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Opening Up but Staying Local: Insights from Partnership Formations between Established and Startup Firms

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Abstract

In this paper, we combine perspectives on organizational myopia and organizational learning to investigate how success and failure shapes the reaction of established firms to external partnering opportunities. We provide a dynamic model in which the general tendency of firms to search locally is moderated by their history of prior failure and prior success in R&D. We argue that while prior failure is important to firms? consideration of novel technological solutions, prior success can make them more receptive to solutions at an earlier stage of development. We examine potential and realized partnerships between established and startup firms for 889 emerging technological opportunities in the bio-pharmaceutical industry between 1997 and 2006 and find support for our theoretical model. The study provides insights into how established firms notice, interpret, and respond to emerging partnering opportunities and explicates the role of prior success and failure affecting different myopic tendencies in organizational search.

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OPENING UP BUT STAYING LOCAL: INSIGHTS FROM PARTNERSHIP FORMATIONS BETWEEN ESTABLISHED AND STARTUP FIRMS

An important line of inquiry within the innovation literature highlights that established firms increasingly partner with young and nascent startup firms to gain access to emerging and potentially disruptive technological solutions (e.g. Arora & Gambardella, 1994; Hagedoorn, 2002). As a result, understanding how established firms search for and recognize emerging partnering opportunities has become increasingly important (Tyler & Steensma, 1995).

It is helpful to model established firms as interpretive systems (Daft & Weick, 1984) which need to recognize and understand the technological opportunities generated by startups (Lane, Koka, & Pathak, 2006; Todorova & Durisin, 2007). Two important streams of research may inform our understanding of how established firms make sense of their environment and select emerging opportunities for partnering. The first perspective focuses on the challenges for established firms managing technological change (Henderson & Clark, 1990; Hill & Rothaermel, 2003) as the very competencies that established firms worked hard to attain may lead to myopia (Levinthal & March, 1993). Applying these ideas to emerging partnering opportunities suggests that established firms tend to search "local" (Nelson & Winter, 1982; Rosenkopf & Nerkar, 2001), as they overlook distant "places," i.e., opportunities that contain novel[1] elements of knowledge and overlook distant "times," i.e., opportunities which are distant from commercialization and immediate payoffs (Levinthal & March, 1993).

[1] Novelty can have many dimensions (Rosenkopf & McGrath, 2011). In this paper it refers to the technological ways through which firms try to solve organizational problems. A technology is novel if it represents a solution with elements of knowledge, which are new to the firm. Greater novelty indicates more elements of new knowledge, which are employed to solve a distinct problem.

A second perspective highlights that organizational actions and search are influenced by events of prior success and failure (Argote & Greve, 2007; Madsen & Desai, 2010).[2] This perspective proposes benefits associated with learning from prior success and failure but is not precise about the type of search (local or distant) such events ultimately result in. Applying these ideas to emerging partnering opportunities suggests that events of prior success and failure in solving R&D problems may inherently influence how firms notice, interpret, and respond to emerging partnering opportunities.

In this paper, we combine both perspectives and investigate how success and failure shape the reaction of established firms to external partnering opportunities which differ in their degree of technological novelty and distance to commercialization. In a first step, we investigate the "myopia" perspective to verify if established firms indeed have the tendency to "search locally" in "place" and "time." More importantly, in a second step, we examine how prior success and prior failure solving R&D problems may influence whether firms go beyond "local search" and pursue partnerships with novel elements of knowledge and opportunities, which only promise payoffs in the distant future.

Doing so, allows us to integrate both views on myopia and the role of failure and success to advance our understanding of organizational search (Greve, 2011; Nelson & Winter, 1982). We argue that firms overlook distant "places" as they narrow the range of technological alternatives considered feasible for partnering to those in the neighbourhood of already pursued technological solutions. To recognize partnering opportunities with novel elements of knowledge, established firms need to consider a broader range of possible technological alternatives (Gavetti, 2012), which we argue is contingent on their history of prior success and

[2] Failure and success in this study relate to events in R&D, which are rare and substantially shape the organizational context as they lead to situations of crisis (failure) or long term commercial success (Lampel, Shamsie, & Shapira, 2009; Rerup, 2009).

failure. While prior failure challenges the established firm's conventional ways of problem solving and allows them to pursue novel elements of knowledge (Cyert & March, 1963; Jansen, Van Den Bosch, & Volberda, 2005), prior success may reinforce existing representations of how problems should be solved and guide firms to pursue partnering opportunities in the neighbourhood of previous attempts (Audia, Locke, & Smith, 2000).

Firms overlook distant "times" as they build commercialization routines leading to preferences for opportunities with immediate payoffs (March, 1991). To recognize partnering opportunities that are more distant from commercialization, established firms must be willing to forgo short term for potential long term gains, which we again suggest is shaped by the firm's history of prior failure and success. Namely, prior success may generate an organizational context in which established firms more readily consider a long term perspective, allowing them to pursue partnering opportunities with a more distant payoff time horizon. Conversely, a history of prior failure leads firms to search problemistically (Cyert & March, 1963), i.e., seeking solutions closer to commercialization. Our arguments hence suggest that prior failure and success very differently shape a firm's receptivity towards solutions containing novel elements of knowledge and solutions with long term payoffs.

The context for the study is the global pharmaceutical industry during the period from 1997 to 2006. We assemble a unique dataset that includes information on established firms' internal R&D and external partnering in product development. We examine partnership formations between established firms and new biotechnology firms (henceforth, startups). Within this industry, established firms increasingly rely on startups to generate new technological solutions and then form partnerships with them to develop new products (Arora & Gambardella, 1994). We identify 889 unique startup partnering opportunities between 1997 and 2006 that

could have been pursued by established firms and then examine the partnerships which were ultimately concluded. Our analysis is conducted on the dyadic level between the established firm with a history of solving a range of therapeutic problems (e.g., cancer, neurology) including successes and failures and startups offering new technological solutions in these therapeutic areas.

Consistent with our arguments, we find that, given a range of partnering opportunities, established firms tend to search locally, as they overlook distant "places" (novel technological solutions) and distant "times" (early stage technological solutions). However, once we take into account the firms' histories of prior success and prior failure, the tendency to search locally does not always hold. Our results account for unobserved differences across firms and changes over time, and are robust to a number of alternative econometric specifications and operationalization of key variables.

The study is a first attempt to systematically identify the reaction of established firms to emerging technological opportunities by explicitly taking into account forces of myopia as well as prior success and prior failure. While scholars have identified the tendency of firms to remain local in their selection of partnering opportunities (Rothaermel & Boeker, 2008), they at most have focused on search for novel elements of knowledge ("spatial myopia") but did not explicitly consider the time dimension (distance to commercialization) and have only started to explicate the roles of prior success and prior failure as important boundary conditions (Greve, 2011).

We demonstrate that when opening up to external startups, established firms follow local patterns but, at the same time, explicate the role prior failure and success to clarify when firms are more likely to pursue distant partnering opportunities. We hence contribute to research which has attempted to identify the organizational antecedents necessary to overcome the myopic

challenges when recognizing and seizing knowledge located outside the firm (Cohen & Levinthal, 1990; Jansen et al., 2005).

The findings from the study also inform the literature on the role of learning from failure and the related idea of problemistic search (Greve, 2011; Madsen & Desai, 2010). We illuminate that failure plays an important role in shaping search direction but has a different effect on the two types of myopia. This helps resolve conflicting arguments that failure leads to both local and distant search in form of "experimentation, change, and innovation" (Levinthal & March, 1993:105). In a similar vein, the study contributes to our understanding of how prior success influences firm behaviour. While some researchers have suggested that success may lead to strategic persistence and can actually trap firms (Audia et al., 2000), we do not find this perspective to be supported. Conversely, the paper reveals that prior events of success may enable firms to consider solutions more distant from commercialization.

THEORY AND HYPOTHESES

Recognizing Partnering Opportunities & Local Search

Established firms increasingly cross organizational boundaries and access new and potentially disruptive technological opportunities by forming partnerships (Hagedoorn, 1993, 2002; Rothaermel & Deeds, 2004). Startups, i.e., young and nascent firms, have taken an important role in the generation of new ideas are believed to substantially push technological change forward (Foster, 1986; Rothaermel, 2001). The result is that in some industries, a division of innovative labor has emerged, in which startups come up with new innovative solutions and then partner with established firms with the complementary assets to develop and commercialize the startups' technologies. (Arora & Gambardella, 1994).

Before established firms can pursue any partnership, they, in an initial step, need to recognize and understand the startup's potentially valuable external technological opportunities (Lane et al., 2006; Todorova & Durisin, 2007). This, however, may be challenging as the interpretation of external information may be subject to organizational myopia, which inhibits firms from pursuing distinct types of technological solutions (Levinthal & March, 1993). Following studies on organizational myopia, we next examine challenges associated with a) overlooking distant "places" (spatial myopia) and b) overlooking distant "times" (temporal myopia), which we apply to the recognition of technological partnering opportunities by established firms.

Overlooking distant places: It is well-known that firms' internal R&D attempts tend to be in the neighborhood and are local to what they already know (Lane & Lubatkin, 1998; Leonard-Barton, 1992; Nelson & Winter, 1982). In a similar vein, firms may not consider technological solutions that are distant to their prior ways of solving problems when evaluating a range of partnering opportunities.

Over time, organizations build distinct competencies, which shape their fundamental cause-and-effect representations of how problems and solutions are interrelated (Fleming & Sorenson, 2004; Lei, Hitt, & Bettis, 1996). While this facilitates the recognition of partnering opportunities close to prior technological solutions, it, at the same time, makes it challenging to identify "distant places," i.e., partnering opportunities with elements of knowledge novel to the established firms (Levinthal & March, 1993; Todorova & Durisin, 2007). First, partnering opportunities that try to solve problems in different ways may not be recognized by established firms as they do not conform to the current logics of problem-solving (Prahalad & Bettis, 1986; Winter, 2000). Firms often define ex ante what technological solutions are considered feasible,

which is guided by their internal preferences in solving problems (Dijksterhuis, Van den Bosch, & Volberda, 1999). Once firms direct their attention and position their "radars" (e.g., those employees responsible for providing information about new technologies to the firm) towards a subset of solutions in the external environment, they are constrained from considering technological solutions that depart from the agreed subset of possible alternatives (Jansen et al., 2005; Monteiro, 2011).

Second, firms consist of coalitions with different interests who compete for power and control over scarce resources (Bower, 1970; Pfeffer, 1992; Reitzig & Sorenson, 2012). The effect of firm coalitions' power generally remains salient once firms cross organizational boundaries. This may lead firms to not consider partnering opportunities which do not support and reinforce previous internal R&D attempts (Jansen et al., 2005; Todorova & Durisin, 2007). In the extreme case, organizational coalitions may active resist to novel technological solutions, in particular if they are perceived to render internal competencies obsolete (Hill & Rothaermel, 2003). Combining those arguments, we expect myopia to be salient in partnership formations as firms overlook those opportunities with novel elements of knowledge.

Hypothesis 1: The likelihood of an established firm forming a partnership with a new startup decreases with the novelty of the *startup's* technological solutions to the established firm.

Overlooking Distant Times: A general tendency of firms is to prefer short term over future gains (March, 1991). Applying the idea to the recognition of emerging technological opportunities suggests that firms may prefer opportunities closer to commercialization, while overlooking opportunities which are at an early stage of development.

Over time, established firms invest substantially in complementary assets and build highly structured competences and routines to develop and commercialize new products (Nelson

& Winter, 1982; Teece, 1986). Simultaneously, aging and larger firms gradually shift their emphasis from future- (exploration) to short term-oriented gains in the form of exploitation as the existence of complementary assets (e.g., a large sales force) allows established firms to effectively create immediate value (March, 1991). Accordingly, researchers have suggested that as a general industry pattern, partnerships with more immediate payoffs will be more prevalent than those that require more time to generate value (Koza & Lewin, 1998). A technology at an early stage of development is associated with high uncertainties, which stem from doubts about the technology per se and the technology's lack of validation in commercial markets (Ahuja & Morris Lampert, 2001). Moreover, early stage technologies have not yet revealed how well they will fit existing commercialization routines, which increases potential adaptation costs for established firms. Given the distinguished competencies and routines of established firms in commercializing new products (Gilbert, 2005), established firms may prefer those partnering opportunities which can be readily converted into immediate returns. At the same time, internal coalitions may prefer immediate payoffs and lower risks to maintain and strengthen their positions of power as evidenced by top management preferences of short over long term gains (Sanchez, 1995; Tyler & Steensma, 1995).

Combining all arguments, established firms exposed to a range of external partnering opportunities may overlook "distant times," i.e., they do not consider partnering opportunities which are far from commercialization. While extant research has not tested this relationship explicitly, there is evidence that established firms at least pay more attention to those solutions which are already commercialized and have proven track records (Monteiro, 2011). We follow this argument and suggest that firms may shy away from partnering opportunities with outcomes distant in "time."

Hypothesis 2: The likelihood of an established firm forming a partnership with a new startup decreases the more distant the *startup's* technological solutions are from commercialization.

Firms that overlook novel technological solutions may be confined to pursuing technological solutions similar to their own internal problem-solving attempts but miss technological solutions that can be disruptive and render the firm's existing competences obsolete (Gavetti, 2012; Tushman & Anderson, 1986). In a similar vein, recognizing technological opportunities early allows firms to have first mover advantages and avoid substantial premiums paid at later stage of development due to the increased bargaining power of the technology supplier (Adegbesan & Higgins, 2011; Rothaermel & Boeker, 2008). It is hence important to understand when firms pursue more local technological solutions and when they become more receptive to opportunities with novel and early stage technologies. We suggest that it is important to consider a firm's history of success and failure as possible contingency, as events of failures and successes have been suggested to shape the direction of organizational search (Argote & Miron-Spektor, 2011; Greve, 2011; Madsen & Desai, 2010). We hence next explore prior success and failure as important boundary conditions for the types of solutions established firms ultimately pursue in partnering.

Failure, Success and Local Search

Extant research highlights the role of experiencing failure and success as important drivers affecting organizational change, risk taking and learning (Argote & Miron-Spektor, 2011; Cyert & March, 1963; Greve, 2003). In a similar vein, prior failure and success may influence how firms interpret and make sense of emerging external partnering opportunities.

Motivated by the behavioral theory of the firm and research on organizational learning , researchers have shown that organizational actions may be differently affected by events of prior failure and success (Baum & Dahlin, 2007; Madsen & Desai, 2010). In the R&D context, firms make substantial financial and organizational investments and develop expectations about the likelihood that their R&D initiatives will succeed. Ultimatelly, this leads to events of failure and success as R&D initiatives, in which the firms have committed substantial resources either fail or lead to to new marketable products. We argue that distinguishing events of success and failure helps us understand a firm's tendency to overlook distant "places" and "times" when it chooses among a range of partnering opportunities. The idea follows previous research on events of successes and failurees and is connected to the idea of performance feedback, which affects organizational learning (Madsen & Desai, 2010; Shepherd, Patzelt, & Wolfe, 2011), R&D search intensity (Chen & Miller, 2007; Greve, 2003) and organizational risk-taking (Audia & Greve, 2006; Greve, 2011). We extend this perspective to the direction of technological search and highlight that a firm's history of prior failure and success differentially shapes the likelihood of partnership formations for opportunitiies with novel elements of knowledge and opportunities which are distant from commercialization.

Failure, Success and Distant Places: Organizational knowledge is not static as firms continuously rely on prior experiences to draw new inferences from previous problem solving attempts (Cyert & March, 1963). Prior failure and prior success may differentially influence a firm's willingness to pursue partnering opportunities with novel technological solutions.

Researchers have long argued that a firm's perception of the external environment may be shaped by events that force it to react to given stimuli (Zahra & George, 2002). Experiencing failure in internal problem-solving attempts may serve as such a stimulus and most likely

broadens the range of alternative solutions established firms consider feasible when searching among partnering opportunities. First, a history of failure serves as an impetus for established firms to re-evaluate their conventional technological solutions and challenges their current logic of how problems and solutions are interrelated (Jansen et al., 2005; Lampel et al., 2009). Prior failure hence increases the range of possible alternatives considered to solve R&D problems (Cyert & March, 1963; Madsen & Desai, 2010), which in turn increases the likelihood that firms will form partnerships for more distant startups opportunities. At the same time, startups developing solutions that are similar to those of the established firm may become less attractive, as established firms may not wish to pursue solutions that are close to those, which have previously failed. Conversely, prior success may reinforce existing representations of cause and effect and further push firms onto paths of local search, further "overlooking" distant places (Audia et al., 2000; Lant, Milliken, & Batra, 1992; Prahalad & Bettis, 1986). This follows the idea that prior success does not challenge existing assumptions, limiting the variety of information processed by the firm (Lant & Montgomery, 1987).

Second, failure and success alter the power structure within the firm and the units associated with pursuing partnering opportunities in different ways. A history of failure mitigates the risk that internal coalitions will use external partnering to merely reinforce their previous commitments in R&D. Extant research has shown that failure puts substantial pressure on the firm from external stakeholders (Salancik & Pfeffer, 1978). Applied to the R&D context, failure compels internal coalitions to change direction in the types of solutions used to solve problems. It is also more likely that failure alters a firm's internal power structure, which directly affects the resource allocation process in such a way that internal coalitions cannot use external initiatives as a mere extension of internal R&D activities. Conversely, prior success strengthens

the power structure of units within the firm (Levinthal & March, 1993), increasing their discretion to allocate resources to partnering opportunities which reinforce their existing R&D paths. Put differently, although success may allow coalitions to have greater discretion about potential resource allocations (Greve, 2003; Levinthal & March, 1981), it is most likely that these resources are directed towards initiatives that are in the neighborhood of existing R&D attempts.

Taken together, our arguments suggest that when exposed to a range of possible partnering opportunities, established firms are more likely to seek technological solutions with novel elements of knowledge if the firm has a history of failure in their own R&D attempts. Conversely, a history of success may narrow the range of opportunities considered feasible and lead firms to increasingly search locally.

Hypothesis 3a: *An established firm's* prior failure to solve R&D problems positively moderates the relationship between the novelty of the *startup's* technological solutions and the likelihood of forming a partnership with the startup.

Hypothesis 3b: *An established firm's* prior success in solving R&D problems negatively moderates the relationship between the novelty of the *startup's* technological solutions and the likelihood of forming a partnership with the startup.

Failure, Success and Distant Times: Prior failure and success may very differently affect the established firm's receptivity towards partnering opportunities that are distant in time, i.e., are at an early stage of development.

We identified that prior failure induce established firms to pursue partnering opportunities with novel elements of knowledge to change direction. At the same time, however, several reasons indicate that prior failure may intensify myopic tendencies towards solutions at an early stage of development. First, a history failure may create a sense of urgency, when evaluating partnering opportunities. Extant research has suggested that firms facing crisis and

situations of failures try to avoid the repetition of this experience in subsequent attempts (Madsen & Desai, 2010). While this implied pursuing novel ways of solving problems, it, at the same time, suggests firms with a history of failure pursue partnering opportunities, which have a higher likelihood of success exemplified by technologies closer to commercialization. The idea resonates with the observation that when experiencing crisis firms sometimes limit the range of information processed towards those, which have immediate performance outcomes (Staw, Sandelands, & Dutton, 1981) and the fact that firms confronted with problems search "problemistically", i.e. motivated towards specific solutions (Cyert & March, 1992:170). Given the long time lags in innovation, partnering opportunities that are distant from commercialization may not be considered as feasible alternatives when firms have a history of failure, as such opportunities do not promise immediate payoffs.

In a similar vein, coalitions with a history of failure may be dominated by efficiency concerns (Staw et al., 1981) to seek technological opportunities which can be easily integrated, provide immediate results and hence have a lower risk to undermine further the coalition's power. The result is that firms with a history of failures may actively avoid opportunities distant from commercialization because they do not want to be accountable for decisions, which will not have an immediate impact on the firm's top and bottom line and potentially lead to another failure.

A history of prior success may quite differently shape a firm's willingness to take a long-term approach when considering a range of possible partnering opportunities (Levinthal & March, 1981). It is well known that prior success leads to confidence in firms about their existing routines and ways of solving problems and helps firms specialize in problems solving (Audia et al., 2000). This allows firms to more clearly understand specific problems and apply

their knowledge towards partnering opportunities, which are more uncertain as they are distant to commercialization (Kim, Kim, & Miner, 2009). Moreover, a history of success allows firms to attend to a broader time horizon in general as they face less urgency to address specific problems. The result is that with a history of prior success, firms may more readily invest long term initiatives. In a similar vein, extant research has suggested that prior success may be an antecedent of exploration (Greve, 2007).

Firm coalitions, which have experienced a history of success also find it easier to take accountability for decisions, which will not have an immediate performance outcomes as they are less pressured towards efficiency (Staw et al., 1981). This resonates with Cyert and March's (1992:189) suggestion that "success tends to breed slack", which acts as a buffer for "risky" decisions. Taking all of these arguments together, we posit that failure and success have opposite predictions in influencing the relationship of early stage partnering opportunities of startups and the likelihood that established firms pursue them in form of partnerships.

Hypothesis 4a: *An established firm's* prior failure to solve R&D problems negatively moderates the relationship between the distance from commercialization of the *startup's* technological solutions and the likelihood of forming a partnership with the startup.

Hypothesis 4b: *An established firm's* prior success in solving R&D problems positively moderates the relationship between the distance from commercialization of the *startup's* technological solutions and the likelihood of forming a partnership with the startup.

METHODS

Background - Partnerships in the Bio-Pharmaceutical Industry

To test our hypotheses, it is mandatory to identify a range of partnering opportunities which established firms could pursue as well as capture those partnerships which were ultimately formed. Both types are observable in the bio-pharmaceutical industry in the form of compounds,

representing technological solutions.[3] Partnering opportunities represent solutions to distinct therapeutic problems, which allows us to capture an established firm's prior experience, failure and success in the therapeutic problems areas addressed by the startup firms. The bio-pharmceutical industry also is characterized by very frequent partnership formations (Powell, Koput, & Smith-Doerr, 1996) as startups rely on established firms to move their innovations downstream in the value chain (Arora & Gambardella, 1994; Rothaermel & Deeds, 2004). Our data comes from various sources, including Recombinant Capital (ReCap- partnerships), Pharmaprojects (drug development) and Adis R&D Insights (drug development) .

Sample

Our sample includes the top 40 publicly traded pharmaceutical firms (by sales in 1997), which were actively pursuing new drug development[4] and, which we assume are searching for new technologies through partnerships. They include established pharmaceutical firms (e.g., Merck & Co. and Pfizer) as well as three biotechnology firms with established product portfolios (Amgen, Chiron, and Genentech) and average revenues of $11.4BN during 1997-2006.

In an initial step, we identify opportunities for partnering by observing realized partnerships in preclinical trials (clinical development candidate selection and investigation of a new drug preparation), Phase 1 trials (evaluation of drug stability, side effects and dosage), Phase 2 trials (drug's efficacy) and Phase 3 trials (large scale clinical testing) between established and new startup firms.[5] We limit ourselves to these stages as startups have usually filed patents and signalled their intent to further develop their technologies through partnering.

[3] These treatments can be chemically (small-molecule) or biologically based (e.g., protein, viral vector, etc.).

[4] Active drug development is measured as new compounds in development in Pharmaprojects in 1997. This way, we exclude firms only pursuing generic drugs, formulation technology or diagnostics.

[5] We define startups as those firms founded in or after 1985 (during the biotechnology revolution) which did not yet have a commercialized product on the market 1997.

Linking information from Recap (partnerships) to Pharmaprojects (drug development projects), we identify 471 partnerships (preclinical - Phase 3) between the established firm and a startup was formed between 1997 and 2006.[6] We consider these 471 observations as partnering opportunities for all established firms a year before the actual partnership was realized. The 471 partnering opportunities belong to 348 new startups' partners. To complement these realized partnering opportunities, we examined in which years, between and inclusive of 1997 to 2007, the 348 startups had technologies (i.e., compounds) available for partnering. By tracking the pipelines of the small startups and determining if any compounds of the firms were flagged as a "Licensing Opportunity" in Pharmaprojects, we identified an additional 446 partnering opportunities by startups representing years in which compounds became available by the startup but were not pursued by any of the established firms in the sample. We made the assumption that each established firm could observe and evaluate all 889[7] possible partnering opportunities leading to 35,560 possible combinations between startups and established firms between 1997 and 2006.[8]

Measures

Dependent Variable:

Partnership Formed – We code the dependent variable as a binary variable taking the value 1 if an established firm did form a partnership with a new startup firm, which had partnering opportunities (preclinical-Phase 3) available in the prior year and 0 otherwise.

[6] The 471 partnerships include 443 unique startup-established firm years and 28 observations in which a startup partnered with more than one established firm.

[7] 443 opportunities (pursued by at least one established firm) plus 446 opportunities (pursued by none of the Top 40 firms).

[8] Established firms merge (e.g., Aventis and Sanofi-Synthelabo; Bayer and Schering AG) so that not all 40 initial firms are active in all years, reducing the final sample.

Independent Variables:

Novelty of partnering opportunity: To arrive at a measure for Novelty, we compare partnering opportunities available from new startups to the recent and ongoing drug development of the established pharmaceutical firms (see Table 2). We take into consideration fine-grained product development using Pharmaprojects and examine over 6500 internal R&D projects pursued by established firms between 1993 and 2006. We extract the therapeutic area (13 broad categories in total, e.g., dermatology, cancer), the underlying material of the solution and the mechanism of action.

[Insert Table 2 about here]

The origin of material gives a broad distinction as to whether the drug development project is based on chemistry (small-molecule), biology (e.g., a protein or viral vector) or if the compound is derived from a natural product and is available from Pharmaprojects. The mechanism of action classifies the pharmacological effect through which the drug may have an effect in the human body and is available in Pharmaprojects. We employed a consulting firm to assess which mechanism of action codes in Pharmaprojects can be further aggregated. A pharmacology expert with 26 years in drug development and a biotechnology graduate student did the classification separately.[9] We consider both elements: origin of material and mechanism of action as pockets of specialized knowledge which are embedded in a technology (Lane & Lubatkin, 1998), and then compare a partnering opportunity to the prior development by the established firm in the same therapeutic area. The prior experience of established firm is based on a 4 year window of projects in development and Table 2 shows how the variable is constructed for a specific startup-established firm combination. Novelty takes scores between 0

[9] We report our results based on the classification by the consulting firm. The conversion table from the Pharmaceutical consultant can be downloaded under : http://bit.ly/12SHdto

and 2, with 0 indicating that the established firm has used the same mechanism and origin of material in the broad therapeutic domain and a value of 2 if the startup's technological opportunity uses a mechanism and origin of material previously not used by the established firm in the broad therapeutic area. Whenever we identify more than one compound available for partnering by a startup in a given year, we average the novelty score as illustrated in the example in Table 1.

[Insert Table 1 about here]

Distance of partnering opportunity to Commercialization: We capture the Distance to Commercialization by examining in which stage of the bio-pharmaceutical drug approval process the compound was at the time it became available for partnering. We distinguish the stages as being preclinical (0), phase I (1), phase II (2) and phase III (3). For a startup having more than one compound available for partnering, we select the latest stage of all available compounds.[10] The variable Distance to Commercialization is reverse coded, so that phase III opportunities receive lower scores (0) and preclinical opportunities receive higher scores (3).

Moderators:

Prior Failure and Success: Using the history of drug development for each established firm, we determine if firms have experienced late stage failure or success in the broad therapeutic area of the technological opportunity (see Table 2). Given that most attempts in R&D are ultimately abandoned, we adopt the perspective that failure can be defined as discontinued product development attempts, in which the firm committed substantial resources and time (Girotra, Terwiesch, & Ulrich, 2010). These commitments are particularly large once bio-pharmaceutical firms start efficacy and large scale clinical testing, which is at Phase 2 and Phase

[10] Results are robust using the average stage.

3 of the drug development process. At this stage firms also start to build expectations of success, which when not met result in experiences of failure (DiMasi, Hansen, & Grabowski, 2003; Shepherd et al., 2011). We use a window of four years (Diestre & Rajagopalan, 2012) and count the number of Phase 2 and Phase 3 failures within the broad therapeutic area of the partnering opportunity to generate the variable Prior Failure. In a similar vein, we count the number of successful drugs (Prior Success) launched in the last 4 years in the therapeutic area addressed by the startup's technological solutions (see Table 2). We only consider successes when we have an indication of an initial approval in either the US, Europe or Japan. When a startup had technological opportunities spanning more than one broad therapeutic area, we average the number of failures and successes per compound to calculate an overall score indicating the average Prior Success and Prior Failure by the established firms in the therapeutic domains address by the startup.

Controls:

We control for various factors which could drive partnering formation. First, we add the variable Compounds Available as the number of compounds that we identified as being available from a startup in a given year. We also generate several dyadic measures between established firm and startup. We use ReCap to capture partnerships within the same research community, which we defined by the broad therapeutic areas (e.g., cancer) of the new startup firm. Prior research indicates that being part of a network and research community may affect subsequent partnering behavior (Gulati, 1999). ReCap indicates the therapeutic area in the "disease" field, by which we could classify them to one of the broad 13 therapeutic areas. Partnerships is a count of all agreements in the past four years in the same therapeutic area. While the startup are all young firms and do not have a large history of partnering with established firms, we still control

through an indicator variable if the established firm and the startup had a previous partnership (Prior Partnerships). We capture geographic differences between startups and established firms by adding the indicator variable Same Country, which is 1 if firms have their HQ in the same country. Finally, we also examine the overlap of knowledge on the technical level between the startup and the established firm. Following prior research, we proxy the general relatedness between the established firm and NBFs knowledge basis through their overlap in patenting activity (Diestre & Rajagopalan, 2012). Patenting information (e.g., IPC codes) cover some of the basic knowledge associated with a broad range of compounds (e.g., its ring structure) but do not contain specific information, for example, that which concerns Mechanism of Action. We use the method suggested by Sampson (2007) to calculate the technological proximity based on patents between two firms (i and j). The distribution of knowledge is captured by a multidimensional vector $F_i = (F_i^1 \dots F_i^s)$, where F_i^s represents the number of patents assigned to firm i in patent class s. Elementary knowledge overlap between established firm i and startup j is defined as:

$$Elementary\ Knowledge\ Overlap = \frac{F_i F_j'}{\sqrt{(F_i F_j')(F_i F_j')}}$$

The variable is 1, when firms are identical in their patenting (strong overlap) and 0 if they are completely orthogonal (no overlap).

We also control for the overall activity of an established firm in the therapeutic domains addressed by the technological opportunities of the startup. First, we control for the total number of compounds established firms initiated in the past four years. The variable New Projects is a count of new project initiated in the therapeutic domains of the partnering opportunity. We also consider if the established firm has a history addressing the same indication in a broad

therapeutic area (e.g., Alzheimer's as subcategory within neurogenerative diseases). The variable Prior Indication is 1 if the firm has already had projects addressing this indication and 0 if not. We also control for a firm's general tendency to experiment. Experimental Orientation relies on the history of drug development (prior 4 years) for each established firm, and counts the number of projects in which firms experimented with at least one new element of knowledge (mechanism of action or origin of material). We capture experimentation in the therapeutic areas addressed by the startup and build the variable Experimental Orientation as a ratio of projects in which firms deviated from what they already knew internally versus all projects initiated in a given therapeutic area (i.e., the variable New Projects). Experimental Orientation is a ratio which is bounded between 0 and 1. A higher score reveals greater activity of firms in experimenting with new ways of solving problems.

We proxy for the complementary assets by determining if the established firm had any Top selling drug (Top 100 Drug) in the therapeutic areas addressed by the startup (indicator variable). Additionally, we add various financial controls of the established firms and available resources. We use the Current Ratio to proxy "financial slack" by the firm in a given year, which is the ratio of its current assets divided by its current liabilities (Greve, 2003). We also include Total Assets as a proxy for the firm's size and performance in form of Return on Assets (RoA).

Empirical specification

We examine the full risk set as well as a choice-based sample with 4 control cases (unrealized in the same year) per realized partnership. Throughout our analysis, we add firm fixed effects using logistic regression analysis wherein the fixed effect is for the established firm. This means that the variation explained will be within (and not across) firms. We note that the

full risk set approach has been criticized as the total number of realized deals is low (around 1.32%) compared to the unrealized ones, which may affect standard errors (Sorenson & Stuart, 2001). We mitigate these concerns by additionally examining a choice-based sampling approach. Following the guidelines set by King and Zeng (2001), we include all partnering opportunities realized plus a small number (4) of partnering opportunities for which partnerships did not occur; recently, similar techniques have been used to study dyadic partnership formations (Mitsuhashi & Greve, 2009) or in the evaluation of partnering opportunities (Tyler & Steensma, 1995)[11]. We employ logistic regression with clustered standard errors and firm fixed effects. We verify that choice-based results are robust using the rare logit modification suggested by King and Zeng (2001). All independent variables are constructed with a lag structure. We consider a compound at risk for partnering the year before a partnership was concluded or if it was flagged as available for licensing and then observe partnering formation in the next year.

[Insert Table 2 about here]

RESULTS

Table 3 shows the summary statistics and correlation table. Examining the correlations, we do not find evidence that multicollinearity may be a cause of concern. The mean VIF for the full models is below 3.34 and individual VIFs for the independent variables and moderators are below 2.33.

[Insert Table 3 about here]

[Insert Table 4 and 5 about here]

We next examine the entire sample in Table 4 and the choice-based sample (1 realized partnering opportunity 4 unrealized) in Table 5. Model 1a/1b show the effect of the control

[11] The paper outlines various partnering scenarios, which are evaluated by all managers participating in the study.

variables on the likelihood of partnership formation. Consistent with prior research, we find that geographic proximity (Same Country) and Prior Partnering have a positive direct effect on the likelihood of forming a partnerships with a startup. Moreover, we find that established firms pursue partnerships in problem areas where they were successful in launching new drugs (Prior Success), already have experience in the therapeutic indication (Prior Indication) and have numerous compounds available for partnering. In the full sample, we find evidence that Knowledge Overlap effects partnership formation but the result does not hold in the choice-based model. Surprisingly, we do not find evidence suggesting that the overall activity in a therapeutic area (New Projects) drives partnership formation and also find no direct effect of Prior Failure.

Model 2a/2b add the Novelty and Distance to Commercialization measures of the partnering opportunity to test the two forms of myopia. As expected, Novelty has a strong negative effect on the likelihood of partnership formation (the marginal effect is equally significant at $p<0.001$ holding all other variables at their mean values). In a similar vein, the Distance to Commercialization of the partnering opportunity significantly reduces the likelihood of subsequent partnership formation.

To test Hypotheses 3a,b and 4a,b, we add interactions to the model. We start in Model 3a/3b by interacting Novelty with Prior Failure. Supporting Hypothesis 3a, we find a positive effect of the interaction, indicating that firms that have experienced failure in solving specific therapeutic problems are more likely to pursue partnering opportunities with novel elements of knowledge. We demonstrate this effect graphically in Figure 1, where we plot the moderation of Novelty at various levels of Prior Failure. Figure 1 indicates the persistent tendency of established firms to search for partnering opportunities in the neighborhood of existing solutions. We see, however, that this tendency is much less salient once firms have experienced failure and

is reversed when failure in the therapeutic areas addressed by the startup firm is at very high levels. Overall, the results provide support for Hypothesis 3a.

When interacting Novelty and Prior Success (Model 4a/4b respectively), we do not find the predicted effect. Instead of the expected negative interaction, we find a positive albeit insignificant effect. We hence do not find support for Hypothesis 3b, which suggested that a history of Prior Success would lead firms to seek technological solutions knowledge in the neighborhood of previous problem-solving attempts.

Hypotheses 4a and 4b are tested next. Models 5a/5b show the interaction of Distance to Commercialization with Prior Failure. However, we do not observe overall strong support for the theorized effect as only in the full model do we see a marginal and negative effect of the moderation of Prior Failure and Distance to Commercialization. This effect is graphically explored in Figure 2. It suggests that at high levels of Prior Failure, established firms indeed prefer partnering opportunities that are close to commercialization, giving partial support for Hypothesis 4a. We observe the opposite effect in Model 6a/6b, which examine the interaction of Distance to Commercialization and Prior Success. Namely, at higher levels of Prior Success, firms more readily pursue partnering opportunities distant to commercialization. The effect is demonstrated graphically in Figure 3 and suggests support for Hypothesis 4b.

Model 7a/7b demonstrate that all interactions that were supported individually also hold in a full model. Interestingly, these models show that when considering both interactions of Distance of Commercialization with Prior Success and Prior Failure simultaneously, we indeed find that they have the expected opposite effects on the likelihood of partnerships formations. While Prior Failure leads firms to shy away from opportunities, distant from commercialization (early stage) Prior Success has the opposite effect as firms more readily pursue early stage

solutions. Both Prior Failure and Prior Success are correlated, which could explain the result. However, their level of correlation does not cause concern in terms of multicollinearity.

Table 8 examines the marginal effects of Novelty and Distance to Commercialization at different levels of the moderators. We examine the 25^{th} and 75^{th} percentile value of Prior Failure and Prior Success, which again supports Hypotheses 3a, 3b and 4b.

[Insert Table 8 about here]

Robustness Tests: We conduct several additional checks to establish the robustness of the findings (Table 6). First, we relax the assumption that all established firms in the sample were at risk of establishing a partnership in a given year. Omitting those years in which an established firm did not pursue a partnership equally supports our results (Model R1). In a similar vein, we show that results are robust when considering a risk set which includes those partnering opportunities in which the established firms did not have any prior experience in the broad therapeutic area (R2). In model R3 (choice based sample), we exclude Biotech firms Amgen, Genentech and Chiron to demonstrate that results remain robust when we only consider established firms that traditionally focused on chemistry based drug development.

[Insert Table 7 about here]

We also operationalize our key variables in different ways. Namely, we use indicator variables for Prior Failure and Prior Success, in which failure and success are operationalized by binary variables (Models R4a and R4b). The results are very similar to using the count variables as in Tables 4 and 5. We alternatively deployed a depreciated failure and success experience in which we consider the complete drug development history (starting 1988) and deploy a discount factor of 80% each year (Model R5a, R5b). Again, results are in line with the main results. However, it is interesting to note that the significance for the Distance to

Commercialization and Prior Failure interaction in models R5a and R5b is slightly lower than before. We conducted further robustness tests operationalizing Novelty and Distance to Commercialization differently. Namely, we created indicator variables for opportunities with at least one element of new knowledge (Novelty greater than 0) and indicator to capture if a compound is before or after proof of concept, which usually is after Phase I. The results using these variables equally support our theory but with slightly lower levels of significance.

DISCUSSION

This paper examines how established firms react to emerging technological opportunities from startup firms, which are considered an important generator of innovative and often radical technological solutions. We take into account that the interpretation, recognition and pursuit of partnering opportunities is influenced by myopic tendencies, as firms tend to overlook technological solutions that are novel or only result in payoffs in the distant future. We further consider that the recognition of external opportunities may be shaped by a firm's prior success and failure. We combine both perspectives and investigate how success and failure shapes the reaction of established firms to external partnering opportunities that differ both in their degree of technological novelty to the established firm and their distance to commercialization.

Doing so, we clarify how prior failure and prior success differently shape the two forms of myopia. While prior failure generates an environment in which firms become more open to novel ways of solving problems, at the same time, it may push firms to seek partnering opportunities which promise short term payoffs. Conversely, prior success may enable firms to take the long term perspective of adding partnering opportunities with more distant payoffs. The study hence, argues for the value of integrating perspectives on myopia and local search with

studies examining events of failure, success to understanding the direction of organizational search activities (Greve, 2011; Laursen, 2012).

While recent studies have examined if failure or success have a stronger effect on organizational learning (Madsen & Desai, 2010) the insight is that prior failure and prior success cannot unambiguously be associated with a distinct search directions as they influence the various forms of myopia in different ways. For example, while failure challenges the firm's current assumptions, it simultaneously generates urgency, leading to both pursuing opportunities with novel elements of knowledge but also opportunities, with immediate payoffs. Given that we find established firms to be quite sensitive to events of failure, we can further not corroborate the idea that failures may be actually overlooked themselves as another form of myopia (Levinthal & March, 1993). We also do not find evidence that prior success "traps" organizations into local paths (Audia et al., 2000). Conversely, in our setting prior success may play a profound role in the consideration of partnering opportunities more distant from commercialization.

We also shed light on some underlying activities that may shape a firm's ability to recognize external partnering opportunities. While previous researchers have generally emphasized the importance of internal R&D per se in sensing and seizing external technological solutions (Cohen & Levinthal, 1990), we provide a more nuanced view as to how prior success and failure shape this ability. Given that firms today continue to face scrutiny of their own internal investments in R&D and are heavily penalized for failure, we argue that this study reveals that failure may actually have some benefits as it opens the firms up towards new ways of problem-solving.

The study has a number of limitations which should provide ample opportunities for future research. The study currently only considers reactions to emerging external technological

opportunities through partnering. However, established firms possess a broad variety of tools to tap into external knowledge, including acquisitions or CVC investments (Keil, Maula, Schildt, & Zahra, 2008; Nicholls-Nixon & Woo, 2003). Restricting our analysis to partnering, however, allows us to identify an unambiguous risk set of opportunities available for partnering. With an acquisition, firms gain access to the full knowledge of a startup, including all patents and prior projects – it is hence more difficult to define what really was at risk before the acquisition transaction took place. Finally, the partnerships observed in this study only constitute a subset of all partnerships in which established firms engage. In this study, we do not capture very early stage discovery partnerships or commercialization partnerships that occur when drugs are already approved. Future research may attempt to expand the study to a broader set of value chain activities.

We believe there is still a great deal to learn about how firms search for new external technological solutions and the potential role events of failure and success play shaping this relationship.

APPENDIX

Table 1: Measure Novelty Example (simplified)

Startup: ZymoGenetics 2000: 2 available compounds for partnering	Established Firm: Merck & Co (1997-2000)	Novelty score	Average Novelty Score
Compound 1: Atacicept Broad Therapy: Immunological	Merck Experience in Immunological:		
Mechanism: B-cell activating factor inhibitor	Mechanism of Action: New to Merck (1)	2	
Origin of Material: Biological-Protein, recombinant	Origin of Material: New to Merck (1)		
Indication: Immunosuppressant, Anti-Cancer	Indication: Known to Merck (0)		
Compound 2: denenicokin Broad Therapy: Cancer	Merck Experience in Cancer:		(2+1)/2=1.5
Mechanism: Interleukin 21 agonist	Origin of Material: New to Merck (1)		
Origin of Material: Biological-Protein, recombinant	Origin of Material: Known to Merck (0)	1	
Indication: Immunosuppressant, Anti-Cancer	Indication: Known to Merck (0)		

Table 2: Measure Prior Success, Prior Failure

Partnering Opportunity: Startup: ZymoGenetics in year t-1 Compound: Atacicept Stage of Development: Preclinial (IV: Distance to Commercialization)	Established Firm: Merck & Co
Broad Therapy: Immunological	Moderator: Prior Success: Count Number of Approved Drugs by Merck in Co. in broad Therapy Area Immunological between t-4 to t-1
	Moderator: Prior Failure: Count Number of Failed Drugs (PII/PIII) by Merck in Co. in Therapy Area Immunological between t-4 to t-1

Table 3: Summary Statistics and Correlation Table

	:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Partnership Formation	1.00																	
2	Startup Age	0.01	1.00																
3	Compounds Available	0.02	0.01	1.00															
4	Partnerships (TA)	0.06	0.03	-0.03	1.00														
5	Prior Tie	0.06	0.13	0.03	0.09	1.00													
6	Same Country	0.02	0.05	-0.01	0.03	0.06	1.00												
7	Overlap Knowledge	0.03	0.12	0.03	0.16	0.09	0.07	1.00											
8	New Projects (TA)	0.06	0.00	-0.05	0.66	0.09	0.00	0.15	1.00										
9	Experimentation (TA)	0.00	-0.02	0.03	-0.01	-0.01	0.01	-0.06	-0.10	1.00									
10	Prior Indication	0.04	0.01	-0.03	0.25	0.05	-0.03	0.13	0.27	0.00	1.00								
11	Top 100 Drug (TA)	0.04	0.03	0.09	0.26	0.07	0.01	0.12	0.34	-0.03	0.17	1.00							
12	Total Assets	0.04	0.07	-0.04	0.28	0.09	-0.05	-0.10	0.39	-0.04	0.24	0.35	1.00						
13	Return on Assets	0.02	-0.02	-0.01	0.11	0.03	0.08	0.01	0.20	-0.05	0.07	0.18	0.24	1.00					
14	Financial Slack	-0.02	0.00	0.01	-0.10	-0.04	0.05	0.16	-0.17	0.01	-0.07	-0.05	-0.44	-0.14	1.00				
15	Failure (TA)	0.03	-0.01	-0.02	0.30	0.04	-0.08	0.11	0.44	-0.08	0.19	0.25	0.24	0.08	-0.09	1.00			
16	Success (TA)	0.05	0.00	-0.02	0.43	0.06	0.00	0.13	0.44	-0.09	0.18	0.33	0.22	0.12	-0.06	0.21	1.00		
17	Novelty	-0.04	-0.03	0.03	-0.29	-0.07	0.01	-0.11	-0.30	-0.01	-0.27	-0.15	-0.26	-0.06	0.11	-0.18	-0.19	1.00	
18	Distance Commercialization	-0.02	-0.11	0.13	0.02	0.00	-0.02	0.02	0.01	0.00	0.01	0.03	0.01	-0.01	0.01	0.01	0.02	0.02	1.00
	mean	0.02	7.75	1.58	2.33	0.06	0.35	0.67	5.00	0.51	0.79	0.32	9.20	0.12	2.51	0.83	0.70	0.96	2.17
	sd	0.13	5.36	1.06	2.67	0.23	0.48	0.15	4.77	0.32	0.38	0.47	1.28	0.12	2.33	1.13	0.86	0.67	1.02
	min	0.00	0.00	1.00	0.00	0.00	0.00	0.07	0.75	0.00	0.00	0.00	4.40	-0.16	0.68	0.00	0.00	0.00	0.00
	max	1.00	19.00	10.00	18.00	1.00	1.00	0.97	34.00	1.00	1.00	1.00	11.73	0.38	18.39	9.00	6.00	2.00	3.00

n=28608

Table 4: Results – Logit - Full Sample – DV Partnership Formation

	(M1a)	(M2a)	(M3a)	(M4a)	(M5a)	(M6a)	(M7a)
Firm Fixed Effects	Y	Y	Y	Y	Y	Y	Y
Year Effects	Y	Y	Y	Y	Y	Y	Y
Main Therapy Area	Y	Y	Y	Y	Y	Y	Y
Startup Age	0.003	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Compounds Available	0.130***	0.157***	0.161***	0.158***	0.157***	0.162***	0.167***
	(0.039)	(0.038)	(0.038)	(0.037)	(0.038)	(0.037)	(0.037)
Partnerships (TA)	0.033	0.030	0.033	0.032	0.030	0.029	0.035
	(0.034)	(0.034)	(0.033)	(0.034)	(0.034)	(0.034)	(0.033)
Prior Tie	0.787***	0.784***	0.784***	0.785***	0.789***	0.775***	0.785***
	(0.129)	(0.129)	(0.129)	(0.129)	(0.128)	(0.129)	(0.129)
Same Country	0.447***	0.440**	0.440**	0.442**	0.441**	0.439**	0.439**
	(0.134)	(0.135)	(0.135)	(0.134)	(0.134)	(0.135)	(0.135)
Overlap Knowledge	0.850*	0.805*	0.801*	0.802*	0.795*	0.835*	0.817*
	(0.388)	(0.388)	(0.389)	(0.391)	(0.390)	(0.382)	(0.384)
New Projects (TA)	0.020	0.019	0.018	0.019	0.019	0.017	0.017
	(0.022)	(0.022)	(0.021)	(0.021)	(0.021)	(0.022)	(0.021)
Experimentation (TA)	0.188	0.175	0.155	0.166	0.174	0.180	0.154
	(0.181)	(0.180)	(0.182)	(0.180)	(0.180)	(0.179)	(0.183)
Prior Indication	0.644***	0.578***	0.545**	0.559**	0.578***	0.585***	0.547**
	(0.174)	(0.169)	(0.171)	(0.171)	(0.170)	(0.167)	(0.171)
Top 100 Drug (TA)	0.321+	0.312+	0.299+	0.304+	0.313+	0.313+	0.299+
	(0.181)	(0.179)	(0.179)	(0.177)	(0.179)	(0.179)	(0.177)
Total Assets	0.293	0.280	0.280	0.280	0.281	0.281	0.280
	(0.231)	(0.233)	(0.236)	(0.235)	(0.233)	(0.230)	(0.234)
Return on Assets	1.379	1.410	1.409	1.400	1.411	1.405	1.391
	(0.884)	(0.892)	(0.891)	(0.899)	(0.894)	(0.896)	(0.902)
Financial Slack	-0.094	-0.094	-0.092	-0.092	-0.094	-0.093	-0.090
	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)
Failure (TA)	0.009	0.004	0.065	0.004	-0.003	0.006	0.051
	(0.051)	(0.052)	(0.052)	(0.052)	(0.054)	(0.053)	(0.052)
Success (TA)	0.140*	0.136*	0.140*	0.182**	0.136*	0.141*	0.167*
	(0.069)	(0.069)	(0.067)	(0.070)	(0.069)	(0.065)	(0.066)
Novelty		-0.228**	-0.292***	-0.260***	-0.226**	-0.232**	-0.305***
		(0.076)	(0.075)	(0.071)	(0.076)	(0.076)	(0.074)
Distance Commercialization		-0.171***	-0.174***	-0.172***	-0.151**	-0.215***	-0.190***
		(0.050)	(0.050)	(0.050)	(0.052)	(0.054)	(0.055)
Novelty X Failure			0.165***				0.160**
			(0.047)				(0.050)
Novelty X Success				0.073			0.046
				(0.071)			(0.073)
Distance Comm. x Failure					-0.054+		-0.079*
					(0.030)		(0.032)
Distance Comm. x Success						0.124**	0.149***
						(0.042)	(0.044)
Constant	-9.146***	-8.973***	-8.951***	-8.972***	-8.973***	-9.021***	-8.989***
	(2.445)	(2.469)	(2.501)	(2.488)	(2.474)	(2.444)	(2.484)
Log Likelihood	-2226.34	-2215.51	-2211.84	-2214.57	-2214.71	-2211.34	-2205.01
Observations	28608	28608	28608	28608	28608	28608	28608

+ p<.10, * p<.05, ** p<.01, *** p<.001

Table 5: Results – Logit – Choice Based Sample – DV Partnership Formation

	(M1b)	(M2b)	(M3b)	(M4b)	(M5b)	(M6b)	(M7b)
Firm Fixed Effects	Y	Y	Y	Y	Y	Y	Y
Year Effects	Y	Y	Y	Y	Y	Y	Y
Main Therapy Area	Y	Y	Y	Y	Y	Y	Y
Startup Age	0.010	0.006	0.006	0.005	0.006	0.005	0.006
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Compounds Available	0.090+	0.118**	0.119**	0.119**	0.118**	0.126**	0.130**
	(0.048)	(0.046)	(0.045)	(0.045)	(0.046)	(0.045)	(0.044)
Partnerships (TA)	0.040	0.033	0.034	0.036	0.032	0.035	0.038
	(0.030)	(0.030)	(0.029)	(0.028)	(0.030)	(0.029)	(0.027)
Prior Tie	0.699***	0.693***	0.706***	0.711***	0.697***	0.679***	0.708***
	(0.172)	(0.171)	(0.169)	(0.170)	(0.170)	(0.169)	(0.165)
Same Country	0.474***	0.469**	0.478***	0.483***	0.470***	0.473***	0.493***
	(0.139)	(0.143)	(0.143)	(0.142)	(0.143)	(0.143)	(0.140)
Overlap Knowledge	0.723	0.646	0.671	0.645	0.627	0.671	0.650
	(0.449)	(0.450)	(0.453)	(0.452)	(0.450)	(0.443)	(0.444)
New Projects (TA)	0.009	0.008	0.007	0.008	0.008	0.004	0.005
	(0.019)	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.018)
Experimentation (TA)	0.189	0.186	0.175	0.161	0.184	0.189	0.158
	(0.170)	(0.166)	(0.166)	(0.167)	(0.167)	(0.164)	(0.168)
Prior Indication	0.713***	0.655***	0.630***	0.629***	0.650***	0.680***	0.631***
	(0.177)	(0.165)	(0.165)	(0.164)	(0.165)	(0.162)	(0.163)
Top 100 Drug (TA)	0.195	0.173	0.167	0.161	0.175	0.172	0.164
	(0.187)	(0.189)	(0.189)	(0.187)	(0.189)	(0.192)	(0.191)
Total Assets	0.040	0.011	0.016	0.009	0.005	0.014	0.005
	(0.060)	(0.065)	(0.071)	(0.075)	(0.066)	(0.068)	(0.082)
Return on Assets	-0.109	-0.131	-0.179	-0.161	-0.132	-0.096	-0.158
	(0.230)	(0.230)	(0.258)	(0.268)	(0.231)	(0.233)	(0.289)
Financial Slack	0.022	-0.008	-0.009	-0.010	-0.006	0.004	0.005
	(0.028)	(0.031)	(0.034)	(0.033)	(0.031)	(0.034)	(0.039)
Failure (TA)	0.049	0.047	0.071	0.051	0.042	0.047	0.079
	(0.040)	(0.041)	(0.045)	(0.042)	(0.042)	(0.042)	(0.049)
Success (TA)	0.177*	0.172*	0.184*	0.252**	0.173*	0.180*	0.242**
	(0.086)	(0.086)	(0.083)	(0.081)	(0.086)	(0.083)	(0.078)
Novelty		-0.241**	-0.315***	-0.298***	-0.240**	-0.240**	-0.345***
		(0.081)	(0.085)	(0.084)	(0.081)	(0.081)	(0.090)
Distance Commercialization		-0.209***	-0.214***	-0.211***	-0.190**	-0.258***	-0.228***
		(0.060)	(0.060)	(0.060)	(0.064)	(0.062)	(0.065)
Novelty X Failure			0.192***				0.190***
			(0.058)				(0.053)
Novelty X Success				0.130			0.098
				(0.095)			(0.090)
Distance Comm. x Failure					-0.065		-0.092*
					(0.045)		(0.042)
Distance Comm. x Success						0.155***	0.175***
						(0.043)	(0.048)
Constant	-3.510***	-3.176***	-3.203***	-3.136***	-3.100***	-3.286***	-3.126***
	(0.793)	(0.832)	(0.865)	(0.897)	(0.835)	(0.829)	(0.937)
Log Likelihood	-1126.51	-1115.28	-1111.06	-1112.95	-1114.77	-1110.43	-1103.13
Observations	2355	2355	2355	2355	2355	2355	2355

+ p<.10, * p<.05, ** p<.01, *** p<.001

Table 6: Robustness Tests – Logit - DV Partnership Formation

	(R1)	(R2)	(R3)	(R4a)	(R4b)	(R5a)	(R5b)
Firm, Year, Main Therapy Effects	Y	Y	Y	Y	Y	Y	Y
Failure (TA)	0.053	0.057	0.099*				
	(0.046)	(0.052)	(0.046)				
Success (TA)	0.210**	0.199**	0.246**				
	(0.065)	(0.067)	(0.084)				
Novelty	-0.380***	-0.374***	-0.387***	-0.462***	-0.545***	-0.304***	-0.338***
	(0.071)	(0.069)	(0.098)	(0.131)	(0.159)	(0.074)	(0.092)
Distance Commercialization	-0.206***	-0.200***	-0.230***	-0.280**	-0.314*	-0.190***	-0.227***
	(0.055)	(0.054)	(0.070)	(0.104)	(0.123)	(0.053)	(0.066)
Novelty X Failure	0.187***	0.180***	0.187***				
	(0.046)	(0.050)	(0.051)				
Novelty X Success	0.101	0.090	0.133				
	(0.066)	(0.069)	(0.094)				
Distance Comm. x Failure	-0.086**	-0.086**	-0.091*				
	(0.030)	(0.032)	(0.044)				
Distance Comm. x Success	0.160***	0.163***	0.183***				
	(0.044)	(0.045)	(0.050)				
Failure (1,0)				0.145	0.252*		
				(0.119)	(0.124)		
Success (1,0)				0.439**	0.575***		
				(0.147)	(0.156)		
Novelty X Failure (0,1)				0.463***	0.455***		
				(0.126)	(0.133)		
Novelty X Success (0,1)				-0.060	0.080		
				(0.160)	(0.160)		
Distance Comm. x Failure (0,1)				-0.198*	-0.197		
				(0.102)	(0.124)		
Distance Comm. x Success (0,1)				0.349**	0.353**		
				(0.129)	(0.130)		
Failure (Depreciated)						-0.014	0.043
						(0.058)	(0.052)
Success (Depreciated)						0.212*	0.254*
						(0.087)	(0.100)
Novelty X Failure (Depreciated)						0.183**	0.178**
						(0.063)	(0.068)
Novelty X Success (Depreciated)						0.068	0.134
						(0.082)	(0.116)
Distance Comm. x Failure (Depr.)						-0.080+	-0.085+
						(0.041)	(0.047)
Distance Comm. x Success (Depr.)						0.122*	0.146**
						(0.049)	(0.056)
Constant	-6.775***	-8.742***	-3.788***	-9.238***	-3.308***	-9.128***	-3.284***
	(1.020)	(2.233)	(0.918)	(2.432)	(0.951)	(2.474)	(0.903)
Log Likelihood	-2203.82	-2376.77	-1013.48	-2200.62	-1100.94	-2205.66	-1107.49
Observations	20998	34639	2165	28608	2355	28608	2355

+ p<.10, * p<.05, ** p<.01, *** p<.001; variables not shown but included in the models: Startup Age, Compounds Available, Partnerships, Prior Tie, Same Country, Overlap Knowledge, New Projects, Experimental Orientation (not in R7), Prior Indication, Top 100 Drug, Total Assets, Return on Assets, Financial Slack

Table 7: Marginal effects:

Marginal Effects of Novelty and Distance to Commercialization at different levels of moderating variables

STATA - Margins	Novelty	Distance to Commercialization	STATA - Margins	Distance to Commercialization
When Failure is at 25th percentile	-0.0630*** (0.0150)	-0.0013* (0.0006)	When Success is at 25th percentile	-0.0465*** (0.0101)
When Failure is at 75th percentile	-0.0079 (0.0151)	-0.0021** (0.0006)	When Success is at 75th percentile	-0.0292* (0.0085)
Changes in the marginal effect	0.0709***	0.0010*	Changes in the marginal effect	0.00119**
When y is at 90th percentile	0.023 (0.0229)	-0.0029*** (0 .0007)	When Success is at 90th percentile	-0.0064 (0.113)

Figure 1: Moderation Novelty and Failure

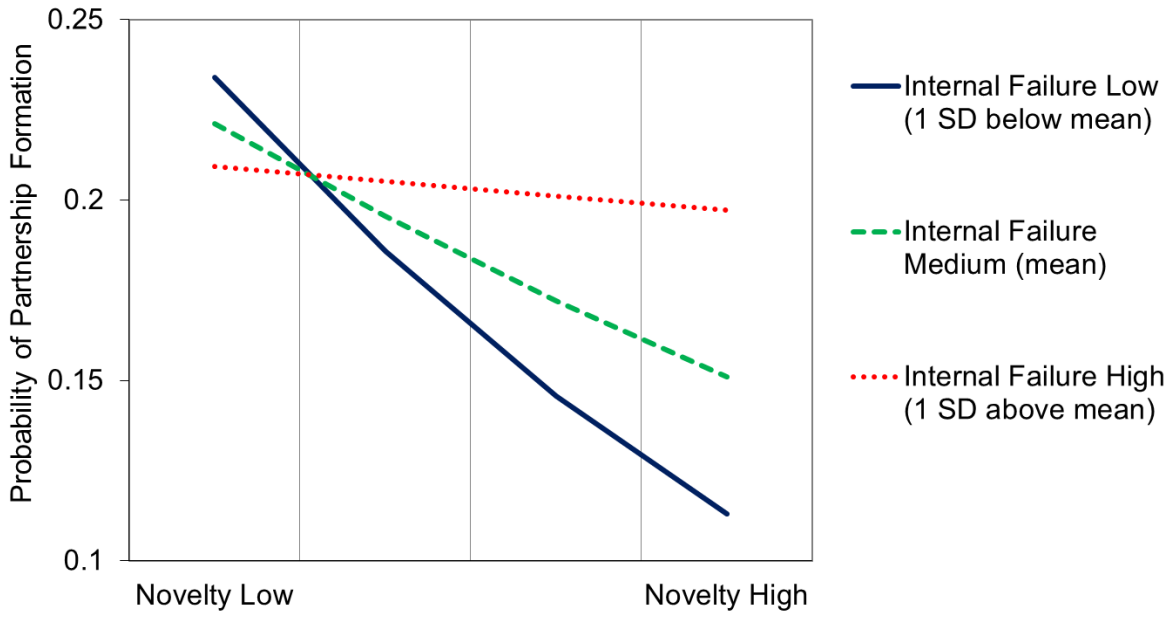


Figure 2: Moderation Distance to Commercialization and Failure

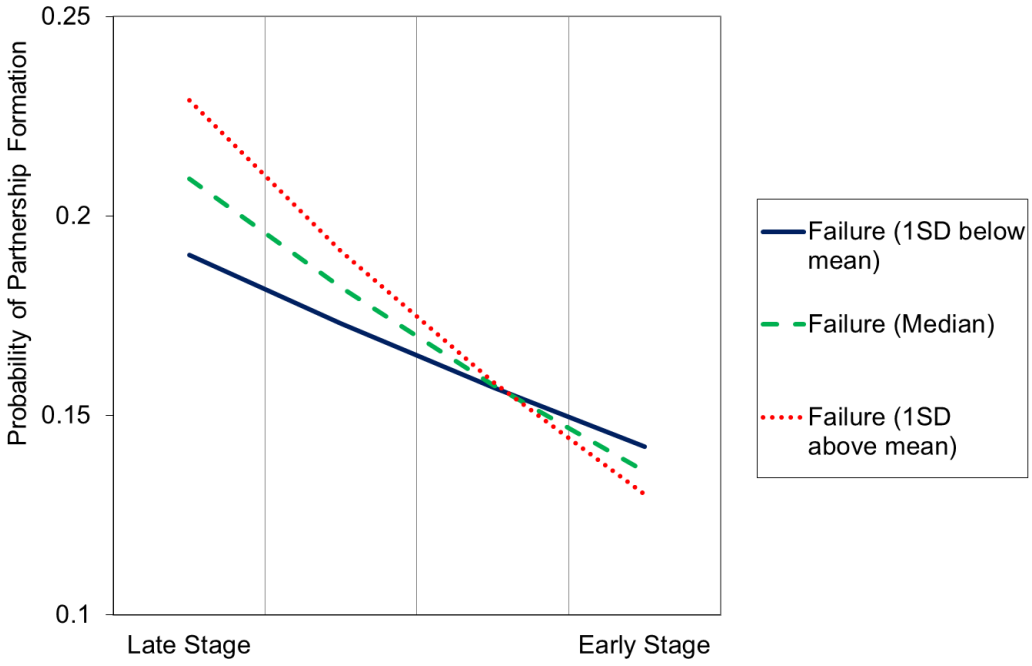
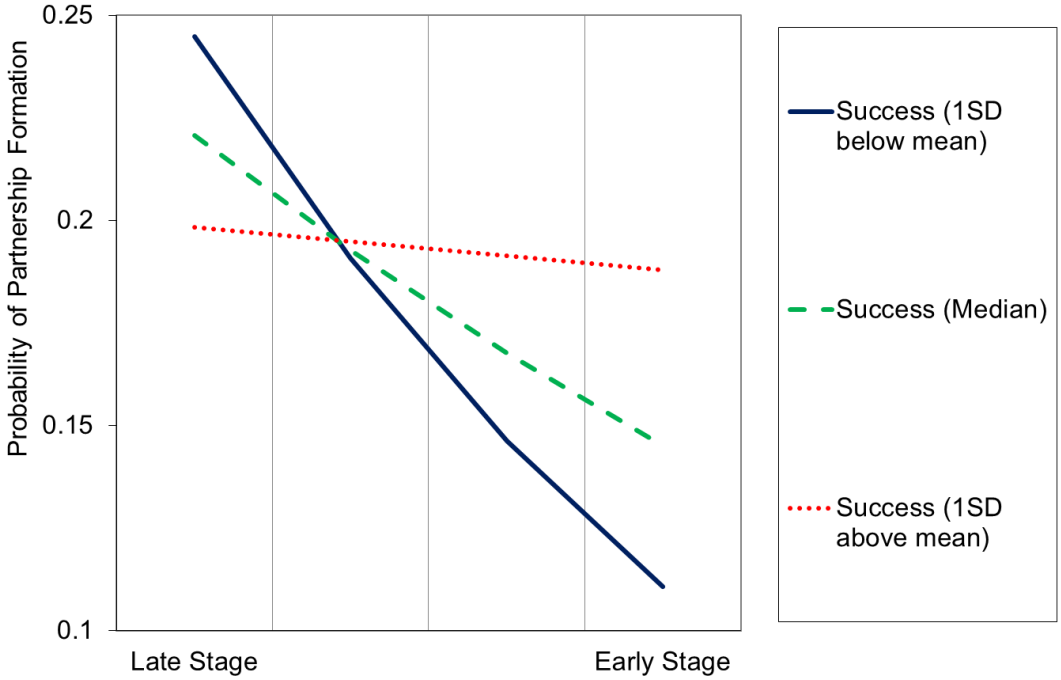


Figure 3: Moderation Distance to Commercialization and Success



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