written and presentation form the

team's work in the past seven weeks and evaluates whether their chosen entrepreneurial opportunity is worth pursuing as a startup.

There are two dimensions that we explore: first, diverse vs. similar networks; second, planning vs. adaptive strategic approaches. At the end of the online class, we recorded the final grade for each student as well as whether a student has found a mentor. Due to the large number of students, the grading for the class was done by peer review. Prior work and a meta-analysis show a strong correlation (0.69) between peer grading and instructor grading. This indicates that peer evaluation is a reliable and valid assessment, especially when averaging five or more peer-assigned grades (Bouzidi & Jaillet, 2009; Cho et al. 2006; Freeman and Parks, 2010; Falchikov & Goldfinch, 2000; Sadler & Good, 2006). After receiving detailed grading criteria from the instructor and being trained on a set of five assignments that the instructor had previously graded, students then grade five submissions before they could see their own scores and feedback. The peer evaluation scores are then averaged into the score for the final project. We then analyze the data and see how different factors (diverse vs. similar network, planning vs. adaptive strategy and their combination) affect the final project quality.

Experimental Procedures and Assessment

The fourth assignment in the class (out of eight) is to find and recruit a mentor to help guide the team with their project. This is the assignment we use for our randomized experiment; and it instructs students to find a mentor either from among those available on the platform or to find someone in their local community. To test how the process of acquiring mentors may depend on the type of strategic processes entrepreneurs choose, we randomized the students to six different versions of the assignment for finding a mentor. The students receive exactly the same assignment except those in the treatment groups who receive an extra paragraph describing the type of mentor they should find and the approach (planning or adaptive) to the strategic process.

Finding a good mentor can be instrumental for helping a budding entrepreneur to launch a successful venture. While some entrepreneurs may benefit from a certain type of mentor, others may benefit from an entirely different type of mentorship. To understand the process of how student entrepreneurs find mentors that best fit their needs, we randomized the students to six different groups, with each group given a slightly modified instruction on finding a mentor.

Students are then evaluated not only on whether they find a mentor but also the type of mentor. The five randomized groups are listed in [Table 1](#). Group 1 is the control group. We gave a simple guideline that it is beneficial to find a mentor with some experience with start-ups and preferably in similar or closely related industries as in the founder's startup. This simple guideline is presented to all the other treatment groups as well.

The main variations introduced to the treatments are along two dimensions: first, diverse vs. similar networks; second, planning vs. adaptive strategic approach. Along the first dimension, we explore whether the mentor's incremental network diversity offered to the founder affects entrepreneurial outcomes. Having a structurally diverse network has shown to provide various information advantages critical to entrepreneurial success. Thus, one of the treatment dimensions is to show students the benefit of having a mentor whose network connections are diverse and different from that of the students' network connections. Through this process, students can be primed to look for a mentor whose connections are diverse (Group 2). The second dimension is the type of entrepreneurial process a student can choose to follow. In the planning logic process (Group 3), a student is asked to have an unwavering vision about the business venture and when choosing a mentor, he should find someone who can help supporting that vision. On the other hand, the adaptive logic process (Group 4) asks a student to adopt a more adaptive approach to entrepreneurship. When seeking a mentor, a student is encouraged to be flexible and open to changes in the business model and to find someone who can co-create the idea and the implementation as well as determine the strategy of the venture with the student. Finally, we explore the interaction effects between the two treatment dimensions. In Group 5, we show students both the benefit of having a mentor with high network diversity as well as asking them to approach entrepreneurship using a planning process. The student is expected to utilize the resources that a mentor can provide to help realize the vision. Similarly, in Group 6, students are shown the benefit of having a mentor with high network diversity but they are asked to adopt an adaptive logic approach to entrepreneurship. Instead of pitching the vision to a mentor, the student should ask the mentor to bring in her diverse resources to co-create the venture along with the student.

Other than the extra 1-2 paragraph describing the type of mentor, the rest of the assignment is the same for everyone. After recording the final grade for each student as well as whether a student has found a mentor, we analyze the data to see how different factors (diverse

vs. similar network, planning vs. adaptive strategy and their combination) affect the result in terms of grades as well as engagements in the class. The 6 different versions of the assignments are listed in Appendix A.

Data

We have a complete record of 1,340 students who have successfully completed the class out of 23,918 students enrolled. The summary statistics about these students are enclosed in [Table 2](#). More than 58% of the students use English as their first language and the mean age for the group is in the early thirties. We also find that the vast majority of the students are male (74%). The median age for the group is between 30-35 years old, and many hold a Bachelor's degree. These demographics are typical for online entrepreneurial classes at NovoEd.

Dependent Variables

To assess entrepreneurial outcomes as well as student learning on MOOCS, we collected detailed records of students' assignment grades, class engagement activities, and their final project grade on the presentation of the entrepreneurial opportunity and business model. This final assignment is not a formal, written business plan, but rather it is a final presentation and short written document that covers the problem, a prototype of the solution, market size analysis, customer interviews, finances, and business model. The earlier assignments include finding mentors, co-founders and teammates; identifying the market opportunity for the business and testing the value proposition with potential customers; creating an initial business model for how to generate revenue and a test for the business model assumptions; and identifying common attributes of successful startups. Ultimately, these earlier assignments are designed to help students complete the business model. Thus student performance on the final startup presentation assignment is a salient early stage outcome measure. Prior literature has found that the quality and completeness of business planning led to lower likelihood of disbanding the startup, quicker product development and subsequent venture organizing activity (Delmar and Shane, 2003). Delmar and Shane (2003) show that entrepreneurs who went through a higher number of the same steps that our final assignment covers, such as 'has the venture gathered information about the market and competition?' and 'have financial projections been developed?' were more likely to survive, develop a product, and file the paperwork and purchase

equipment to actually start a firm. In contrast to their work, our experimental design allows us to examine two different approaches to the business planning and strategic formulation process – one that is more adaptive and one that is driven more by an initial vision. Thus, the completeness of activities very similar to our final assignment have been shown to be associated with important entrepreneurial outcomes.

While a high peer evaluation does not necessarily entail that the venture will ultimately be successful, a low peer evaluation is one indicator that customers, investors, or employees may also decide that the venture is not promising. At the early stages of entrepreneurship, a key goal is to convince potential cofounders, early employees, users and investors that the venture is an exciting and potentially viable opportunity. Peer evaluations of the quality of the final assignment are thus a highly relevant measure. Entrepreneurs that do this successfully are likely to have an easier time gathering the initial resources (teammates, users, investors) compared with teams that are ranked poorly by peers and fellow entrepreneurs or who failed to complete these initial steps to validate the potential market opportunity. While we do not observe if the individual will eventually become a successful entrepreneur (which may take a decade or longer), whether he has completed a final presentation on the startup opportunity and his performance on this presentation, which is meant to convince others he has a viable business opportunity, gives us some indication of the likelihood that the individual will become a successful entrepreneur in the future. Thus, we use the grade in the final startup presentation as the main outcome metric. The project could be done either in a team or by a single person. When there are multiple people on the team, each team member still receives an individualized grade that is determined by both the team score as well as an independent user score. The team score assesses the project quality; and the user score assesses the individual contribution to the project. In addition to the project grades, we also calculated the final grade of each person for the entire class. The final grade and the project grade are highly correlated and our results do not differ when using the final grade of the class.

Students were provided with a specific set of evaluation criteria to judge the startups. As an example, a high scoring project would have earned points for the following attributes: customer interviews, customer survey, and market size analysis. The customer interviews included points for the following: a description of the insights gained into consumers' value and features they stated that they need, and a description of how customers currently solve this

problem or need. The survey included one to four points according to whether a team included a survey of potential customers, whether the survey was informative for their startup idea or whether it merely reconfirmed their beliefs. The market analysis included points for estimating the market size of the correct market, whether it was informed by their customer interviews and survey, if they gave consideration to the target market, and whether the team expressed the market size in dollars and had an awareness of whether the market size was small or large.

We also focus on the likelihood of a student finding a mentor as the second outcome measure. It is an important outcome metric linking the manipulation to the final class grades. After the assignment was due, we recorded whether a person has found a mentor and the number of people approached before finding the mentor. These measures can help to assess the immediate outcomes of the randomized experiment, potentially uncovering the mechanism of why a certain treatment offers better outcomes.

Results

Using the randomized experiment, we examine how teaching different strategies of selecting a mentor can actually generate different outcomes in entrepreneurship as well as student learning. Except for the mentoring assignment, all the students receive exactly the same course content including the course videos, course websites, other homework assignments, and class forums. To ensure our randomization worked, we summarize the statistics of the students in each of the six randomized groups in Table 3. First, we show the differences in demographics. In terms of speaking English as the primary language, age and gender, the group means are similar. We did a pair-wise comparison among the groups and none of the differences are statistically significant. We also compared the grades of the prior assignments. Again, we do not detect a statistically significant difference among the groups. Overall, these results suggest that our randomization worked.

We then show whether our treatment manipulation actually worked in Table 4. We conducted a survey a few weeks after the mentoring assignment. In the survey, we ask the students to rate the diversity of the mentor's network as well as if they adopted a planning or an adaptive approach to entrepreneurship. The first two columns show whether respondents who learned the benefit of having a diverse mentor actually found a mentor with high network diversity. The scale for measuring the diversity of the mentor's network is between 0 and 1, with

1 being that the mentor's network is significantly diverse and different from that of the mentee and 0 when the mentor's network is very similar. The first column shows whether finding a mentor who can introduce network diversity to the student has the desired effect. Overall, we see that a student in any of the groups (Diverse, Diverse Planning and Diverse Adaptive) seeking a mentor with high network diversity has a statistically higher probability of finding such a mentor. On average, a student who learns the benefits of having a mentor with diverse networks is more likely to find a mentor with high network diversity by 3.7 percentage points. Next, we examine which of the 6 randomized groups was responsible for the increase in Column 2. Overall, we see that being in the diverse planning group has a significant effect on actually getting a mentor with a diverse network. In Column 3 and 4, we explore if the treatment effect for using the adaptive or planning approach was successful. We ask the student to rate on a scale of 1-9 the extent to which he has chosen an adaptive approach to entrepreneurship, with 1-4 being more toward the planning approach, 5, being a mixed strategy, and 6-9 being more toward the adaptive approach. Thus, we created a binary variable of 1 to measure the adaptive approach if the student scored above 6. Overall, we see that a student in any of the treatment groups that adopted the adaptive approach to entrepreneurship is more likely to use it. In Column 4, we show that students who were shown the benefits of the adaptive approach are about 5.1% more likely to using it than students who were shown the planning approach. In Column 5, we show that the effect is present for both adaptive group and the diverse adaptive group as both are more likely to use adaptive logics than the other groups. Overall, these results suggest that our treatment worked.

Next, we examine whether the randomization affects the outcome of our interest: student engagement and final outcome of the peer evaluation of the startup project, as shown in Table 5. First, we examine whether the randomization affects the likelihood of completing the final presentation or the class in the first place. Completion of the class can have significant implications for understanding student learning and entrepreneurial outcomes. In fact, one of the biggest problems faced in MOOC classes is the low retention rate. While many students expressed initial interest by signing up for a class, since it is costless to do so, it is common that only a small percentage of the students actually complete it. In our setting, less than 20% of the students completed at least one assignment, and less than half of these students actually completed the class. If adding one or two paragraphs on an assignment can change the

probability of a student completing the class, it would not only boost retention in MOOCs, it could also affect the likelihood of a student successfully completing a startup presentation and further pursuing his entrepreneurial venture.

Interestingly, we find that a simple randomization on class assignments can indeed change student outcomes for both the likelihood of completing the class as well as the final grades. The addition of one to two paragraphs on a single assignment can generate a significant effect on various performance metrics. As shown in Column 1 Table 5, we find that students pursuing a planning process are 1.3% more likely to complete the class compared to the baseline of students following adaptive logics. Perhaps, a clear vision of the business model helps in motivating students to realize their goals, and as the result, they are more likely to continue learning and complete the class.

Next, we explore whether the randomization has an effect on the final grades received in the class. We graphed the distribution of the final grades according to the randomized group the students were assigned to in Figure 1. Interestingly, the worst performing group is the adaptive group whose mean is similar to the control group. This indicates that asking students to pursue adaptive logic is no better than giving them minimal instructions on how to find a mentor. Because the control group may represent a mixture of students using different approaches to the assignment, we use the adaptive group as the baseline group to compare the performance of the other groups (Table 5). As shown in Column 2 of Table 5, the planning logics group also received a higher score on average than the students in the adaptive logic group, by about 0.53 points or a 2.1 percentage improvement. Contrary to prior theory that a diverse network can help with entrepreneurial success, we find that a mentor who has a structurally diverse network is not statistically different from the baseline group. Interestingly, a mentor with diverse networks can be helpful only if the student also chooses a specific entrepreneurial strategy. When the student applies either a planning or adaptive strategy to finding a mentor and he also looks for a mentor with diverse sources of connections, his entrepreneurial outcomes can improve. Specifically, we find that coupled with a planning approach, a student with a diverse mentor receives better final grades by 0.511 points (2.1 percentage improvement) compared to the baseline group. Similarly, coupled with an adaptive approach, a student with a diverse mentor receives an additional 0.448 points. These results are also evident as shown in Figure 1; the top scoring groups are planning, planning diverse and adaptive diverse.

We also included demographic controls in the model and our results are largely similar. Interestingly, we observe age affects the final grade while being a male or an English speaker does not affect it. Older students are significantly more likely to receive higher grades at the end of the class. These controls did not change our core results that the coupling a specific venture strategy with a diverse mentor produced better entrepreneurial outcomes than the baseline group. Similarly, pursuing planning logic alone without a diverse mentor also performed better than the rest of the groups. Lastly, to ensure that the randomization is not a fluke, we compared the grades of earlier assignments before we randomly assigned students to the treatment groups. In Column 4, we show that none of the groups are performing significantly better than the baseline group. This indicates that our randomization worked and our inferences are likely to be causal.

While it is interesting to compare the other groups against the adaptive logic group, we are ultimately interested in the pairwise comparison among the six groups to see which strategy of pursuing a mentor is superior Table 6. Each individual cell of the table shows the difference in the average grades between the group represented by the row and the group represented by the column. Specifically, it is group average of the row minus the group average of the column. For example, in the first column, we compared the adaptive group with the rest of the groups. We find that using the adaptive approach alone is a significantly worse strategy than using the planning approach to entrepreneurship (Row 6, Column 1). On average, the entrepreneurs in the planning group score .552 points higher, or a 4.89% improvement, on their final presentation than the ones in the adaptive group. Contrary to the notion that entrepreneurs should be flexible to capture opportunities when they are presented, our results indicate that the planning strategy is actually the superior approach to entrepreneurship, at least for early stage of the venture. Having a strong and clear vision about the venture helps entrepreneurs to create a viable business model.

However, the adaptive approach to entrepreneurship is not all a loss. We find that when it is combined with the network diversity strategy (diverse adaptive), the disadvantage of using the adaptive approach is mostly mitigated. The average final grade of the business presentation in the diverse adaptive group is significantly higher than the grades in the adaptive group (Row 3, Column 1) and it is not statistically different from pursuing the planning strategy alone (Row 3, Column 5). In contrast to the adaptive approach, having a diverse mentor does not boost the outcomes for the planning group (diverse planning). While the diverse planning group also performs better than the adaptive group, it did not outperform the planning group that did not

specifically look for a mentor with a diverse network (Row 4, Column 5). However, the fact both the diverse planning and diverse adaptive groups perform better than the adaptive group, does not necessarily imply that a diverse mentor was the key to entrepreneurial success. When the entrepreneur simply seeks a mentor with a diverse network, he does not derive much benefit from it, as none of the results in Row 2 is statistically significant. Only when a particular strategy of pursuing entrepreneurship (planning or adaptive) is used can the entrepreneur reap the benefits of a mentor with diverse networks. We also compare the control group with the other five groups but none of the differences is statistically significant (Row 6). This is evidence that the control group is likely to consist of a mixture of different students using different approaches.

Overall, these results suggest that finding key resources such as mentors requires a correct matching between the type of mentor and the type of entrepreneurial process. If the entrepreneur chooses a planning strategy, finding a mentor with diverse network connections can be helpful but not significantly more so than having a mentor without these strategic resources. As long as a mentor can help and support the vision of the entrepreneur, the entrepreneur benefits regardless of the mentor's network resources. By contrast, if the entrepreneur chooses an adaptive strategy such that he is willing to co-create a vision with the mentor, he would actually benefit from having a mentor with diverse networks. Following that strategy alone can actually negatively affect entrepreneurial outcomes when compared to any other strategy. However, when a student using the adaptive approach tries to simultaneously find a mentor with diverse network connections, he can actually become better off. Because the information and resources a mentor with diverse network connections can provide could be very helpful for finding new opportunities, an entrepreneur using an adaptive approach is more likely to seize the opportunity and more willing to use the information to form strategies. Also, if customer or market feedback indicates that the venture should change strategies and move in a different direction, it is more likely that the mentor may have connections that could help with the change. An entrepreneur following the adaptive logics could be more willing to use these resources even if these resources can deviate from his original vision. As a result, an entrepreneur may benefit from having a mentor with diverse networks more than others in capturing new opportunities presented by the mentor.

The treatment effect on finding a mentor

Next we examine whether the results we observe were due to having a mentor. First, we show that having a mentor impacts entrepreneurial outcomes and that having a mentor strongly correlates with final grades. A mentor is correlated with an increase of 0.974 points, which is about a 5-percentage increase (Column 1 of Table 7). Since we did not randomize mentors to students, we cannot comment about the direction of causality. For example, because early stage projects are highly uncertain, it could be that mentors do not agree to work with bad projects. We also examined the number of mentors approached and its impact on outcomes; and we find no impact (Column 3). In Column 4, we included additional demographic controls including gender, spoken language and age. Again, we observe that having a mentor has a strong correlation with the final grades, but the number of mentors approached has no effect.

Next, we explore whether the randomized assignments among the six groups generate a difference in the likelihood of finding a mentor. We graphically show the likelihood of finding a mentor in each of the six randomized groups in [Figure 2](#), and the pairwise comparison among the six groups in Table 8. Note, we captured whether a student found a mentor a few weeks after the mentor assignments. Thus, our data does not record situations when a mentor was found later in the class. However, our results at least show the likelihood of finding a mentor within a reasonable time for each of the randomized groups. As shown in Table 8, the diverse planning group yields the best results for landing a mentor. On average, the diverse planning group is 4.2% more likely to find a mentor than the diverse group that simply pursues a mentor with diverse networks alone. Even when compared to the diverse adaptive group, the diverse planning group is 4.7% more likely to find a mentor. Lastly, compared to the planning group that does not specifically pursue a diverse mentor, the diverse planning group still yields a better chance of finding a mentor by 5.6%. Perhaps having a strong vision about the business model is more attractive to prospective mentors. When a prospective mentor hears a pitch from an entrepreneur who has strong convictions about the business model and opportunity, the mentor is more likely to help. Furthermore, a mentor with diverse networks are also more likely to agree to mentoring the entrepreneur because the mentor believes that the resources she provides are more likely to be used to generate a return. On the other hand if the mentor has similar connections to the student, the mentor may feel that he could not easily provide resources that the student does not already have.

Overall, we are encouraged to see the power of using randomized assignments on MOOCs to understand the process of entrepreneurship. By simply modifying the wording of a class assignment, we are able to introduce meaningful changes on student outcomes. In general, students who approach entrepreneurship with planning logics tends to yield better results. Students are more likely to complete the class and their final grades are generally higher. On the other hand, students who pursue entrepreneurship with adaptive logics seem to generate the worst outcomes (in terms of convincing peers that a business opportunity has been found). This group is even inferior to the control group that did not receive additional instructions on how to find a mentor. Perhaps in the early stage of developing an entrepreneurial venture, it is better to have a strong vision of the business venture as opposed to being flexible in changing the direction. Having a clear and strong vision can help an entrepreneur acquire strategic resources such as mentorship. As a result, an entrepreneur that follows the planning logic route is more likely to find a mentor especially if he focuses on finding a mentor with diverse and unique network connections. Similarly, individuals in the planning logic group also approached fewer people before finding a suitable mentor. Because advising an entrepreneur could potentially take a lot of time and resources, a mentor is more likely to advise when the entrepreneur can present a vision for a business opportunity that the mentor could believe in. As the result, a planning strategy in the entrepreneurial process can be beneficial, at least in the early stages of forming a venture.

However, an adaptive logic strategy is not without benefits. If an entrepreneur chooses to follow an adaptive logic, he can still benefit when he is able to find a mentor who has a diverse social network. A mentor that brings key resources can help an entrepreneur craft a vision and take advantage of any new opportunities. Because a mentor and entrepreneur are likely to co-create a vision together in the adaptive logic process, a mentor who can bring strategic resources can be especially helpful. The entrepreneur is more likely to take advantage of the new information and the mentor is more likely to help in utilizing the information. By contrast, an entrepreneur that pursues a planning logic may not always take advantage of resources from the mentor unless the resource can help advance his vision.

Limitations and Future Research. Interpreting the implications of these results should be done in light of the limitations of our research context. We do not claim that the evidence presented here is definitive and we acknowledge that our results are specific to the early stage of

venture formation. Future work may follow-up with these entrepreneurs to determine the extent of longer-term impacts. We examine just one setting (an entrepreneurship online course) with two randomized interventions; and it is focused on potential entrepreneurs and ventures at the early stage. While peer evaluations have been shown to be correlated with instructor evaluations, neither peers nor instructors are investors or venture capitalists. While the project areas range from biotech (one venture was founded by a Stanford medical school alum focused on protein folding simulation) to software, many of the venture ideas relate to internet, mobile and software-based ventures. Another open question is whether the pattern of results that we find is due to the fact that many who sign up for online classes are relatively inexperienced entrepreneurs. Would experienced entrepreneurs do better with the more adaptive approach, even in the absence of diverse mentors? Or would mentors simply matter less for an experienced set of founders? Future research should examine these limitations, which represent areas that are ripe for further theorizing and data collection. Such potential research questions building on this line of work include the extent to which the findings extend to later stage ventures, how accurately early peer evaluations predict future venture outcomes such as fundraising, product release or growth, and finally any important industry or institutional context contingencies. The power of the randomization along with the fact that our data spans thousands of individuals in many countries and industries provides reassurance that the results may apply beyond this setting. While our research design has its limitations, it makes progress on disentangling the endogenous matching process between individuals, social network ties and strategy that has previously confounded efforts to determine the best ways to approach and work with an additional network tie. We are hopeful that the structure and repeatability of our experiment should spur future research in this direction using similar research designs in other contexts and with many variations on the randomized intervention.

CONCLUSION AND DISCUSSION

This paper presents a novel research design that enables a focused test of the hypothesis that the value of a social network tie is shaped in part by the strategy formulation process. We use a randomized, controlled experiment to examine whether the combination of network ties and strategic process influences the outcomes of the earliest stages of entrepreneurship. By using a training intervention in the form of an assignment during an online class (a massive open,

online course or MOOC), we show that the type of network tie that results in the greatest benefit depends on the type of strategic process the entrepreneur uses in his firm. Contrary to prior work that has argued that social networks are resistant to change due to history, personality and past actions (Powell and Grodal 2005), we find that a relatively short educational intervention and interaction with a new mentor network tie has a strong effect on project outcomes. However, to capture the benefits of the social network tie, an individual must use the appropriate strategic process. By prompting a change in network formation, we find evidence of a causal relationship between having a mentor with a diverse network and the use of a planning or adaptive strategic process. This relationship impacts entrepreneurial performance.

Interestingly, we find that a simple randomization on class assignments can change early stage entrepreneurial outcomes. Overall, the adaptive logic group performs the worst in our experiment while entrepreneurs who use a planning logic without a diverse mentor have comparatively better grades on their final startup presentations. However, adaptive logic is not entirely bad. We also find that entrepreneurs who pursue mentors with diverse networks and also adopt adaptive logic do significantly better as well. These results suggest that finding key resources such as mentors requires a correct match between the type of mentor and the type of entrepreneurial process. By contrast, if entrepreneurs choose an adaptive strategy such that they are willing to co-create a vision with the mentor, they would actually benefit from having a mentor with diverse networks. The information and points of views a mentor with a diverse network can provide would be very helpful to the entrepreneur as he can better utilize the information to form strategies.

Alongside identifying an important contingency, we contribute to recent literature that has sought to better identify social network effects (Wu 2013; Azoulay, Stuart & Wang, 2013; Feldman et al., working paper). Our findings suggest that the standard approach to estimate the impact of a diverse or a cohesive social network may either over or under-estimate its value depending on the research context. Since network formation is an endogenous process, existing literature may be overestimating the network effect given that higher “quality” individuals likely match with certain network ties. However, if the sample is made up of individuals who largely take a planning approach to the strategy formation process, then existing literature may underestimate the benefits of diverse network ties for individuals who adopt a more adaptive strategic approach. In addition, our findings suggest that the approach to strategy formulation

may be an important, yet often overlooked factor that our novel research design was able to mitigate

Contribution to social network theory

Prior literature on social networks shows that the structure of social networks has an important influence on work performance (Burt 1992, Wu 2013), including in entrepreneurship (Aldrich and Kim 2007, Stuart and Sorenson 2005, Stuart and Sorenson 2007) and innovation (Powell and Grodal 2005). On one hand, ties to information-rich nodes such as brokers who have diverse network ties aid the collection and recombination of novel information and resources. On the other hand, more cohesive network ties and network closure offer advantages in fostering trust and cooperation (Coleman 1988). More cohesive network ties have been shown to inhibit the ability of managers in large firms to change their social networks when assigned to a new business unit (Gargiulo and Benassi 2000).

However, previous research has not considered whether the task or the type of strategic process impacts the benefits from social network ties. Furthermore, observational data dominant in prior work makes causal inferences difficult to determine. The endogenous matching process between individuals and the choice of strategy have previously confounded efforts that attempt to determine the best ways to approach and work with an additional network tie. Our study overcomes these specific challenges through a novel experimental methodology using an online course. We conduct a randomized, controlled experiment that intervenes directly in the social network and strategic processes of aspiring entrepreneurs. In doing so, we reconcile a puzzle in previous literature, where despite the strength of weak ties, eg. Mentorship ties, (Granovetter 1973), a recent meta-analysis finds that weak ties affect small firm performance less than structural holes or overall network diversity (Stam et al. 2014). Our findings indicate that the type of weak ties that could offer higher overall network diversity is more beneficial than just having a weak tie. This is particularly so for entrepreneurs and managers who combine weak ties with a strategic process that benefits them.

We contribute to research on the strategic value of networks by suggesting that cohesive networks provide a disadvantage; and diverse networks are more important when flexibility and adaptation are necessary. Our findings complement a growing stream of recent work which outlines the conditions when different types of networks are most valuable. For instance, direct and indirect social network ties to investors have been shown to increase the likelihood of raising

investment resources (Stuart and Sorenson 2005) due to the status that is reflected in network ties (Stuart and Cable, 2002). In addition, we know that for ventures undergoing an initial public offering (IPO) the value of inter-organizational ties to venture capital firms and investment banks is contingent on the state of the market (Gulati and Higgins 2003). Vissa and Chacar (2009) find that team demographics and social networks complement one another and jointly shape an entrepreneur's performance outcomes. Interestingly relative to our findings, Hite and Hesterly (2001) argue for a life cycle model of firm networks, where initially firms have a dense, cohesive, closed network and gradually evolve towards networks with more structural holes and networks based on economic calculations. Complementing this work, our findings suggest that the venture's strategic process must be taken into account and that adaptive process would not benefit from a dense, cohesive, closed network.

Contribution to literature on firm strategy and entrepreneurship

Recent literature at the intersection of strategy and entrepreneurship has shown that in uncertain environments, strategic planning may not be the optimal mode of strategy formulation. Adaptive, discovery-driven strategic processes have been proposed as more appropriate alternatives to strategic planning in high velocity, uncertain and unstable strategic contexts (McGrath 2010). Research in entrepreneurship has contributed to the recent debate on processes for strategy formulation by showing that adaptive, "non-predictive" processes of strategy making have important advantages (Wiltbank et al. 2006). Experienced entrepreneurs may use improvisation (Baker et al. 2003), bricolage (Baker and Nelson 2005), and effectuation (all various forms of adaptive strategies) to gather resources, innovate and create value (Sarasvathy 2001). Brown and Eisenhardt (1997) show in a sample of computer industry firms that continuous change using semi-structures and sequenced steps is preferable to planning or simply reacting to industry developments. Recent developments in strategy have emphasized a similar concept of dynamic capabilities or the capacity to change in response to new opportunities (Eisenhardt and Martin 2000, Teece 2007). However, little work has examined whether less experienced managers or first-time entrepreneurs are also able to effectively use such adaptive tactics.

Ventures are an ideal setting to examine these strategic processes, since they are unencumbered by the existing commitments of established incumbents. Ventures would appear to benefit from a more adaptive strategy-making process since they usually have new, untested

business models more akin to experiments involving qualitatively different strategies rather than proven models for scaling products or services (McGrath 2010). Previous literature has largely focused on founders and shows that founding team characteristics such as a team's functional background (Boeker 1989) and degree of expertise (Cavarretta and Furr 2011) influence the ventures' decision to change strategies; and that strategic change is primarily decided upon and carried out by the initial founding team (Furr et al. 2012).

However, despite these separate literatures on social network theory and strategy, relatively little work (that we are aware of) examines the question of how the strategy making process interacts with the characteristics of social network ties. Our paper contributes to this work by showing that adoption of a more adaptive strategic process can actually be harmful to the venture if it is not combined with diverse network ties. In fact, a more planning oriented approach of having a strong vision is usually better than an adaptive approach alone. This finding is in contrast to prior work that has argued for the advantages of a more adaptive strategy making approach for ventures. However, it is consistent with prior simulation-based work that identifies the downsides to too little formalism in organizations and suggests that entrepreneurial firms may benefit from adding structure (Davis et al. 2009).

Based on the growing knowledge about social network theory, policymakers and educators are designing institutions, policies and programs aimed at altering and improving the social networks of aspiring entrepreneurs and innovators (Bruneel et al. 2012). For example, the recent JOBS Act, the I-Corps program by NSF and Startup America in the U.S., includes a significant component of mentoring and many other countries are implementing similar programs.⁵ Despite literature on social network theory and the social networks of entrepreneurs, we know relatively little about whether such externally introduced changes in social network ties produce their intended outcomes. Literature on the strategy formulation process and altering the process through training has been limited largely because of the difficulty to observe micro processes and to determine causality from observational data. Our research design is among the first randomized controlled trials (RCTs) that we are aware of that overcomes certain limitations by using a randomized intervention in a MOOC to gather data through a novel research design. Our results also have important implications for policymakers, managers of accelerator programs and educators seeking to influence the entrepreneur's social networks or train entrepreneurs in

⁵ https://www.nsf.gov/news/special_reports/i-corps/

strategic processes. The findings from our study indicate that such programs and policies may actually harm entrepreneurs and their ventures if these programs and policies naively encourage entrepreneurs and managers to build diverse network connections or, separately, to follow more adaptive and flexible approaches to building ventures. Adaptive strategic processes need to be paired with social network ties with diverse connections to reach their full potential. Also a strategy that encourages entrepreneurs to create a strong vision and use more planning logic may be more reliable as it performs well regardless of the social network ties of the entrepreneur.

Understanding how the process of entrepreneurship and how social capital complements or substitutes these effects requires more exploration. Given that many policymakers and incubators teach the adaptive approach to pursuing a venture and pair student entrepreneurs with mentors, it is critical to causally establish whether these strategies can actually improve entrepreneurial outcomes. In our setting, we examine the interplay between the strategic process of entrepreneurship and having mentors who can introduce diverse resources at the earliest stage of forming a venture. Contrary to the popular notion that the adaptive process is more beneficial, we find the planning approach to be superior. However, a mentor with diverse social networks can mitigate the disadvantage of using the adaptive approach. Overall, we are encouraged to see the power of randomized assignments on MOOCs to understand the process of strategy and entrepreneurship in ways that challenge observational studies. By simply modifying the wording of a class assignment, we are able to introduce meaningful changes on student outcomes. Furthermore, our experimental design can easily incorporate other types of treatments, and verify findings.

	Do not need to find a mentor with diverse networks	Find Mentor with Diverse network
No Specific Approach	Control: No Additional Guidance. Describe benefits of having a mentor. Ask students to find a mentor.	Diverse Mentor. Describe potential benefits of having a mentor with diverse social ties. Find a mentor who has a diverse network of connections that are different from yours.
Adaptive Approach	Adaptive Logics. Describe the general idea of the business idea and be open to consider alternative solutions and ideas from the mentor.	Diverse Mentor & Adaptive Logics. Describe potential benefits of having a mentor with diverse social ties. When you come across such a mentor, pitch your business idea and be open to consider alternative solutions and ideas. Ask the mentor to provide resources to help you co-create the project.
Planning Approach	Planning Logics. Describe your vision of the business. Find a mentor who shares and agree with your vision and solutions. Ask the mentor to help guide you to build a product or service according to the vision.	Diverse Mentor & Planning Logics Describe potential benefits of having a mentor with diverse social ties. When you come across such a mentor, pitch your vision and see if the mentor shares and agrees with your vision. Ask the mentor to provide resources to help you realize the vision.

Variable	Obs.	Mean	Std. Dev.	Min	Max
English	1670	.588	.492	0	1
Male	1670	0.741	.438	0	1
Age	1670	2.169	.833	1	4
Final Grades	1410	11.649	2.858	3.288	19.971
Completion	23918	.138	.345	0	1

Note: Student demographics: English is a binary variable indicating if English is the primary language. Male is a binary variable indicating if the student is male. Age is grouped into four categories: 1 if the person is less than 25 years old; 2 if the person is between 25 and 35, 3 if the student is between 35-50, and 4 if the person is older than 50. The final grade is out of 24 points.

Table 3: Summary Statics for Each Randomized Group					
	Obs.	English	Male	Age	Earlier Grades
Adaptive	3977	.215 (.411)	.372 (.484)	.678 (1.043)	16.479 (3.111)
Diverse	3976	.209 (.406)	.370 (.483)	.689 (1.024)	16.529 (3.239)
Diverse Adaptive	3995	.216 (.411)	.363 (.481)	.660 (1.029)	16.397 (3.225)
Diverse Vision	3978	.219 (.413)	.384 (.486)	.694 (1.059)	16.667 (3.211)
Vision	3990	.211 (.408)	.382 (.486)	.703 (1.067)	16.604 (3.158)
Control	4002	.221 (.415)	.378 (.485)	.694 (1.055)	16.725 (3.144)

Table 4: Treatment Effect on Finding the Type of Mentorship				
Dep. Var.	(1) Diverse	(2) Diverse	(3) Adaptive	(4) Adaptive
Diverse Treatment	0.037* (0.021)			
Adaptive Treatment			0.051** (0.026)	
Adaptive		0.001 (0.039)		0.100** (0.045)
Diverse		-0.011 (0.033)		0.065 (0.041)
Diverse Adaptive		0.049 (0.035)		0.068* (0.041)
Diverse Planning		0.059* (0.034)		--
Planning		-0.013 (0.036)		0.054 (0.040)
No Guidance		--		0.014 (0.039)
Constant	0.224*** (0.028)	0.228*** (0.036)	0.380*** (0.030)	0.347*** (0.037)
Observations	1,670	1,670	1,670	1,670
R-squared	0.002	0.004	0.002	0.005

Note: Regressions of the final grade against the 6 randomization-groupings. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Diverse treatment variable is 1 if the randomized groups are Diverse, Diverse Adaptive or Diverse Planning. Adaptive Treatment variable is 1 if the randomized group is Adaptive, Planning or Control.

Table 5: The Treatment Effects on the Peer Evaluation of the Final Startup Presentation

Dep. Var.	(1) Completed Class	(2) Final Grade	(3) Final Grade	(4) Earlier Grade	(5) Earlier Grade
Diverse	-0.00273 (0.00774)	0.298 (0.269)	0.333 (0.267)	0.0499 (0.160)	0.0567 (0.159)
Diverse Adaptive	0.00591 (0.00773)	0.448* (0.265)	0.434* (0.266)	-0.0824 (0.158)	-0.0652 (0.157)
Diverse planning	0.00575 (0.00773)	0.511** (0.256)	0.451* (0.259)	0.188 (0.158)	0.192 (0.157)
Planning	0.0134* (0.00773)	0.525* (0.302)	0.541* (0.303)	0.125 (0.157)	0.125 (0.156)
No Guidance	0.0107 (0.00772)	0.402 (0.267)	0.375 (0.266)	0.246 (0.158)	0.243 (0.158)
English			0.127 (0.206)		0.277*** (0.0977)
Male			-0.234 (0.203)		0.414*** (0.0986)
Age			0.321*** (0.113)		-0.0977 (0.0598)
Disclose Age			1.497*** (0.418)		0.448 (0.306)
Constant	0.133*** (0.00547)	11.29*** (0.188)	10.74*** (0.418)	16.48*** (0.112)	16.33*** (0.198)
Observations	23,918	1,411	1,411	4,866	4,866
R-squared	0.0003	0.004	0.020	0.001	0.011

Note: Regressions of the final grade against the 6 randomization-groupings. Clustered standard errors are in parenthesis. Column 1 shows whether the student has completed the class. Column 2-3 shows the effect of the randomization on the final project grades. Column 4-5 is a manipulation check, showing that the effect of the randomization should be zero on assignment grades before the treatments took place.

*** p<0.01, ** p<0.05, * p<0.1

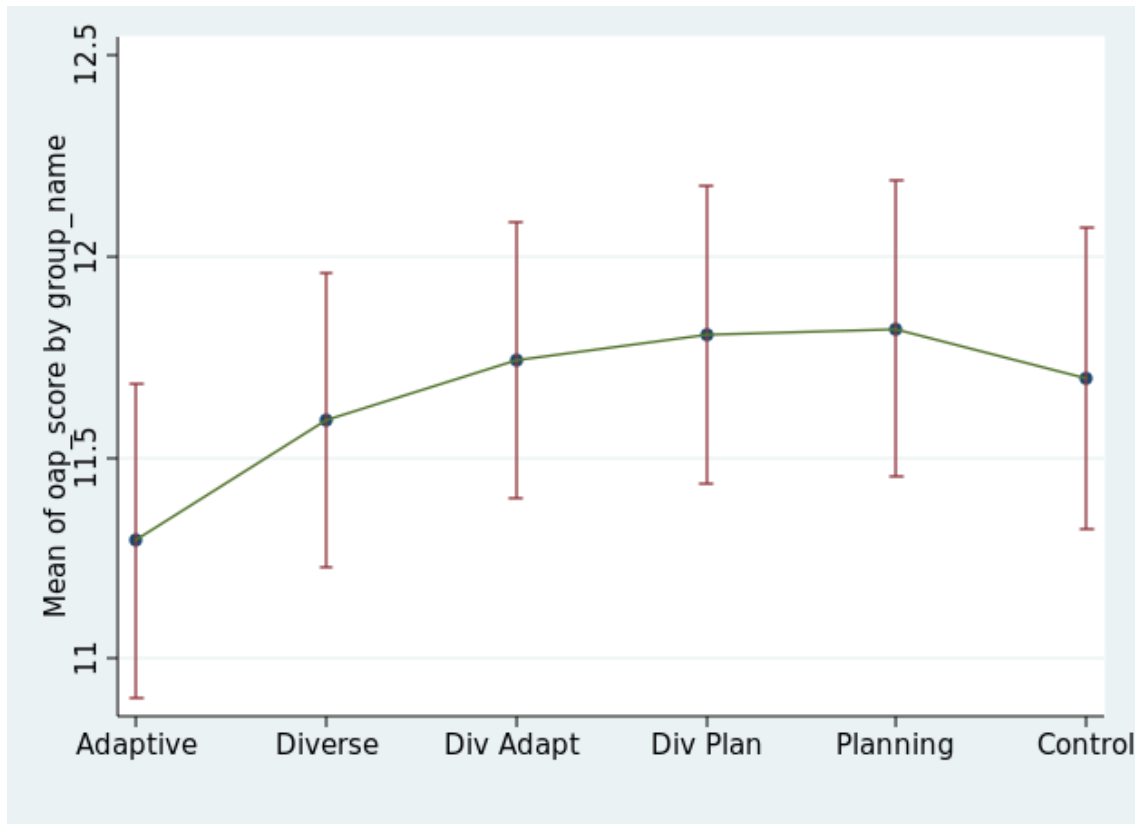


Figure 1: Final grades by treatment groups

Group Name	Adaptive	Diverse	Diverse Adaptive	Diverse Planning	Planning	No Guidance
Adaptive	--	-.280 (.276)	-.444* (.267)	-.516** (.267)	-.552** (.276)	-.400 (.277)
Diverse	.280 (.276)	--	-.164 (.258)	-.236 (.267)	-.272 (.267)	-.120 (.268)
Diverse Adaptive	.444* (.267)	.164 (.258)	--	-.0713 (.259)	-.108 (.259)	.0439 (.260)
Diverse Planning	.516** (.267)	.236 (.267)	.0713 (.259)	--	-.0365 (.267)	.115 (.268)
Planning	.552** (.276)	.272 (.267)	.108 (.259)	.0365 (.267)	--	.152 (.269)
No Guidance	.400 (.277)	.120 (.268)	-.0439 (.260)	-.115 (.268)	-.152 (.269)	--

Note: Each cell is the difference in the final grades between the corresponding row and column groups, specifically, it is Final Grade(Row) – Final Grade(Column). It tests whether the two groups have different final grades on average.

Table 7: The effect of having mentor on final grades			
Dep. Var.	(1) Final Grade	(2) Final Grade	(3) Final Grade
Has a Mentor	0.974** (0.376)	0.718* (0.394)	0.762* (0.390)
Number of Mentors Approached		-0.0110 (0.0232)	-0.0144 (0.0229)
Having a Diverse Mentor		0.683* (0.373)	0.593 (0.370)
Pursued Adaptive Approach		0.588 (0.405)	0.592 (0.411)
English			0.0208 (0.249)
Male			-0.0768 (0.216)
Age			0.381*** (0.128)
Disclose Age			1.629*** (0.514)
Constant	11.35*** (0.317)	11.23*** (0.387)	10.55*** (0.525)
Observations	1,080	1,075	1,075
R-squared	0.027	0.047	0.073

Regressions of the final grade against the 6 randomization-groupings. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

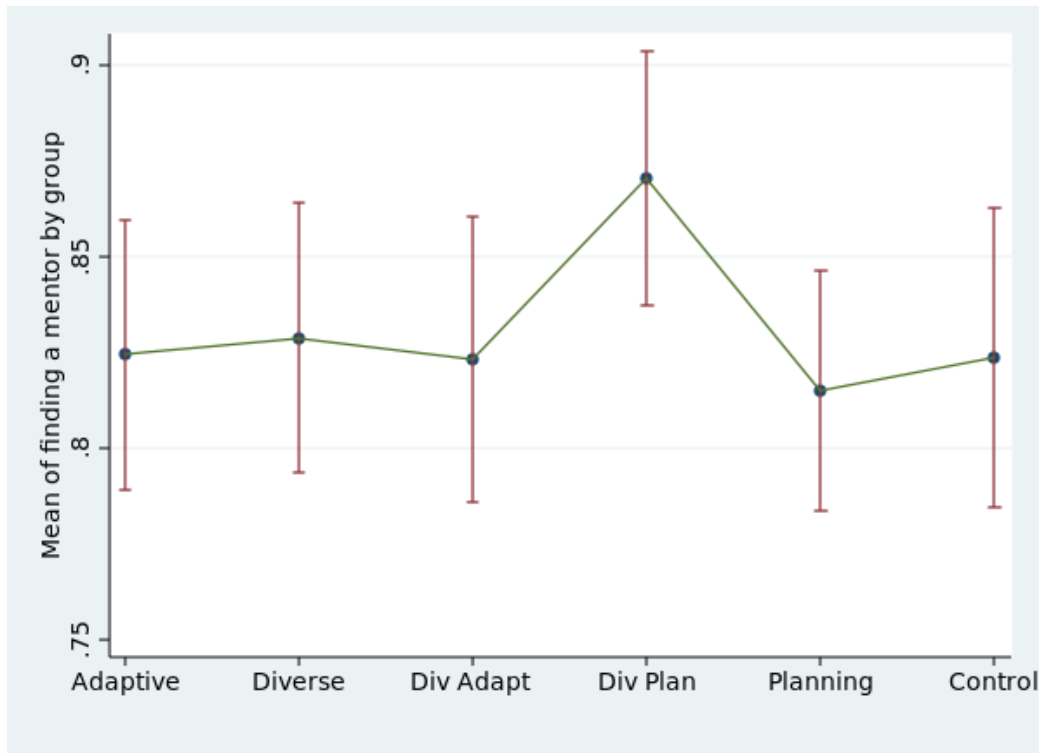


Figure 2: Group averages on whether a mentor was found

Table 8: Pairwise comparison on whether a mentor was found among the six randomized groups

Group Name	Adaptive	Diverse	Diverse Adaptive	Diverse Planning	Planning	No Guidance
Adaptive	--	-.00425 (.0254)	.00126 (.0262)	-.0462** (.0247)	.00942 (.0239)	.00093 (.0269)
Diverse	.00425 (.0254)	--	.00551 (.0261)	-.0419* (.0247)	.0137 (.0239)	.00518 (.0268)
Diverse Adaptive	-.00126 (.0262)	-.00551 (.0261)	--	-.0474* (.0255)	.00816 (.0247)	-.000331 (.0275)
Diverse Planning	.0462** (.0247)	.0419* (.0247)	.0474* (.0255)	--	.0556** (.0233)	.0471 (.0261)
Planning	-.00942 (.0239)	-.0137 (.0239)	-.00816 (.0247)	-.0556** (.0233)	--	-.00849 (.0253)
No Guidance	-.00093 (.0269)	-.00518 (.0268)	.000331 (.0275)	-.0471 (.0261)	.00849 (.0253)	--

Appendix A.

<p>The first few paragraphs of the actual Assignment used for the experiment. The actual assignment is about 2 pages long with detailed deliverables. The paragraphs highlighted in bold were added to each treatment.</p>
<p>1. Control: No additional Guidance</p>
<p>To find a mentor, look for someone with either: 1) startup experience in the same industry or a closely related industry to your startup idea, 2) years of industry experience in the same industry or a closely related industry to your startup idea, 3) a potential user/customer or partner for your startup idea, or 4) someone with startup or industry experience more generally.</p> <p>You can ask for an introduction from someone who knows them, or approach them directly or by email, or you might simply approach those you encounter in your everyday life. You can explain to them that you are working on a startup for this class and would like to talk with them briefly about your startup idea. You can also message mentors through the NovoEd site by clicking on “Community” and then “Mentors” and then searching the mentors already registered on the site.</p>
<p>2. Diverse Mentor</p>
<p>To find a mentor, look for someone with either: 1) startup experience in the same industry or a closely related industry to your startup idea, 2) years of industry experience in the same industry or a closely related industry to your startup idea, 3) a potential user/customer or partner for your startup idea, or 4) someone with startup or industry experience more generally.</p> <p><i>Mentors with diverse social ties that are different from yours social network is especially useful for introducing new resources to you as an entrepreneur. Their diverse networks can be a critical asset to you. They are also more likely to understand your vision and its potential impacts, help you shape your idea to get the maximum return, and identify and provide critical resources when needed. When you are looking for mentors, it is important to identify their network resources, such as finding out not only whom they know but whom their friends know as well.</i></p> <p>You can ask for an introduction from someone who knows them, or approach them directly or by email, or you might simply approach those you encounter in your everyday life. You can explain to them that you are working on a startup for this class and would like to talk with them briefly about your startup idea. You can also message mentors through the NovoEd site by clicking on “Community” and then “Mentors” and then searching the mentors already registered on the site.</p>
<p>3. Adaptive Logics</p>
<p>To find a mentor, look for someone with either: 1) startup experience in the same industry or a closely related industry to your startup idea, 2) years of industry experience in the same industry or a closely related industry to your startup idea, 3)</p>

a potential user/customer or partner for your startup idea, or 4) someone with startup or industry experience more generally.

You should tell them briefly about who your user or customer is and what general problem you want to solve in the industry for the user or customer. You do not necessarily need to propose a solution though you might mention an initial idea. Then, you should ask them what they think and how they would approach that problem. Resist the temptation to “pitch” them on your idea and instead focus on co-creating the project with them. It’s your responsibility to execute, but remain open to change if they are willing to commit time, introductions or resources. Indicate that you are open to shifting the goals of the project or the approach in response to their suggestions. In exchange, you simply ask them if they would commit to helping you build a product/service as a mentor. Mentors provide feedback from time to time, make introductions, or provide other resources. The important thing to remember is that mentors commit resources in exchange for a chance to reshape the goals of the project, to influence what future will ultimately result.

You can ask for an introduction from someone who knows them, or approach them directly or by email, or you might simply approach those you encounter in your everyday life. You can explain to them that you are working on a startup for this class and would like to talk with them briefly about your startup idea. You can also message mentors through the NovoEd site by clicking on “Community” and then “Mentors” and then searching the mentors already registered on the site.

4. Diverse Mentor & Adaptive Logics

To find a mentor, look for someone with either: 1) startup experience in the same industry or a closely related industry to your startup idea, 2) years of industry experience in the same industry or a closely related industry to your startup idea, 3) a potential user/customer or partner for your startup idea, or 4) someone with startup or industry experience more generally.

Mentors with diverse social ties that are different from yours social network is especially useful for introducing new resources to you as an entrepreneur. Their diverse networks can be a critical asset to you. They are also more likely to understand your vision and its potential impacts, help you shape your idea to get the maximum return, and identify and provide critical resources when needed. When you are looking for mentors, it is important to identify their network resources, such as finding out not only whom they know but whom their friends know as well.

You should tell them briefly about who your user or customer is and what general problem you want to solve in the industry for the user or customer. You do not necessarily need to propose a solution though you might mention an initial idea. Then, you should ask them what they think and how they would approach that problem. Resist the temptation to “pitch” them on your idea and

instead focus on co-creating the project with them. It's your responsibility to execute, but remain open to change if they are willing to commit time, introductions or resources. Indicate that you are open to shifting the goals of the project or the approach in response to their suggestions. In exchange, you simply ask them if they would commit to helping you build a product/service as a mentor. Mentors provide feedback from time to time, make introductions, or provide other resources. The important thing to remember is that mentors commit resources in exchange for a chance to reshape the goals of the project, to influence what future will ultimately result.

You can ask for an introduction from someone who knows them, or approach them directly or by email, or you might simply approach those you encounter in your everyday life. You can explain to them that you are working on a startup for this class and would like to talk with them briefly about your startup idea. You can also message mentors through the NovoEd site by clicking on "Community" and then "Mentors" and then searching the mentors already registered on the site.

5. Planning Logics

To find a mentor, look for someone with either: 1) startup experience in the same industry or a closely related industry to your startup idea, 2) years of industry experience in the same industry or a closely related industry to your startup idea, 3) a potential user/customer or partner for your startup idea, or 4) someone with startup or industry experience more generally

You should tell them briefly about who your user or customer is and what general problem you want to solve in the industry for the user or customer. You should pitch them on your startup idea. Share with them your vision and see if they agree and share that vision. Provide them with whatever market data and evidence you have so far that shows that this is a promising venture. If they do not agree with your vision and plans, then you need to keep looking for a mentor who is a good match with your vision of the startup and its market. If you cannot find a mentor in this way, then it may be a sign that you need to adapt and change your vision or pitch and try again to find a mentor. Explain to them the planning that you have done for this venture thus far and ask for their advice. In exchange, you simply ask them if they would commit to helping you build a product/service as a mentor. Mentors provide feedback from time to time, make introductions, or provide other resources.

You can ask for an introduction from someone who knows them, or approach them directly or by email, or you might simply approach those you encounter in your everyday life. You can explain to them that you are working on a startup for this class and would like to talk with them briefly about your startup idea. You can also message mentors through the NovoEd site by clicking on "Community" and then "Mentors" and then searching the mentors already registered on the site.

6. Planning Logics & Diverse Mentor

To find a mentor, look for someone with either: 1) startup experience in the same industry or a closely related industry to your startup idea, 2) years of industry

experience in the same industry or a closely related industry to your startup idea, 3) a potential user/customer or partner for your startup idea, or 4) someone with startup or industry experience more generally.

Mentors with diverse social ties that are different from yours social network is especially useful for introducing new resources to you as an entrepreneur. Their diverse networks can be a critical asset to you. They are also more likely to understand your vision and its potential impacts, help you shape your idea to get the maximum return, and identify and provide critical resources when needed. When you are looking for mentors, it is important to identify their network resources, such as finding out not only whom they know but whom their friends know as well.

You should tell them briefly about who your user or customer is and what general problem you want to solve in the industry for the user or customer. You should pitch them on your startup idea. Share with them your vision and see if they agree and share that vision. Provide them with whatever market data and evidence you have so far that shows that this is a promising venture. If they do not agree with your vision and plans, then you need to keep looking for a mentor who is a good match with your vision of the startup and its market. If you cannot find a mentor in this way, then it may be a sign that you need to adapt and change your vision or pitch and try again to find a mentor. Explain to them the planning that you have done for this venture thus far and ask for their advice. In exchange, you simply ask them if they would commit to helping you build a product/service as a mentor. Mentors provide feedback from time to time, make introductions, or provide other resources.

You can ask for an introduction from someone who knows them, or approach them directly or by email, or you might simply approach those you encounter in your everyday life. You can explain to them that you are working on a startup for this class and would like to talk with them briefly about your startup idea. You can also message mentors through the NovoEd site by clicking on “Community” and then “Mentors” and then searching the mentors already registered on the site.

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