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Advising Entrepreneurs: Optimal Recommendation of Alternatives

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Abstract. ***Problem definition*:** Facing emergent business challenges, entrepreneurs often seek guidance from experienced advisors. When multiple alternatives could potentially solve the entrepreneur's problem, advisors can lead the entrepreneur's exploration by choosing which alternative(s) to suggest and in what sequence. ***Methodology/results*:** We develop a dynamic game-theoretic model that captures the sequential interaction between an advisor and an entrepreneur. The advisor chooses how to recommend alternative solutions, and the entrepreneur chooses which solution to try. The trial's success depends on the viability of a solution and the entrepreneur's execution capability. When a trial of a recommended solution fails, the belief about the viability of the solution is updated. ***Managerial implications*:** Our analysis reveals that the advisor should strategically recommend alternatives based on the entrepreneur's execution capability, trial costs, and correlation between alternatives (among other factors). When the trial of the first alternative fails, the advisor should readily offer a new alternative if the entrepreneur's capability is either very high or very low. Otherwise, the advisor should encourage the entrepreneur to try the same solution multiple times. In order to motivate and sustain the entrepreneur's exploration over time and across solutions, the advisor may find it optimal to recommend inferior solutions before superior ones (e.g., when trial costs are different or the entrepreneur can improve her capability with experience) or recommend multiple solutions simultaneously (e.g., when there is correlation between alternatives).

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1. Introduction

Although startups are mythologized as enterprises founded on moments of inspiration, entrepreneurs succeed by overcoming a series of challenges from inception (Mollick 2020). When novel and urgent challenges emerge, entrepreneurs often have limited (or no) expertise in identifying possible solutions. Additionally, they only have a brief and defined window of time, or "runway," in which they have to implement a viable solution (Ries 2011, Shepherd and Gruber 2021). Therefore, startups frequently turn to external experts—known as "mentors" or "advisors"—who identify candidate solutions (Baragwanath 2018). The challenges faced by startups may occur in essential business functions such as hiring, fundraising, and business model development, or a variety of technical realms such as information technology, analytics, and legal strategy. Advisors are experienced experts on technical and business problems who have engaged in or provided counsel to businesses in related domains (Wood 2021). The value that startups gain from professional advisors is evident in the proliferation of over 200 startup accelerators in the United States alone, all of which offer a core value proposition centered around providing guidance and support for startups (Wilson 2022).

Salient aspects of the advisor-entrepreneur interaction can be illustrated through some examples.[1] Consider Becky, a first-time entrepreneur who envisioned developing a hardware solution to track a chronic disease condition. Before the product was engineered, Becky's advisor made introductions to leading physicians so that Becky could test the validity of the problem. After several lukewarm conversations, Becky's advisor suggested an alternative pathway that would not require FDA approval. Becky pivoted successfully and now offers a software solution that has found traction as a management solution for a behavioral ailment. Another advisor we spoke with discussed Vernon, a scientist-entrepreneur whose platform has the potential to significantly accelerate new drug discovery and development.

Following the advisor's introductions, Vernon pursued conversations with companies developing a specific niche of cancer therapies. The advisor did not make introductions to companies in other segments until Vernon was able to fully explore the platform's fit for cancer therapies. Broadly, as entrepreneurs strive to turn their ideas into successful outcomes, guidance from an experienced mentor can expose the entrepreneur to new ways of thinking about her challenges (Baragwanath 2018). Such guidance could be crucial in averting failure and sustaining the entrepreneur's journey.

Although advisors may be able to identify multiple pathways for entrepreneurs, they lack the authority to compel entrepreneurs to pursue the recommended alternatives. Ultimately, the decisions regarding which alternatives to pursue and when to terminate a venture lie within the discretion of the entrepreneurs. Furthermore, providing guidance can be a challenge because of several factors. Primary among them is the uncertain nature of entrepreneurship, which could be attributed to the inherent risk in the suggested pathway (Ries 2011) or the entrepreneur's inability to successfully execute a trial (Thomke 2001, Arora et al. 2021). These factors jointly contribute to a significant failure rate for startups (Hyytinen et al. 2015, CBInsights 2021). Secondly, entrepreneurs typically have a short window of time to try different pathways before they terminate their venture (Bhaskaran et al. 2021). Third, advisors must expend time, effort, and social capital to enable an entrepreneur to try an alternative. This cost is incurred in the form of high-value introductions, developing roadmaps to try solutions, or obtaining access to specialized equipment or services (Wood 2021).

This paper aims to study the interaction between an advisor and an entrepreneur. In particular, we interrogate the following question: *how should an advisor recommend alternative solutions to an entrepreneur?* As we discuss later (in Section 2), a rich stream of literature has focused on how a firm or individual should evaluate options that are already available or become available in a sequence. However, little is known about the question of how options should be *suggested* by an external advisor to such a decision maker. Given the practical observations of trial uncertainty and time constraints, we also consider: *how do the entrepreneur's execution capability and timeline affect which option is recommended? And when?*

To answer these questions, we develop a dynamic game-theoretic model in which an advisor guides an entrepreneur in solving a business problem. The entrepreneur has a fixed time horizon beyond which they cannot continue to operate their venture if they do not solve the problem at hand (i.e., the venture's runway constitutes a finite number of decision-making rounds). The advisor chooses which of the available solution(s) to recommend in each round, whereas the entrepreneur decides which of the recommended solutions should be tried in that round. If a trial is successful, the solution is adopted and implemented by the entrepreneur. A trial could fail either because the solution itself is not viable or because the entrepreneur's execution of the trial was defective; after a failure, the belief about the viability of the solution is updated. The venture continues in this iterative cycle of solution recommendation and trial until one of the following three outcomes occurs: (i) the most recent trial is successful, (ii) all trials fail until the end of the runway, or (iii) the entrepreneur decides to terminate the venture or pursue her external option (not recommended by the advisor).

Analysis of this model yields several practical insights. First, we find that it is optimal for the advisor to lead the entrepreneur by strategically sequencing recommendations. If the initially recommended alternative's trial fails, the advisor should readily recommend a new alternative only if the entrepreneur's capability is either very high or very low. Otherwise, the advisor should encourage the entrepreneur to continue trying the same solution multiple times, especially when the entrepreneur has a long runway. We also characterize conditions under which the advisor finds it optimal to recommend inferior alternatives before the superior ones. For instance, this happens in situations where (i) the entrepreneur's trial cost varies significantly from one alternative to another, or (ii) the entrepreneur can learn from early trials and improve her capability. Although this reversed recommendation approach seems to be at odds with the entrepreneur's perspective, it could increase the overall success rate of the venture by motivating the entrepreneur to continue and try new alternatives even after early failures. We also consider a variation of the model in which different solutions are correlated (positively or negatively). One crucial insight from this analysis is that the advisor might find it useful to recommend alternative solutions simultaneously and early in the horizon.

The remainder of the paper is organized as follows. We review the related literature in Section 2 and present the model setup in Section 3. In Section 4, we characterize the equilibrium strategies and analyze the impact of the entrepreneur's trial costs on those strategies. We characterize the effect of entrepreneur's execution capability on the equilibrium strategies in Section 5. In Section 6, we generalize the model and present additional insights. We conclude with a summary of managerial insights and directions for future research in Section 7. All proofs and technical details are presented in the Online Appendix.

2. Literature Review

This study relates to two streams of research: entrepreneurial operations and innovation project management. We next review these research streams and highlight our contributions.

2.1. Operations for Entrepreneurs

Startups are distinct from established companies (Blank 2013, Fine et al. 2022) and require special consideration because of their unique challenges and opportunities (McDougall et al. 1992). For instance, entrepreneurs have to deal with a high level of uncertainty about their target markets and the outcome of their technological developments (Atuahene-Gima and Ko 2001, Wu and Knott 2006). Moreover, they frequently encounter resource constraints (Ries 2011), fluid business problems (Bhaskaran et al. 2021), and unsuitable personnel (Blank 2013, Arora et al. 2021). As such, entrepreneurs are more prone to execution errors compared with established firms (Thomke 2001, Arora et al. 2021). The entrepreneurial operations literature suggests two different approaches for startups facing this challenge. Some studies suggest that entrepreneurs should prioritize identifying their target customer(s) before focusing on improving execution capabilities (Ries 2011, Aulet 2013), whereas others advocate for building capabilities first (Yoo et al. 2016a, Fine et al. 2022).

Many entrepreneurs have noted that whereas clear entry plans are desirable, they are not readily available for their ventures (Marion et al. 2012). The absence of clear plans inevitably leads to using trial-and-error learning (Garud and de Ven 1992, Sommer et al. 2009) and regularly results in the termination of their venture after an unproductive chain of investments (Boulding et al. 1997, Eisenmann 2021). Some entrepreneurs use heuristics to make decisions rather than optimization to address emerging challenges (Busenitz and Barney 1997); some others use deferral as a development strategy (Mueller et al. 2012, Yoo et al. 2016b). However, with the guidance of advisors, entrepreneurs could increase the likelihood of successful commercialization (Delmar and Shane 2003, Wood 2021) and make more informed and sophisticated decisions (e.g., to continue or disband an idea) (Chwolka and Raith 2012). While significant work has emerged in operations management to study entrepreneurial challenges (e.g., Babich and Sobel 2004, Yoo et al. 2016a, Bhaskaran et al. 2021, Kagan et al. 2024), we believe there is an important gap that remains to be addressed: understanding the role of advisors in guiding entrepreneurs. This paper takes a step in this direction by considering how advisors should recommend options to entrepreneurs while taking into account the entrepreneur's capability to execute and the iterative nature of the solution validation process.

2.2. Innovation Project Management

Innovation projects present a distinct challenge because of the relatively high level of uncertainty involved (Kavadias and Hutchison-Krupat 2020). This uncertainty is an important contributor that makes project failure a natural and commonplace occurrence (Loch and Terwiesch 1998, Mihm et al. 2003). Therefore, multiple trials may be needed before a successful solution is found (Weitzman 1979, McCardle 1985, Sommer and Loch 2004). With each iteration, additional information is gathered about available options, which may be new technologies or competing design options (McCardle 1985, Krishnan and Bhattacharya 2002, Kwon and Lippman 2011, Smith and Ulu 2017). While collecting more information is generally better, the decision may be hastened by operational factors such as production constraints (Kornish and Keeney 2008), the ability to learn about untested alternatives (Adam 2001, Erat and Kavadias 2008), or the limited availability of resources in the context of startups (Bhaskaran et al. 2021, Sudhir and Yoo 2023). In addition to an alternative's objective fit to the problem at hand, the timing of its adoption could also depend on the evolution of adjacent technologies (Cho and McCardle 2009, Oraiopoulos and Kavadias 2014). A notable commonality among these studies is that they focus on centralized systems in which a firm or an individual identifies and discovers solutions internally and through their own efforts. However, in many contexts, identifying and/or discovering solutions is delegated to an external entity. This is especially true for entrepreneurs who commonly seek recommendations from advisors, who use their expertise to identify possible alternatives to explore (Wood 2021). A key contribution of our paper is to model the interactions between an entrepreneur and an advisor. The advisor makes recommendations regarding alternative solutions, whereas the entrepreneur makes the final decisions on which alternative to try (or when).

A stream of literature on delegated innovation at the interface between operations management and economics has identified several strategies to help firms manage and improve the execution of delegated innovation projects (Kavadias and Ulrich 2020). Firms can increase the success rate of their projects by creating a collaborative atmosphere among contributors (Özkan-Seely et al. 2015, Rahmani et al. 2018, Crama et al. 2019, Gupta et al. 2023) or by using deadlines to thwart potential procrastination (Bonatti and Hörner 2011, Wu et al. 2014, Zhang 2016). Firms may also implement better monitoring processes and/or incentives to improve contributors' performance (Holmström 1979, Roels et al. 2010, Manso 2011, Halac et al. 2016). We complement this literature by focusing on the phase of the project that precedes execution, where firms identify and evaluate alternative solutions to their business problem.

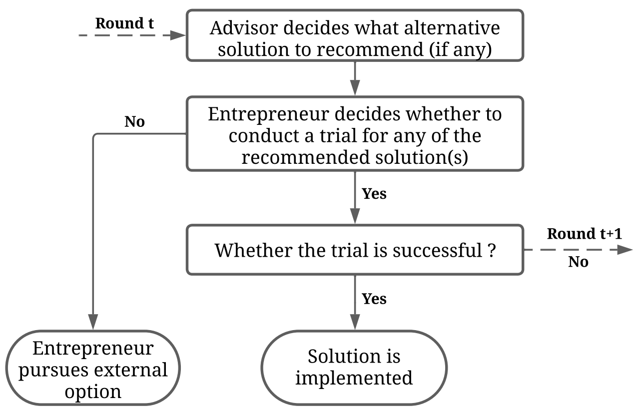
This is particularly pertinent to the context of entrepreneurship, where startups could benefit from exploring multiple solutions instead of relying on a single solution.

An emerging set of studies has considered situations where firms enlist external partners to identify and/or evaluate alternative solutions. In some instances, firms employ providers to generate solutions for their business problems (Terwiesch and Loch 2004, Rahmani and Ramachandran 2021). In other instances where several candidate solutions have already been identified, firms may engage agents to explore the viability or quality of those solutions (Erat and Krishnan 2012, Shalpegin et al. 2018, Schlapp and Schumacher 2022). These studies have mainly focused on incentive designs as a lever to mitigate the agent's tendency to prolong the search. We contribute to this stream of research in three key ways. First, we study an advisor-entrepreneur relationship, which differs from the classic agency relationship in terms of authority and decision rights. Specifically, although the advisor can offer several solutions, the decisions regarding which solutions to try and when to terminate the venture are made by the entrepreneur. As such, the advisor relies on dynamic recommendations of solutions to sustain the entrepreneur's exploration and improve the success rate of the venture. This is an important aspect of advising, which, to the best of our knowledge, has not been explored by prior studies. Second, we consider scenarios where each solution can be explored multiple times. Consequently, the belief regarding the feasibility of solutions can be iteratively updated. This represents a significant distinction from the prevailing literature on delegated innovation, which examines multiple solutions but limits each solution to a single conclusive trial. Finally, we incorporate other salient and essential features of entrepreneurship, including an entrepreneur's execution capability, her ability to learn from previous trials, and the impact of correlations between options. These factors influence the advisor's strategy in presenting alternatives and the entrepreneur's willingness to explore new options. The integration of these elements has resulted in new managerial insights that, to the best of our knowledge, have not been previously identified in existing research.

3. Model

We consider an advisor who is guiding an entrepreneur in her quest to find a viable solution to a critical problem.[2] The advisor is aware of K potential solutions to the entrepreneur's problem, which we refer to as *alternative solutions* or *options*. In each round, denoted by $t \in \{1,2,\ldots,N\}$, the advisor decides what alternative solution(s) to recommend (if any), and the entrepreneur decides whether to conduct a trial for any of the recommended solutions. Figure 1 illustrates the sequence of events and decisions in each round.

Figure 1. Sequence of Events and Decisions



This iterative interaction between the advisor and entrepreneur continues until one of the following conditions arise: (i) when a trial is successful (which implies the entrepreneur implements the solution), (ii) when all trials fail until the end of the runway (i.e., round N has been reached), or (iii) when the entrepreneur chooses to terminate the venture or pursue her external option. To simplify the exposition, we focus our main analysis on situations where there are two alternative solutions, which can potentially solve the entrepreneur's problem, denoted by option a and option b ($K=2$).

3.1. Advisor's Choice

We denote the advisor's choice in round t by o_t. Specifically, in the first round, $o_1 \in \{\phi, a, b, \{a,b\}\}$, where ϕ denotes not recommending any option, and $\{a,b\}$ denotes recommending both options at once. In any subsequent round, $o_t \in \{\phi, \{a,b,\{a,b\}\backslash\{o_1,\ldots,o_{t-1}\}\}\}$ for $t>1$. This formulation captures that the advisor recommends each option only once. When an option is recommended, the entrepreneur has access to it and can choose to try it in any of the subsequent rounds. The advisor does not have the authority to coerce an entrepreneur to try recommended options. When the advisor recommends a new solution, the entrepreneur can choose to try the new solution, retry previous solutions, or pursue an external option. The advisor incurs two types of cost: first, the advisor incurs a cost $c_o>0$ for recommending each new solution to the entrepreneur. For example, an advisor may expend time and effort on making high-value introductions, developing roadmaps to try solutions, or setting up connections with domain experts (Wood 2021). Second, the advisor may also incur a cost for supporting the entrepreneur during the trial(s), which we denote by $c_g \geq 0$ (per trial). This may be in the form of providing access to specialized fabrication equipment or support in building low-fidelity prototypes of solutions (Biggs 2012).

3.2. Entrepreneur's Choice

We denote the entrepreneur's choice in round t by μ_t. In each round t, the entrepreneur can choose to try any option (among all those that have been recommended by the advisor until round t) or pursue her external option. Specifically, $\mu_t \in \{\phi, o_1, \ldots, o_t\}$, where ϕ denotes pursuing the external option. The entrepreneur incurs a cost for conducting a trial for each recommended option, which we denote by $c(\mu_t)$. Specifically, $c(a) = c_a$, $c(b) = c_b$, and $c(\phi) = 0$. These costs could be incurred in the form of prototyping, licensing, labor, traveling, or third-party testing (Jensen 2018, Hansen and Özkil 2020).

3.3. Success Probabilities and Evolution of Beliefs

The probability of a successful trial depends on two factors: the viability of the option (θ) and the probability of conducting a trial without errors (denoted by γ). The probability γ depends on the entrepreneur's prior experience in the domain and internal resources available for the trial.[3] Henceforth, to simplify our discussions, we refer to γ as the entrepreneur's "capability" to execute a trial. Therefore, the probability that a trial is successful is given by $P \doteq \gamma \times \theta$. Suppose an option with viability θ is tried in a round and the trial fails. Using Bayes' rule, the updated viability of that option is

$$\theta^1 = \frac{(1-\gamma)\theta}{(1-\gamma)\theta + 1 \times (1-\theta)} = \frac{(1-\gamma)\theta}{1-\theta\gamma}.$$

More generally, we denote the probability that a trial of option a (b) is successful after n (m) failures by $P_a(n) \doteq \gamma \times \theta_a^n$ ($P_b(m) \doteq \gamma \times \theta_b^m$). Here, θ_a^n and θ_b^m denote the updated viability of options a and b after n and m failures, respectively. The prior beliefs about the viability of option a and option b are $\theta_a \doteq \theta_a^0$ and $\theta_b \doteq \theta_b^0$. Suppose at the beginning of a round, options a and b have been tried n and m times, respectively. The entrepreneur tries option b and fails. Whereas the viability of option a remains at θ_a^n, the viability of option b is updated as follows:

$$\begin{aligned}\theta_b^{m+1} &\doteq Pr(\text{option b being viable} \mid \\ &\qquad \text{after } m+1 \text{ failures of option } b) \\ &= \frac{(1-\gamma)\theta_b^m}{(1-\gamma)\theta_b^m + 1 \times (1-\theta_b^m)} = \frac{(1-\gamma)\theta_b^m}{1-\theta_b^m\gamma}. \qquad (1)\end{aligned}$$

As the trials continue without success, the posterior belief deteriorates. That is, θ_b^m is decreasing in m. However, the extent to which the posterior belief declines depends on the execution capability of the entrepreneur (γ). When the entrepreneur has high execution capability, the posterior belief diminishes at a faster pace than when the entrepreneur has low capability. For instance, when the entrepreneur has perfect execution capability (i.e., $\gamma = 1$), the posterior belief upon the very first failure reduces to zero, whereas when the capability is low (i.e., $\gamma \ll 1$), the parties remain relatively more hopeful about the viability of the solution, as the failure of that option could be associated with errors in executing the trial (Thomke 2001, Arora et al. 2021).

We also generalize this model in several ways. For instance, we consider scenarios where γ can improve with trials in Section 5. In Section 6.1, we consider situations where alternative solutions are interdependent (i.e., trying a solution cannot only lead to an update of belief about that solution but also about the other solution).

3.4. Payoffs

When an option's trial is successful, the entrepreneur implements the solution and gains a net benefit U (i.e., value generated minus final implementation costs) and pays the advisor a reward f (with $0 \le f < U$).[4] In addition to the payment f, the advisor obtains a net benefit $V \ge 0$ from the venture. The parameter V captures the benefit that the advisor can obtain in the form of enhanced reputation and opportunities to develop additional business. When the end of the runway is reached or the entrepreneur chooses to not try any of the recommended options, the advisor will not reap any value from the venture. However, the entrepreneur can pursue her external option with value v_k (where $0 \le v_k \le U - f$). The parameter v_k succinctly captures a combination of external options that may be available to the entrepreneur. First, v_k may represent the quality of a default solution that the entrepreneur has unearthed prior to engaging the advisor. It may also include the potential gain from selling the venture, the liquidation value of the remaining physical assets, or the market value of the startup's intellectual property. In essence, if the solutions suggested by the advisor are not viable or the entrepreneur stops trying them, the entrepreneur receives a gross value of v_k.

3.5. Informational Structure

In the main model, we consider situations where the advisor knows that there are multiple alternative solutions to the problem, but the entrepreneur becomes aware of those options only after they are presented. This is consistent with practical observations, especially involving first-time or early-stage entrepreneurs who encounter a problem for the first time. In Online Appendix A.3, we extend the model to another informational structure in which the entrepreneur is aware of available solutions but still needs the guidance of the advisor to conduct trials.

3.6. Advisor and Entrepreneur Perspectives

In order to capture the strategic actions of the advisor and the entrepreneur, we develop a dynamic and stochastic game-theoretic model. In each round t, the advisor decides whether to recommend a new option, and then the entrepreneur decides whether to try any of the recommended options. We denote the advisor and entrepreneur's expected payoffs in round t by $\pi_t^A(\cdot)$ and $\pi_t^E(\cdot)$, respectively. In addition, we denote the number of rounds options a and b have been tried prior to round t by state parameters n_t and m_t, respectively. In each round t, the parties choose their actions by maximizing their individual expected payoffs as follows:

$$o_t^* = \arg\max_{o_t} \ \pi_t^A(n_t, m_t | o_t, \mu_t^*(o_t)), \tag{2}$$

$$s.t. \ \mu_t^*(o_t) = \arg\max_{\mu_t} \ \pi_t^E(n_t, m_t | o_t, \mu_t), \tag{3}$$

with $\pi_{N+1}^A(\cdot) = 0$, $\pi_{N+1}^E(\cdot) = v_k$, $\pi_t^A(\cdot|o_t, \mu_t = \phi) = 0$, and $\pi_t^E(\cdot|o_t, \mu_t = \phi) = v_k$. Recall that $o_t \in \{\phi, \{a, b, \{a, b\} \backslash \{o_1, \ldots, o_{t-1}\}\}\}$ and $\mu_t \in \{\phi, o_1, \ldots, o_t\}$. The entrepreneur's expected equilibrium payoff in round t is as follows:

$$\begin{aligned}&\pi_t^E(n_t, m_t | o_t^*, \mu_t^* = a)\\ &= -c_a + P_a(n_t)(U - f) + (1 - P_a(n_t))\pi_{t+1}^E\\ &\quad (n_t + 1, m_t | o_{t+1}^*, \mu_{t+1}^*),\end{aligned} \tag{4}$$

$$\begin{aligned}&\pi_t^E(n_t, m_t | o_t^*, \mu_t^* = b)\\ &= -c_b + P_b(m_t)(U - f) + (1 - P_b(m_t))\pi_{t+1}^E\\ &\quad (n_t, m_t + 1 | o_{t+1}^*, \mu_{t+1}^*).\end{aligned} \tag{5}$$

The advisor's expected equilibrium payoff in round t is as follows:

$$\begin{aligned}&\pi_t^A(n_t, m_t | o_t^*, \mu_t^* = a)\\ &= -c_o I_{\{o_t^* \neq \phi\}} - c_o I_{\{o_t^* = \{a,b\}\}} - c_g + P_a(n_t)(V + f)\\ &\quad + (1 - P_a(n_t))\pi_{t+1}^A(n_t + 1, m_t | o_{t+1}^*, \mu_{t+1}^*),\end{aligned} \tag{6}$$

$$\begin{aligned}&\pi_t^A(n_t, m_t | o_t^*, \mu_t^* = b)\\ &= -c_o I_{\{o_t^* \neq \phi\}} - c_o I_{\{o_t^* = \{a,b\}\}} - c_g + P_b(m_t)(V + f)\\ &\quad + (1 - P_b(m_t))\pi_{t+1}^A(n_t, m_t + 1 | o_{t+1}^*, \mu_{t+1}^*).\end{aligned} \tag{7}$$

In the next section, we characterize the entrepreneur and advisor's equilibrium choices. Throughout the paper, without loss of generality, we present the formal results for the case where $\theta_a < \theta_b$ (the results for $\theta_a > \theta_b$ are analogous). In addition, to simplify the exposition, we present the results for the case where both options have the same trial costs (i.e., $c_a = c_b = c$) and the entrepreneur has two rounds (i.e., when $N = 2$) unless stated otherwise. Specifically, we present results for situations with different trial costs in Section 4 and with multiple rounds in Section 6.2. Table A.1 in the Online Appendix summarizes the key notations.

4. Results

4.1. Optimal Recommendation of Alternatives

In order to determine the optimal sequence in which alternatives should be recommended to the entrepreneur, the advisor must take into account how the order of recommending alternatives will influence the entrepreneur's responses. Proposition 1 presents the equilibrium strategies that arise from the sequential interaction between the advisor and the entrepreneur for $\theta_a < \theta_b$ (the results for $\theta_a > \theta_b$ are analogous). Figure 2 illustrates these results for all values of θ_a and θ_b.

Proposition 1 (Equilibrium Strategies). *Suppose* $\theta_a < \theta_b$. *There exist thresholds* $\underline{\theta}_b$, $\overline{\theta}_b$, *and* $\ddot{\theta}_a$ *such that*

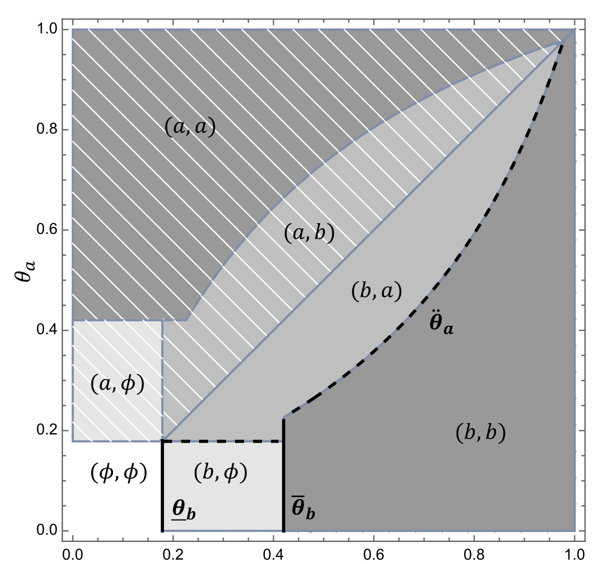
i. *In the first round, it is optimal for the advisor (entrepreneur) to recommend (try) option b if and only if* $\theta_b > \underline{\theta}_b$. *Otherwise, it is optimal for the advisor (entrepreneur) to not recommend any option (pursue the external option).*

ii. *In the second round (and if the first-round trial fails), it is optimal for the advisor (entrepreneur) to recommend (try) option a if and only if* $\theta_a > \ddot{\theta}_a$. *Otherwise, it is optimal for the entrepreneur to try option b again if* $\theta_b > \overline{\theta}_b$, *and to pursue the external option if* $\underline{\theta}_b < \theta_b \leq \overline{\theta}_b$.

iii. *The thresholds* $\ddot{\theta}_a$, $\underline{\theta}_b$, *and* $\overline{\theta}_b$ *are nondecreasing in c.*

The advisor's recommendation strategy described by Proposition 1 is influenced by two central ideas: first, although the advisor determines which option to recommend and when, the advisor also recognizes that the entrepreneur has autonomy over which option to try in

Figure 2. (Color online) Equilibrium Strategies (μ_1^*, μ_2^*)



Note. Parameters are $\gamma = 0.7$, $c_a = c_b = 3.5$, $c_o = 0.5$, $c_g = 0.5$, $U = 40$, $V = 5$, $f = 10$, $v_k = 2$, and $N = 2$.

each round; second, the entrepreneur's perception of an option will be updated after a failed trial. When one option has a significant advantage over the other option (i.e., $\theta_b \gg \theta_a$ and $\theta_a \leq \ddot{\theta}_a$), the advisor recommends only the superior option (the option with the higher prior viability), and the entrepreneur will try this option in both rounds; this occurs in the (b, b) region of Figure 2. Even if the advisor suggests the other option, the entrepreneur may not have the incentive to try the new option. That is because the updated belief about the viability of the first option (θ_b^1) remains relatively high even after the failure in the first round such that it is preferable to try the first option again.

When the two options are closer in terms of prior belief about their viability (i.e., $\ddot{\theta}_a < \theta_a < \theta_b$), after the first trial fails, the updated viability of the first option falls sufficiently below the viability of the other untried option. This incentivizes the advisor to recommend the other option in the second round despite the additional cost of recommending, and the entrepreneur is also willing to try this new option. This occurs in the (b, a) region of Figure 2. Finally, when the prior beliefs about the viability of both options are low, the advisor finds it optimal to recommend only a single option in the first round and none at all in the second round, effectively leading the entrepreneur toward pursuing her external option if the first trial fails; this occurs in the (b, ϕ) region.

The entrepreneur's cost of trying an option in each round may depend on several factors, such as the availability of resources and the impact of a trial on current operations for the entrepreneur. The entrepreneur's cost directly makes trials less efficient, thus reducing the entrepreneur's willingness to engage in the venture; further, the entrepreneur is also less willing to continue the venture after the first-round failure when c is larger. Therefore, the participation thresholds for the first round ($\underline{\theta}_b$) and for the second round ($\overline{\theta}_b$ or $\ddot{\theta}_a$) are nondecreasing in c (as shown in Proposition 1(iii)).

4.2. Optimal Recommendation of Alternatives with Asymmetric Trial Costs

We now consider a more general situation where the trial costs of the two options are different (i.e., $c_a \neq c_b$). That is, trying an option with a lower prior viability could be more or less costly than trying an option with a higher prior viability. We define $\delta \doteq \frac{c_a - c_b}{c_o}$ to capture the degree of difference between trial costs compared with the advisor's recommending costs (note that $\delta < 0$ if $c_a < c_b$). The next proposition characterizes the effect of δ on the equilibrium strategies. In order to simplify the exposition and focus on the most insightful cases, we present the results for situations where the viability of option b is sufficiently high (i.e., $\theta_b > \overline{\theta}_b$) that the advisor has the incentive to recommend option b and the entrepreneur has the incentive to try that in both rounds. The result for the other case where $\theta_b < \overline{\theta}_b$ is presented in Online Appendix B.1.1.

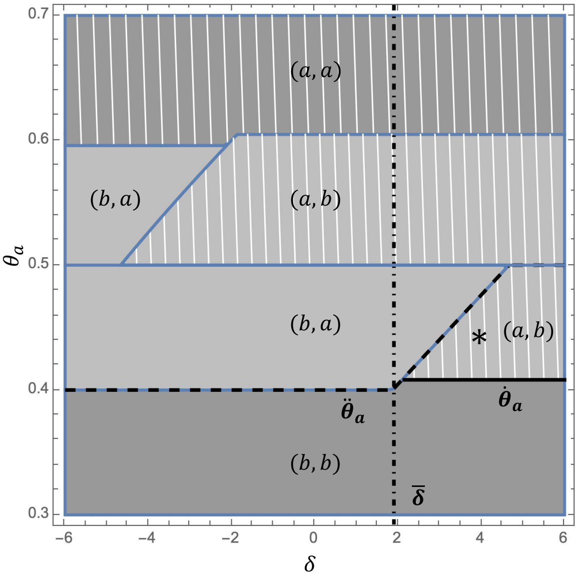
Proposition 2 (Effect of Trial Cost Differences). *Suppose $c_a \neq c_b$, $\theta_a < \theta_b$, and $\theta_b \geq \overline{\theta}_b$. There exist thresholds $\overline{\delta}$, $\dot{\theta}_a$, and $\ddot{\theta}_a$ such that*

i. *If $\delta \leq \overline{\delta}$, it is optimal for the advisor to recommend option b in the first round. In the second round (and if the first-round trial fails), it is optimal for the advisor to recommend option a if $\theta_a > \ddot{\theta}_a$ and to not recommend a new option otherwise.*

ii. *If $\delta > \overline{\delta}$, it is optimal for the advisor to recommend option b in the first round if and only if $\theta_a < \dot{\theta}_a$ or $\theta_a > \ddot{\theta}_a$. Otherwise (i.e., if $\dot{\theta}_a \leq \theta_a \leq \ddot{\theta}_a$), it is optimal for the advisor to recommend option a in the first round. In the second round (and if the first-round trial fails), it is optimal for the advisor to recommend option a if $\theta_a > \ddot{\theta}_a$, recommend option b if $\dot{\theta}_a \leq \theta_a \leq \ddot{\theta}_a$, and to not recommend a new option if $\theta_a < \dot{\theta}_a$.*

Proposition 2 generalizes the findings from Proposition 1, which focused on the situation in which trial costs of the two options are similar (i.e., δ is close to zero); this generalization is illustrated in Figure 3. Echoing Proposition 2, Figure 3 shows that in a majority of instances, the advisor recommends the more viable option in the first round. Further, if the difference in the viability of options is large, the advisor does not suggest a new alternative in the second round. Indeed, as we know from Proposition 1, when the trial costs of the two options are similar (i.e., δ is close to zero), the advisor should first recommend an option that has a

Figure 3. (Color online) The Effect of Trial Cost Differences (δ) on Equilibrium Strategies (μ_1^*, μ_2^*)



Note. Parameters are the same as in Figure 2 with $\theta_b = 0.5$ and $\gamma = 0.5$.

higher likelihood of success. However, when costs are different (i.e., $|\delta|$ is large), it might be optimal for the advisor to recommend the inferior option in the first round. For instance, this occurs in the (a, b) region of Figure 3 when $\theta_a \leq 0.5$. Some prior studies on search and delegated search have also shown that trying alternatives in the decreasing order of their success rate may not always be optimal (e.g., Adam 2001, Erat and Kavadias 2008, Schlapp and Schumacher 2022). However, the underlying mechanism for our result is different, driven by variations in the authority and decision rights of the advisor and entrepreneur (as discussed in Section 2).

To understand the intuition behind this result, we focus on an illustrative instance in Figure 3 denoted by "*", where $\delta = 4$, $\theta_a = 0.45$, and $\theta_b = 0.5$. Here, it is optimal for the advisor to recommend option a in the first round in spite of its inferiority in both the viability and cost dimensions. In this context, it is worth noting that values of $\theta_a < 0.5$ correspond to situations in which option a is a priori less viable, and values of $\delta > 0$ reflect that the trial cost of option a is larger. Yet the advisor recommends option a first. Why? In such scenarios, as θ_b is only slightly larger than θ_a, trying a different alternative in each round can maximize the overall probability of success for the venture. If the advisor recommends option b first, the entrepreneur would choose to try that option twice (even after updating belief about its viability) to avoid the high cost of trying option a. However, from the advisor's perspective, such an approach would be inefficient, as option a has a higher prior viability than the updated viability of option b that has failed once. Therefore, the advisor recommends the inferior option a first to induce the entrepreneur to try both options. Additionally, we can observe in Figure 3 that the region in which (a, b) is optimal increases with δ (which measures the cost differential $c_a - c_b$); in other words, the advisor is even more likely to recommend the inferior option first when inducing the entrepreneur to try that option in the later round becomes harder. Notably, this sequential recommendation of alternatives (with the inferior option being presented first) remains optimal even if the advisor's recommending cost c_o is equal to zero (see details in Lemma A.3 in the Online Appendix).

4.2.1. Comparison with the First-Best Solution.

As a benchmark, we compare the results in Proposition 2 with those under the first-best solution. We present the full characterization of the first-best solution in Online Appendix A.1. The next proposition presents the key differences.

Proposition 3 (First-Best Solution with Asymmetric Trial Costs). *Consider conditions in Proposition 2. Under the first-best solution, there exists a threshold $\hat{\theta}_a^{AFB}$ such that*

i. *If $\delta \leq \overline{\delta}$, it is optimal to try option a in the first round if and only if $\theta_a > \hat{\theta}_a^{AFB}$.*

ii. *If $\delta > \overline{\delta}$, it is always optimal to try option b in the first round.*

Recall from Proposition 2(ii) that when $\delta > \overline{\delta}$, it is optimal for the advisor to offer the inferior option a in the first round if $\dot{\theta}_a \leq \theta_a \leq \ddot{\theta}_a$. However, Proposition 3(ii) indicates that in the first-best solution, exploring the superior option first is always preferable when δ is large. When the advisor is external, he cannot coerce the entrepreneur to try a new alternative simply by recommending it. Therefore, as explained after Proposition 2, the advisor offers the inferior solution first to ensure that the entrepreneur tries both solutions rather than trying one solution repeatedly. In other words, the advisor uses the sequence of recommendations as an indirect mechanism to manage the entrepreneur's exploration of alternatives. On the other hand, according to Proposition 2(i), when $\delta \leq \overline{\delta}$, the advisor should always offer the superior option b in the first round. However, under the first-best solution, it could be optimal to try option a in the first round (Proposition 3(i)). In this scenario, although the prior viability of option a is lower than that of option b, its lower trial cost can make it a preferable choice to try first. This shift in the first-best solution arises because the parties maximize the total surplus, leading to a more balanced assessment of the trade-off between options' viability and trial costs.

5. Execution Capability and Optimal Recommendation

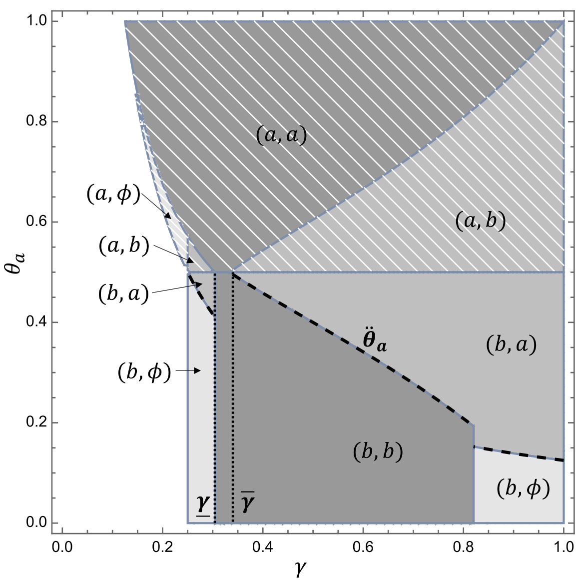
An entrepreneur's execution capability, which could depend on her prior experience in the domain and her available internal resources, can affect the success rate of trials and, consequently, the venture's survival. In this section, we first study how the entrepreneur's execution capability in conducting trials can affect the advisor and entrepreneur's equilibrium strategies. We then generalize our analysis to situations where the entrepreneur can learn from the experience of conducting trials and enhance her execution capability for future trials.

Proposition 4 (Effect of Entrepreneur's Execution Capability). *Consider the equilibrium strategies and threshold $\ddot{\theta}_a$ characterized in Proposition 1. There exist thresholds $\underline{\gamma}$ and $\overline{\gamma}$ such that*

i. *If $\gamma > \overline{\gamma}$ or $\gamma < \underline{\gamma}$, then $\ddot{\theta}_a < \theta_b$, indicating that it is optimal for the advisor to recommend option a in the second round when $\theta_a > \ddot{\theta}_a$. In addition, the threshold $\ddot{\theta}_a$ is decreasing in γ when $\gamma > \overline{\gamma}$ or when $\gamma < \underline{\gamma}$.*

ii. *If $\underline{\gamma} \leq \gamma \leq \overline{\gamma}$, then $\ddot{\theta}_a \geq \theta_b$, indicating that it is optimal for the advisor to not recommend option a in the second round.*

Figure 4. (Color online) Effect of Entrepreneur's Execution Capability (γ) on Equilibrium Strategies (μ_1^*, μ_2^*)



Note. Parameters are the same as in Figure 2 with $\theta_b = 0.5$.

Proposition 4 shows that a one-size-fits-all approach will not be optimal for the advisor. Indeed, the entrepreneur's execution capability affects the advisor's decision on whether to recommend a new option in the second round. A key result from Proposition 4 is that it is optimal for the advisor to recommend a new solution in the second round (and if the first-round trial fails) when the entrepreneur's execution capability is either very high or very low. However, when the entrepreneur's execution capability is in an intermediate range, it is optimal for the advisor to not recommend a new solution and instead encourage the entrepreneur to try the initial solution again.

Figure 4 illustrates the results in Proposition 4. When an entrepreneur with higher capability fails to succeed in the first round, it results in a sharper downward revision of belief about the viability of the failed option; this makes a retrial less favorable. As a result, the advisor recommends the second option when the entrepreneur's capability is sufficiently high. The advisor may also recommend the new alternative in the second round when the entrepreneur's execution capability is sufficiently low and solutions have similar chances of success; observe the (b, a) region of Figure 4 for values of $\gamma \approx 0.27$ and $\theta_a \approx 0.47$. In this scenario, the entrepreneur's execution capability is so low that the entrepreneur does not have the incentive to try the first option again. Yet, given that the two options are intrinsically quite viable, the advisor finds it valuable to encourage another trial by the entrepreneur. Thus, the advisor should recommend a fresh option so that the entrepreneur would continue the venture.

The figure also illustrates additional regions, specifically (b, ϕ) and (b, b), where the advisor should not recommend a new alternative in the second round, even if the first-round trial fails. In such cases, the equilibrium strategy once again varies depending on the entrepreneur's capability. When her capability falls within an intermediate range, the entrepreneur will retry the same option in the second round (resulting in the (b, b) region) because the success probability of the failed option is still relatively high (recall that $P(\cdot) = \gamma \cdot \theta_b^1$). However, when her capability is either very low or very high, the entrepreneur prefers to pursue her external option (resulting in the (b, ϕ) region). This preference stems from either her lack of confidence in her ability to conduct a trial (when γ is low) or a significant decline in the updated viability of the failed solution (when γ is high).

5.1. Entrepreneur's Capability Improvement

In many scenarios, entrepreneurs can learn from the experience of conducting trials and reduce the risk of errors in the future (Politis 2005, Toft-Kehler et al. 2014). We next generalize the model to situations where the entrepreneur's execution capability improves after a trial. Let the entrepreneur's second-round capability (if the first-round trial fails) be $\gamma_2 \doteq \xi\gamma$, where $\xi \in \left[1, \frac{1}{\gamma}\right]$. Here, ξ captures the degree of capability improvement gained from experience, even if the past trial is unsuccessful.[5] The following proposition depicts the effect of execution capability improvement on the equilibrium strategies. Note that in order to simplify the exposition and focus on the most insightful cases, we consider situations where the viability of option b is sufficiently high (i.e., $\theta_b > \overline{\theta}_b$) that the advisor has the incentive to recommend option b and the entrepreneur has the incentive to try that in both rounds. (Similar results hold when $\theta_b < \overline{\theta}_b$. See details in Online Appendix B.2.1.)

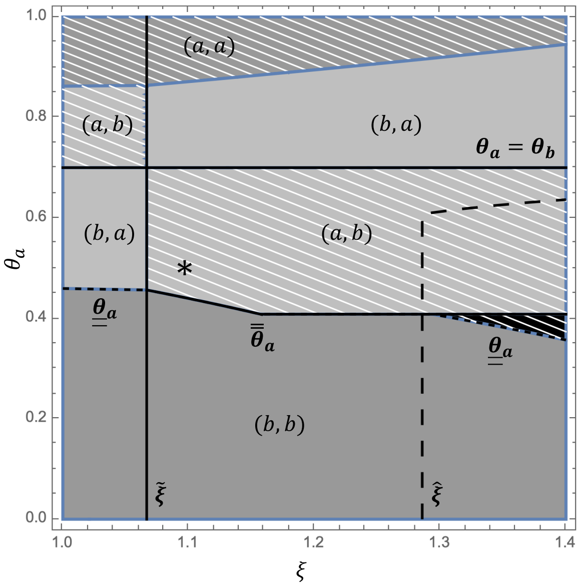
Proposition 5 (Capability Improvement). *Suppose $\theta_a < \theta_b$ and $\theta_b \geq \overline{\theta}_b$. There exist thresholds $\tilde{\xi}$, $\hat{\xi}$, $\overline{\overline{\theta}}_a$ and $\underline{\underline{\theta}}_a$ such that*

i. *If $\xi < \tilde{\xi}$, it is optimal for the advisor to recommend option b in the first round. In the second round (and if the first-round trial fails), it is optimal for the advisor to recommend option a if and only if $\theta_a \geq \underline{\underline{\theta}}_a$.*

ii. *If $\tilde{\xi} \leq \xi < \hat{\xi}$, it is optimal for the advisor to recommend option a in the first round if and only if $\theta_a \geq \overline{\overline{\theta}}_a$. Otherwise, it is optimal for the advisor to recommend option b in the first round. In the second round, it is optimal for the advisor to recommend option b (option a) if and only if $\theta_a \geq \overline{\overline{\theta}}_a$ ($\underline{\underline{\theta}}_a \leq \theta_a < \overline{\overline{\theta}}_a$).*

iii. *If $\xi > \hat{\xi}$, it is optimal for the advisor to recommend option a in the first round and option b in the second round if and only if $\theta_a \geq \overline{\overline{\theta}}_a$. When $\underline{\underline{\theta}}_a \leq \theta_a < \overline{\overline{\theta}}_a$ ($\theta_a < \underline{\underline{\theta}}_a$), it is optimal for the advisor to recommend **both** options a and b*

Figure 5. (Color online) Effect of Entrepreneur's Capability Improvement (ξ) on Equilibrium Strategies (μ_1^*, μ_2^*)



Notes. Parameters are the same as in Figure 2, with $\theta_b = 0.7$ and $c = 8$. The equilibrium strategies in the black region are $(o_1^*, o_2^*) = (\{a, b\}, \phi)$ and $(\mu_1^*, \mu_2^*) = (a, b)$.

(option b) in the first round and not recommend any option in the second round.

Figure 5 illustrates the results of Proposition 5. When the entrepreneur gains limited capability improvement from a trial (i.e., $\xi < \tilde{\xi}$), the advisor should follow a similar strategy as characterized in Proposition 1. Specifically, it is optimal for the advisor to recommend the superior option in the first round and recommend a new option in the second round only if its viability is high (i.e., $\theta_a \geq \underline{\underline{\theta}}_a$). However, when the entrepreneur can make significant improvements in her capability from the trial (i.e., $\xi \geq \tilde{\xi}$), it becomes optimal for the advisor to recommend the less desirable option in the first round. For example, at the "$*$" point in Figure 5 (with $\xi = 1.1$, $\theta_a = 0.5$, and $\theta_b = 0.7$), it is optimal for the advisor to recommend option a in the first round despite its inferior viability. Although in this situation, the optimal strategy calls for temporarily withholding the superior option, this approach maximizes the overall success rate of the venture. Specifically, if the first trial fails, the entrepreneur can try the better option in the second round with largely improved capability, which results in a higher overall success rate as compared with other approaches (i.e., when the entrepreneur tries the same option in both rounds or tries the better option first).

Additionally, as is shown in Figure 5, the advisor may find it optimal to offer both options simultaneously in the first round when the trial cost is high and the entrepreneur can make a significant improvement in her capability from trying different solutions (see the black region in Figure 5). Prior studies suggest that simultaneous consideration of alternatives is more valuable in perfect test conditions (Loch et al. 2001, Sommer et al. 2009); our result adds to this literature by showing that the advisor may find it optimal to present alternatives simultaneously even when trials are imperfect. When the trial cost is high, the entrepreneur may lack the motivation to attempt option a because of its low viability (i.e., $\theta_a < \overline{\overline{\theta}}_a$). In this scenario, if the entrepreneur's capability improvement is also high (i.e., $\xi > \hat{\xi}$), it is optimal for the advisor to recommend both options simultaneously in the first round as long as the viability of option a falls within an intermediate range (i.e., $\underline{\underline{\theta}}_a \leq \theta_a < \overline{\overline{\theta}}_a$). This simultaneous offering, even though it is costly for the advisor, informs the entrepreneur about existing options and enables them to anticipate the possibility of exploring the other alternative in subsequent rounds. As such, this approach motivates the entrepreneur to try option a first, despite its initial low viability, to leverage capability improvement and maximize the overall success rate across both rounds. Even if the first trial fails, the significant capability improvement gained from the first trial improves the success rate for the trial of option b in the second round.

5.2. A Case with a Different Informational Structure

In Online Appendix A.3, we extend the model to another informational structure in which the entrepreneur is aware of available solutions but still needs the guidance of the advisor to implement them. For instance, the entrepreneur may know that the advisor has relationships with a couple of contract manufacturers; however, the entrepreneur does not have the relationship or knowledge to directly work with them in a timely and efficient manner to test their suitability as manufacturing partners. In this scenario, where the entrepreneur can anticipate the advisor's future offerings, we find that our key results remain directionally the same (see Proposition A.4 in the Online Appendix). The one notable difference is the simultaneous presentation of alternatives (when $\xi > \hat{\xi}$) does not occur in this setup. As explained above, in the main model, the advisor chooses the simultaneous presentation of alternatives to either encourage the entrepreneur to initiate the venture or to strategically influence them to try a specific option first, thereby enhancing the overall success rate of the venture. When the entrepreneur is aware of available solutions, she can anticipate the advisor's potential recommendation in future rounds, and therefore, the simultaneous offering is no longer needed.

Table 1. Joint Probability Distribution of Options with Correlation Factor s

	Option b is viable	Option b is not viable	
Option a is viable	$\theta_a\theta_b + s$	$\theta_a - \theta_a\theta_b - s$	θ_a
Option a is not viable	$\theta_b - \theta_a\theta_b - s$	$1 - \theta_a - \theta_b + \theta_a\theta_b + s$	$1 - \theta_a$
	θ_b	$1 - \theta_b$	1

Notes. $s \in [\underline{s}, \overline{s}] \subseteq [-1, 1]$ such that $\underline{s} \doteq \max\{-\theta_a\theta_b, (1-\theta_a)(\theta_b - 1)\}$ and $\overline{s} \doteq \min\{\theta_a, \theta_b\} - \theta_a\theta_b$. This range ensures that joint probabilities are in the unit interval.

6. Extensions

6.1. Correlation Between Options

In the main model, we considered situations where the viabilities of options are mutually independent. We now extend it to scenarios where testing one option also informs about the viability of untried options, implying a possible correlation (Adam 2001, Erat and Kavadias 2008). For instance, in positively correlated cases, failing with one option decreases the likelihood of success with another. This was the experience of Ergon, who had invented a chemical pollution control process and discovered alternative international markets for its technology (Kirtley and O'Mahony 2023). However, if Ergon's technology fails in one market, it was also likely to fail in others. Conversely, Lightbikes, an electric bicycle startup, considered negatively correlated alternative battery technologies: one solution was heavier and offered a greater range; another was lighter with a shorter range. Such trade-offs can be observed commonly in hardware-focused ventures (e.g., Hadidi et al. 2021).

To capture the dependency between options, we introduce a correlation factor s such that the viability of an option, conditional on the other option's viability, increases in s. The joint probability distribution of option a and option b can be obtained as shown in Table 1. This formulation indicates that option a and option b are positively (negatively) correlated when s is positive (negative), and there is no correlation between them when $s = 0$ (as in the main model).

Using Table 1, we obtain the updated belief about the viability of options (see details in Lemma A.7 in the Online Appendix). The next proposition characterizes the impact of the correlation factor s on the equilibrium strategies.

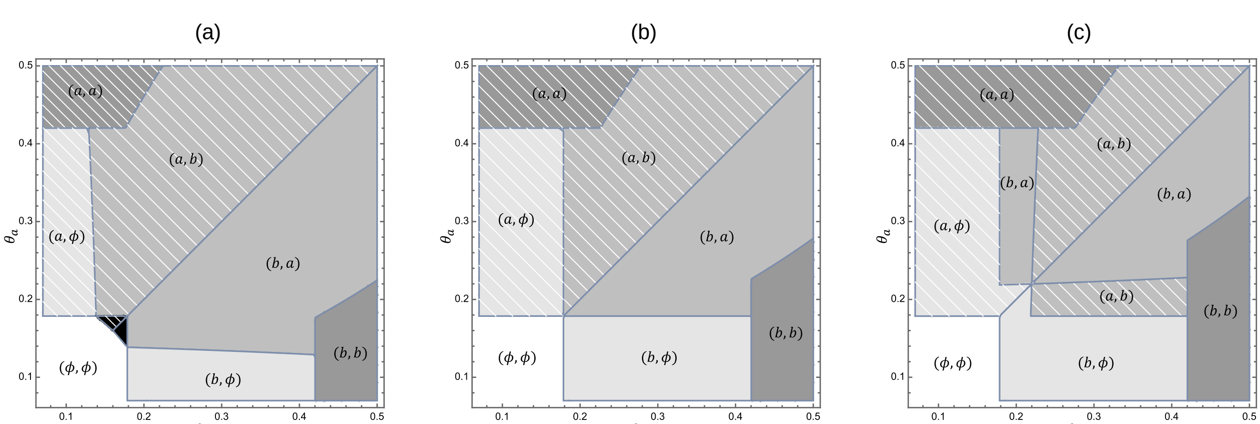
Proposition 6 (Effect of Correlation). *Suppose $\theta_a < \theta_b$. It is optimal for the advisor to recommend option b in the first round unless one of the following conditions holds:*

i. *When $s > 0$, $\tilde{\theta}_b < \theta_b < \overline{\theta}_b$, and $\dddot{\theta}_a \le \theta_a \le \ddot{\theta}_a$, it is optimal for the advisor to recommend option a in the first round and option b in the second round (if the first-round trial fails).*

ii. *When $s < 0$, $\theta_b < \dot{\theta}_b$, and $\theta_a > \dot{\theta}_a$, it is optimal for the advisor to recommend **both** options a and b in the first round.*

When options are independent, the advisor recommends the superior option first (Proposition 1). However, positive correlations ($s > 0$) may lead advisors to suggest the inferior option initially, whereas negative correlations ($s < 0$) could make it optimal to recommend both options simultaneously despite higher costs. Figure 6 illustrates these results. In the positive correlation case in Figure 6(c), the initial recommendation of the less

Figure 6. (Color online) Effect of Correlation Between Options on Equilibrium Strategies (μ_1^*, μ_2^*)



Notes. (a) Negative correlation, $s = -0.05$. (b) No correlation, $s = 0$. (c) Positive correlation, $s = 0.05$. Parameters are the same as in Figure 2. The equilibrium strategies in the black region in Figure 6(a) are $(o_1^*, o_2^*) = (\{a,b\}, \phi)$, whereas $(\mu_1^*, \mu_2^*) = (b, a)$ for $\theta_a < \theta_b$ and $(\mu_1^*, \mu_2^*) = (a, b)$ for $\theta_a \ge \theta_b$.

viable option can be seen in the (a, b) region (for instance, when $\theta_b = 0.3$ and $\theta_a = 0.2$). Why does the advisor recommend the inferior option first? In this scenario, if option b is recommended in the first round and fails, it reduces the viability of both options b and a to the extent that the entrepreneur will terminate the venture rather than trying any option in the second round. On the other hand, if the advisor recommends option a in the first round, option b will still remain viable and profitable to try despite the reduction in its updated viability. Even when the advisor incurs no recommendation cost ($c_o = 0$), this approach of initially presenting the inferior option remains optimal (see details in Lemma A.11 in the Online Appendix).

The proposition also shows that when there is a negative correlation between the two options (i.e., $s < 0$), the advisor could recommend both options simultaneously in the first round (part ii); this can be seen in the black region in Figure 6(a). Recall that if the two options were independent, it is optimal for the advisor to recommend one option in each round (Proposition 1). A comparison between Figure 6, (a) and (b) highlights the effect of negative correlation. Broadly, we observe that the negative correlation shrinks the regions in which the same option is tried twice and enlarges the regions in which the entrepreneur tries two different options over the two rounds. In scenarios where both options seem unviable, the advisor can still induce the entrepreneur to try one by recommending both. The negative correlation makes the unexplored option more appealing after a first-round failure, encouraging the entrepreneur to try both options over the two rounds while prioritizing the one with higher initial viability. Prior papers that considered the exploration of related alternatives have shown the importance of transferable learning between trials (Thomke 2001, Erat and Kavadias 2008) and the influence of organizational form (Bremner and Eisenhardt 2022). Our results in this section extend this literature by explicitly incorporating the role of the advisor in directing exploration.

6.2. Multiple Rounds: Entrepreneur's Runway

In this section, we extend our analysis by considering scenarios where the entrepreneur's runway is $N (\geq 2)$ rounds. The total number of rounds N could represent the amount of resources available for the entrepreneur (which determines the runway) or the entrepreneur's speed of conducting trials. The next proposition characterizes the equilibrium strategies in this more general setting.

Proposition 7 (Effect of Number of Rounds). *Suppose $N \geq 2$, $\theta_a < \theta_b$ and $c_g = 0$. There exist thresholds n_a and n_b (with $n_a + n_b \leq N$) such that*

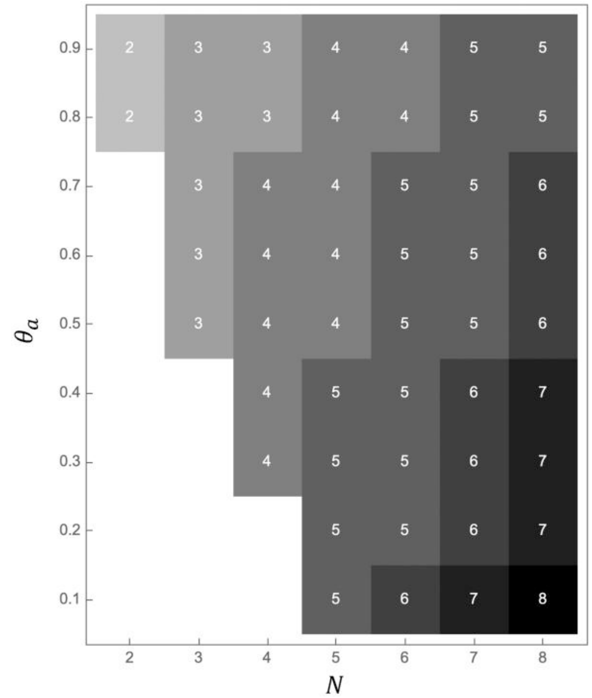
i. *It is optimal for the advisor (entrepreneur) to recommend (try) option b in the first round (in rounds $t = 1, \ldots, n_b$) and to recommend (try) option a in round $n_b + 1$ (in rounds $t = n_b + 1, \ldots, n_b + n_a$).*

ii. *The thresholds n_a and n_b are nondecreasing in N.*

iii. *If $n_a + n_b < N$, then the venture is terminated at the end of round $n_a + n_b$ if all trials fail.*

Proposition 7 generalizes the results from Proposition 1 while recommending additional insights about how the length of the startup's runway influences the recommendation of alternatives. First, in line with Proposition 1, we find that it is optimal for the advisor to recommend the option with a greater probability of success in the first round; indeed, more generally, the more viable option is tried repeatedly in several early rounds. Proposition 7 also recommends a structural generalization of the advisor's decision on when to recommend the alternative solution. This decision is driven by a trade-off for the advisor: while delaying the recommendation of the alternative reduces the expected recommending costs for the advisor, delaying the alternative (in the face of repeated failures of the first option) also decreases the overall probability of finding a viable solution. The influence of the decision horizon on the balance between these two forces can be observed in Figure 7, where we vary the viability of option a and the total number of rounds N. The

Figure 7. When to Recommend the Second Option? Effect of Runway (N)



Notes. The numbers on the plot represent the equilibrium round where the advisor (entrepreneur) recommends (starts trying) the alternative option a (i.e., round $n_b + 1$). Parameters are the same as in Figure 2, with $c_g = 0$ and $\theta_b = 0.9$.

Table 2. An Example of Recommending Alternatives in Equilibrium Strategies for $N = 6$

Round	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
Updated θ_b	0.90	0.73	0.45	0.20	0.20	0.20
Updated θ_a	0.80	0.80	0.80	0.80	0.55	0.26
Advisor recommendation (o_t)	$\boldsymbol{b}$	ϕ	ϕ	$\boldsymbol{a}$	ϕ	ϕ
Entrepreneur choice (μ_t)	b	b	b	a	a	a

Note. Parameters are the same as in Figure 7 with $\theta_a = 0.8$ and $N = 6$.

number in each cell of the figure illustrates the optimal round in which the advisor should recommend the alternative option (i.e., round $n_b + 1$, as specified in Proposition 7). It can be seen that the advisor tends to recommend the alternative earlier when the horizon is shorter. Further, for any length of the horizon N, when the prior viability of option a (θ_a) is larger, the advisor should recommend the alternative earlier, as trying it over a larger number of rounds is valuable to both the advisor and the entrepreneur.

Closer inspection of the results reveals that it could be optimal for advisors to nudge entrepreneurs to persist in the face of repeated failures. The advisor accomplishes this by withholding the recommendation of an alternative even after multiple failures reduce the viability of the first option. As an extreme but not uncommon example, consider Table 2, which shows the optimal recommendations by the advisor along with the updated viability levels of different options (on the equilibrium path). After the first-round trial (and failure) of option b, its viability θ_b^1 is 0.73, which is already lower than the prior viability of option a ($\theta_a = 0.8$), yet the advisor withholds option a. Remarkably, even in the third round—after option b's viability has fallen to 0.45 after two successive failures—the advisor abstains from recommending option a. A key driver in this example is the relatively low execution capability of the entrepreneur, which reduces the likelihood that the alternative's trial will be successful. However, when the entrepreneur's execution capability (γ) is high or the entrepreneur's cost-benefit ratio (i.e., $\frac{c}{U-f-v_k}$) is high, the advisor tends to recommend the alternative option earlier to ensure that the entrepreneur continues the venture.

7. Conclusions

The journey of an entrepreneur is seldom smooth and linear. The narrow expertise of founders and the novelty of pursuits combine to produce obstacles that they may not have the ability to solve themselves. When an entrepreneur encounters an emergent issue, she seeks the expertise of an external advisor who can identify candidate solutions. Advisors have been instrumental in accelerating the resolution of entrepreneurial challenges in a variety of domains, including technology selection, product development, human resources, and business model optimization. While the number and impact of advisors have grown with the growth in entrepreneurial activity itself, management research has not paid attention to a critical question in the advisor-entrepreneur relationship: how should the advisor present alternatives to the entrepreneur?

We explore this question through a stylized model of an advisor deciding how to recommend solutions to an entrepreneur seeking to solve a problem before her runway ends. The potential solutions vary in viability and trial cost. If a trial of a solution fails, the belief about the solution's viability is updated. The advisor decides which alternative to recommend to the entrepreneur at any juncture, but the entrepreneur chooses which alternative to try and when to terminate if unsuccessful. Our model yields insights both for advisors and entrepreneurs in such settings.

Advisors should strategically recommend alternatives based on the entrepreneur's execution capability, trial costs, runway, and the characteristics of potential alternatives. While intuition suggests that recommending the more viable option first is preferable, there are several circumstances in which this approach would be suboptimal. For instance, when trial costs vary significantly or the entrepreneur can improve her capability through experience, the advisor may find it optimal to recommend inferior solutions first as a way to motivate and sustain the entrepreneur's exploration over time and across solutions. In addition, there are situations where the advisor finds it optimal to recommend multiple solutions simultaneously (e.g., when there is correlation between alternatives).

For entrepreneurs, our findings reveal new dimensions of value from an operational standpoint. We find that advisors tend to recommend more alternatives to startups with greater capability. Before engaging the advisor, entrepreneurs may invest in a more robust team, develop execution skills, or demonstrate greater commitment to the process to improve their operational capability. Entrepreneurs can also improve the odds of finding a successful solution from the advisor by improving their capability during the project. Beyond improving the probability of subsequent trials succeeding, capability improvement also increases the advisor's willingness to introduce new alternatives to the entrepreneur. Our analysis also suggests that entrepreneurs should approach advisors earlier, when their runway is longer, as this would increase both the number of alternatives recommended and the number of trials. In sum, entrepreneurs benefit more from their engagement with advisors when they are more prepared and proactive in seeking advice.

Our results may also be valuable for accelerators, incubators, venture capitalists, and educational institutions, which actively bring entrepreneurs in contact with advisors. These possibilities also suggest several opportunities for future research to extend our model and analysis. First, we believe our general framework can be applied, with suitable modifications, to situations in which entrepreneurs work with multiple advisors. Second, although our work focuses on driving first-order insights on the recommendation of alternatives, future research can explore other operational aspects of entrepreneurship, such as time and resource management, pivoting strategies, and professional development. Finally, the structural insights from this paper can be empirically tested in practical settings such as incubators and accelerators, which enable connections between advisors and entrepreneurs.

Endnotes

[1] These examples are gleaned from our in-depth engagement and conversations with founding leaders of a highly successful university startup incubator and conversations with instructors of the vaunted NSF I-Corps program. For additional information, please see https://beta.nsf.gov/funding/opportunities/innovation-corps-teams-program. The identities of these startups are disguised upon request from founders and their mentors.

[2] Our model applies well to several common entrepreneurial problem domains such as technological obstacles, manufacturing capability identification, market segment definition, etc.

[3] This is consistent with prior studies that have considered the relationship between the success probability of a project and the agents' capability (e.g., Mansfield and Brandenburg 1966, Schmidt and Porteus 2000, Bhaskaran and Ramachandran 2011).

[4] The parameter f can also capture situations where the advisor receives equity in the venture. For example, if the equity share is β, the parameters can be transformed as $f = \beta U$ and $U - f = (1 - \beta)U$.

[5] In Online Appendix A.2, we generalize this model to situations where the entrepreneur's capability improvement in the second round can vary depending on whether the entrepreneur is trying the same solution or a new solution.

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