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Prior Knowledge and New Product and Service Introductions by Entrepreneurial Firms: The Mediating Role of Technological Innovation

by Jintong Tang and Patrick J. Murphy

Most research on new product and service development by entrepreneurial firms takes an individual-level, prelaunch perspective or firm-level postlaunch perspective. Our study examines two components of the new product and service introduction process: how entrepreneurs' prior knowledge underpins (1) firm technological innovation prior to the introduction of new products and services (prelaunch) and (2) postlaunch viability of those new products and services. Our findings, based on a series of analyses of data from 158 entrepreneurial firms, show that formal technological innovation fully mediates the relation between prior knowledge and the introduction of viable new products and services.

Introduction

The introduction of innovative new products and services is critical for organizational survival and success (Damanpour 1991). The process enables firms to increase market share and market value (Chaney and Devinney 1992), improve performance (Roberts 1999) and enhance survival (Banbury and Mitchell 1995), and adapt to the market context in which they are embedded (Brown and Eisenhardt 1995). The process has also been noted as instrumental in creating new markets (Burgelman 1991) and raising visibility and legitimacy among customers and competitors (Schoonhoven, Eisenhardt, and Lyman 1990). It is widely accepted that organizational knowledge is vital to the innovative aspects of new product and service development (Atuahene-Gima 2003; Atuahene-Gima and Li 2004; Deeds, DeCarolis, and Coombs 1999; Katila 2002; Katila and Ahuja 2002; Keller 2001). Firms accomplish innovation by translating internal knowledge and knowledge spillovers from other entities into new products or services (Katila 2002). Among all the antecedents

Jintong Tang is an assistant professor of management and entrepreneurship at John Cook School of Business, Saint Louis University.

Patrick J. Murphy is an associate professor of management and a tenured member of DePaul University's entrepreneurship faculty.

Address correspondence to: Jintong Tang, Management, Saint Louis University, 3674 Lindell Blvd., DS 469A St. Louis, MO 63108, USA. E-mail: jtang3@slu.edu.

of innovation, previous research tends to focus on firm specialization (Kimberly and Evanisko 1981), formalization (Burns and Stalker 1994), centralization (Thompson 1965), administrative intensity (Damanpour 1987), slack resources (Rosner 1968), and internal communication (Ross 1974).

Within this broad area, entrepreneurial firms herald unique considerations about the emergence and existence of opportunities to create new products and services (Murphy 2010; Shane and Venkataraman 2000). The utter novelty of entrepreneurial venture offerings affords performance in competitive markets, which makes the identification of new opportunities essential (Ardichvili, Cardozo, and Ray 2003). The extent to which entrepreneurial firms are able to develop and bring new products and services to market based on such opportunities is thus a basic success indicator (Shepherd and DeTienne 2005). Because of the high relevance of innovation, multiple streams of research examine innovation from a range of perspectives (Deeds, DeCarolis, and Coombs 1999; Greve 2003; Murphy 2010; Smith, Collins, and Clark 2005). The most voluminous of these streams emphasizes the knowledge, skills, abilities, competencies, and other human performance characteristics that fall into the realm of human capital theory (Becker 1964; Schultz 1959).

In this paper, we strengthen and clarify the linkages between prior knowledge and opportunities for the development of new product and services (Corbett 2007; Ko and Butler 2006; Shepherd and DeTienne 2005). Whereas new product and service offerings are important to entrepreneurial firm performance, our contribution addresses two gaps in this research area.

First, previous research makes distinctions between administrative and technical innovations (Daft 1978; Kimberly and Evanisko 1981), radical and incremental innovations (Dewar and Dutton 1986; Ettlie, Bridges, and O'Keefe 1984; Nord and Tucker 1987), initiation and implementation stages of the adoption of innovation (Marino 1982; Zmud 1982), diffusion and adoption of innovations (Kimberly 1981), and innovating and innovativeness (Van de Ven and Rogers 1988). However, those studies view technological innovation and new product and service introduction interchangeably. The problem with this view is that the elements seem to occupy different stages of the entrepreneurial process when it comes to the practical matter of market entry (Edwards and Gordon 1984). Because these elements contribute to the process in distinct ways, different firm characteristics influence each one and lead to different consequences for firms (Marino 1982). Moreover, firm technological innovation tends to occupy a discrete part of a firm's internal operational model, whereas new product or service development is generated internally as well as purchased externally (Damanpour 1991). On these grounds, technological innovation and new product and service development are germane to firm-level activities in terms of stage (e.g., invention, development, and application) and source (e.g., internal and external) in different ways.

Second, research on the novelty and viability of new product and service introductions emphasizes external opportunities but makes calls for the examination of firm-centric phenomena based important unresolved issues (Atuahene-Gima and Li 2004). For instance, whereas some new products and services stem from multiple firm technological innovations as a common source, others derive from just one distinct firm technological innovation (Shane 2003). However, the research usually emphasizes individual-level underpinnings of new product and service offerings (e.g., creativity and human capital). In other words, the research does not emphasize firm-centric

underpinnings, such as technological innovation policies and practices, to help explain the viability of new products and services. This shortcoming warrants concern because entrepreneurial firms invest significant resources in developing new technological innovations and improving their new products and services. Yet, failure rates in development initiatives are substantial, with approximately 33 percent of new products and services never being launched (Corbett, Neck, and DeTienne 2007).

Examining the firm-level underpinnings of these conceptual issues promises implications for important practical aspects of entrepreneurship. Entrepreneurs can and do embed technological innovation into firm culture, resources, routines, and procedures. Sometimes, they house innovation in a research and development department. Such entrepreneurial firms combat the inertia of size and tradition and achieve innovation by putting special formal systems in place to promote, enable, and maintain innovative activities (Van de Ven et al. 1999, p. 201). For example, firm technological innovation is robust in actual firms that have flatter organizational structures, more horizontal communication, and distinct innovation departments and processes (Kolodny et al. 1996). Firm-level technological innovation is thus distinctly important because entrepreneurial firm performance stems from the management of innovation (Covin and Slevin 1989).

Following Shane (2000), we define technological innovation as work activities that concern new products, services, and production processes (Shane 2000). Following Amason, Shrader, and Tompson (2006), we define new product and service introductions as new market offerings introduced by firms to meet external uses or needs in the market environment. Whereas technological innovations concern the generation of breakthrough ideas, new products and services are different in that they entail external shaping of the innovations toward application, market entry, competition, and viability.

In light of these definitions and the issues articulated in this introduction, our conceptual and empirical study examines the issues to extend existing theory about the knowledge–innovation linkage in entrepreneurship. We specifically address two principal research questions:

(1) Are entrepreneurial firm technological innovations demonstrably distinct from new products and services introduced by those firms?
(2) Do firm technological innovations mediate the linkage between entrepreneurs' prior knowledge and firm new product and service introductions?

To address the first question, we review literatures on technological innovation and new product and service development and formulate arguments about the linkage and distinction between new products and services and the technological innovations that give rise to them. For the second question, we build on those arguments with respect to the role of prior knowledge and formulate a conceptual model of the relation between prior knowledge and new product and service introductions. The model casts firm technological innovation as a distinct and practical step in the entrepreneurial process. Finally, we develop two hypotheses that assess the conceptual model using hierarchical regression and statistical tests for mediation.

Conceptual Background and Theoretic Review

Firm-Level Technological Innovation and New Product and Service Introductions

The entrepreneurship literature has two research streams on innovation. The first stream examines innovation as a single insight, and the second stream

describes a process composed of multiple stages. According to the first stream, innovation is "fundamentally the introduction of something new" (Amason, Shrader, and Tompson 2006, p. 127). The stream also describes innovation as the commercialization of an invention (Myers and Marquis 1969). More specifically, innovation can be a technology, strategy, or managerial practice a firm uses for the first time or a significant improvement to an existing process (Nord and Tucker 1987).

According to the second stream, innovation is "a process that begins with an invention, proceeds, with the development of the invention, and results in the introduction of a new product, process or service to the marketplace" (Edwards and Gordon 1984, p. 1). Here, innovation begins with the selection of an idea for development with the goal of commercialization and market entry. This stream also defines innovation as the process of identifying and utilizing opportunities to create new products, services, or work practices (Van de Ven 1986). The process may also entail multiple stages. For example, Damanpour (1991) proposed two stages of initiation and implementation. The former consists of perceiving problems, gathering information, forming attitudes, and attaining resources, whereas the latter consists of modifications to innovations, early utilization, and the establishment of an organizational routine. This conceptualization reflects the long-held view that an invention and the subsequent innovation that it makes possible are distinct from one another economically and sociologically (Kolodny et al. 1996; Schumpeter 1939).

Entrepreneurial firms are distinct from small businesses due to the novelty of their products or services, endogenous innovation within the firm, and exogenous innovation (Katz and Green 2008). From a process perspective, innovation thus entails two aspects: firm technological innovation and new product and service introductions. The former entails internal generation of the innovations or processes that lead to new products and services. By contrast, the latter refers to new products or services introduced to meet an external use or market need.

Three-dimensional printing (3DP) provides an illustration of the differences between a technological innovation and new product or service (Shane 2000). Based on the single 3DP process, entrepreneurs are able to introduce a wide variety of wholly different new products and services to markets. Despite sharing the same 3DP process as a common source, those new products and services range from ceramic molds for casting metal parts, artificial bone material for weight bearing indications in surgery, to a chain of stores to make sculptures from photographs. Again, this result provides evidence for the notion that inventions and the innovation based on such inventions are different in important ways (Schumpeter 1939). Similarly, technologies like Wi-Fi and digital video formatting (e.g., Blu-Ray) provide examples of the distinction between technological innovations and new products and services. In those cases, the sole innovations were invented in the context of firms (Wi-Fi has its origins in National Cash Register and AT&T; Blu-Ray emerged from internal projects by Sony and Philips) and are distinct from the many new products such as wireless headsets, routers, and optical media products based on them (Shapiro and Varian 1999).

We argue that technological innovations are distinct from new product and service introductions on two basic premises. First, new product and service introductions indicate the commercial significance of a firm's technological innovations. They do not affect firm survival and growth until the ideas inherent in them are introduced to the market. Technological innovations do not generate value for entrepreneurial firms until commercial viability is realized, a market

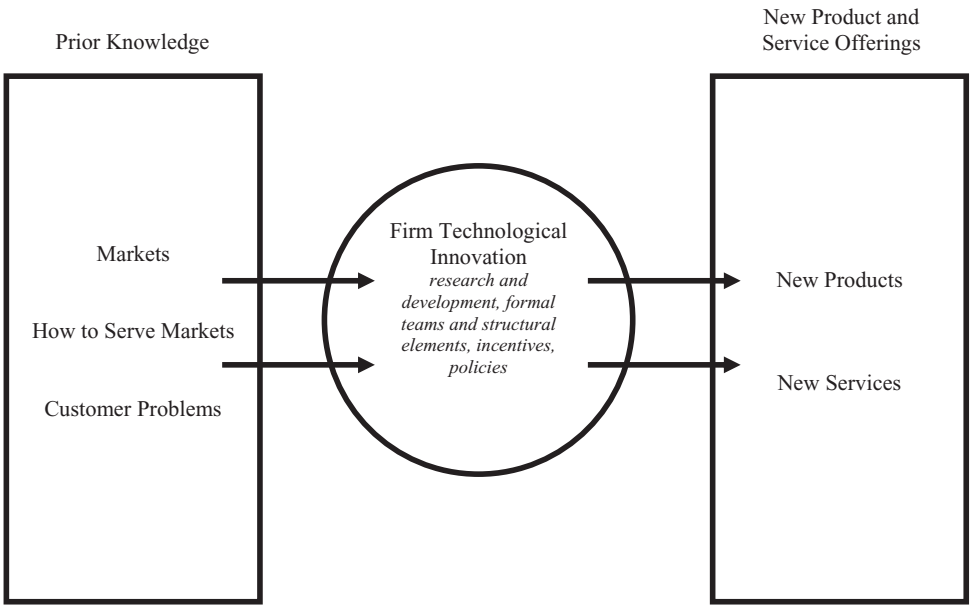
is discovered, profit is generated, and continuous profit when facing market competition is sustained (Dimov 2007). This argument holds that the elements of viability derive directly from products and services, not technological innovations. Second, a technological innovation can result in multiple new products and services (Shane 2000) or, moreover, it may not lead to any new products or services. Further still, a new product or service based on the technological innovations may be developed but never commercialized (Schoonhoven, Eisenhardt, and Lyman 1990). These arguments hold that there is a clear inflection point in firm operations that separates technological innovations from new products and services.

The distinction between these constructs is relevant and instrumental to firm entrepreneurship activity. Although the notion may seem clear conceptually, very little research assumes and almost no research explicitly describes this important difference. Moreover, no studies have offered evidence for examining it. Figure 1 illustrates firm technological innovation in this fully mediating role. In the next section, we review the research on prior knowledge and its effect on new product and service development and develop hypotheses based on this review to guide an empirical test of the model.

Prior Knowledge and New Product and Service Introductions

Prior knowledge refers to idiosyncratic information about a particular subject such as the knowledge that accumulates through work experience (Cooper, Gimeno, and Woo 1994; Evans and Leighton 1989) or education (Gimeno et al.

Figure 1
Prior Knowledge and New Product and Service Offerings Mediated by Firm Technological Innovation



1997). Prior knowledge of markets entails possessing information about how particular markets operate (Shane 2000). Such specific knowledge is procured via experience and heralds a more specific stock of information that can become tentative as a market evolves. Knowing how to serve markets means knowing how to meet consumer needs, not just knowing what those needs are (Shane 2000). Knowledge of specific customer problems involves knowing what customers would prefer instead of other alternatives (Shane 2000) and is instrumental in developing new products and services in which potential customers will respond positively. Human capital theory postulates that increased knowledge in a particular field allows individuals to become increasingly efficient and to focus on the key dimensions that contribute to the positive outcome of decisions (Weber 1980). At bottom, the human capital perspective assumes that identifiable aspects of individuals, such as their prior knowledge, enable firm performance outcomes when firm membership consists of those individuals (Corbett 2007; Shepherd and DeTienne 2005).

Prior knowledge enhances new products and services for multiple reasons. First, since entrepreneurs' prior knowledge accumulates over relatively long stretches of time, such as the knowledge gained from experience in an industry or formal education (Becker 1964), it is considered more legitimate, reliable (March 1991), elegant, and robust (Hutchins 1983). Prior knowledge, as a resource, raises an entrepreneur's familiarity with many different aspects of a business setting based on a history of professional activities and interactions with customers and competitors. Such familiarity, combined with the legitimacy and reliability of the knowledge, allows an entrepreneur to perceive the subtle aspects of performance with a more informed schema for sensemaking.

Second, since the communication, sharing, and transfer of information are intense in entrepreneurial firms, prior knowledge is assimilated and integrated into venture operations. As a result, sensemaking (Delmar and Davidsson 2000), strategic management decisions (Hitt et al. 2001), venture performance (Gimeno et al. 1997), and entrepreneurial discovery (Casson 1995; Corbett 2007; Shane 2003) are enhanced. All of these outcomes promote the development of viable new products and services.

Third, the process of developing new products and services involves finding creative and unique ways to remedy inefficiencies in a market system. However, as firms focus on new knowledge and ideas, previous market and customer information are more difficult to access (Argote 1999). This trade off makes entrepreneurs' prior knowledge idiosyncratic and inimitable across firms (Murphy 2010). Without a clear emphasis on technological innovation, firms must build directly on prior knowledge with new products and services that simultaneously adapt to the turbulent environment. The daunting managerial challenges associated with this prior knowledge and new product and service linkage process are long bemoaned (Schultz 1959).

Finally, new product and service introductions do begin with unique combinations of prior knowledge types and require additional knowledge. The information required to make new product and service offerings attractive to the market requires specific knowledge about customer problems, how to respond to those problems, and the market itself (Shane 2000). Entrepreneurs with such specific knowledge have access to information and use it to form beliefs about efficient resource use. Then, as they capitalize on new knowledge, their knowledge accumulates (Rao and Drazin 2002). Thus, entrepreneurs use prior knowledge to shape an

opportunity into a viable market offering through a kind of learning process (Ardichvili, Cardozo, and Ray 2003; Corbett 2007). From this perspective, entrepreneurs' prior knowledge represents a valuable, rare, and difficult-to-imitate resource (Barney 1991) that will bring viable market offerings to the entrepreneurial firms.

H1: Greater prior knowledge leads to more viable new product and service introductions by entrepreneurial firms.

Firm Technological Innovation as a Mediator

If we fully apply the process of innovation to the entrepreneurship context, the distinction between technological innovations and new product and service introduction is analogous to the distinction between ideas and opportunities (Dimov 2007). Every opportunity has an initial idea as its "progeny" and that opportunity recognition is a creative process where initial insight develops gradually into a fully shaped idea for a new product or service. Thus, opportunity development moves beyond single-insight attribution. Similarly, as technological innovations precede the development of new products or services, there is temporal disparity between the two constructs. As technological innovations are not yet modified into market offerings that hold promise for the generation of value by an entrepreneurial venture, they serve as an intervening variable between prior knowledge and new product and service offerings. Prior knowledge affords the identification of opportunities in a market system, but firms introduce new products and services via the technological innovation stage. On these grounds, the relationship involves mediation.

Our hypothesis rests on several assumptions from prior research. First, prior knowledge affects the viability of new product and service introductions via absorptive capacity, which is the ability to recognize the value of new information, assimilate the new information, and apply the new information for technological innovation development (Cohen and Levinthal 1990). The ability to assess and capitalize on outside knowledge is largely a function of the level of prior knowledge such as basic skills or knowledge of the most recent technological innovations in a given field. Prior knowledge increases the ability to put new knowledge into memory and recall and utilize it (Bower and Hilgard 1981). Thus, more prior knowledge enables the extraction of knowledge from external sources (Cohen and Levinthal 1990), the integration of acquired knowledge with technological innovations (Zahra and George 2002), and the introduction of new products and services.

Second, entrepreneurs' prior knowledge enhances problem-solving skills, which allows them to restructure "knowledge portfolios" and fully utilize knowledge assets (Galunic and Rodan 1998). As a result, for instance, their understanding of technological innovations is broader, and the ability to develop technological innovations is stronger (Zahra and George 2002). As technological innovations are the foundation for new product and service introductions, a firm's ability to offer more viable new products and services is enhanced when greater prior knowledge underlies the firm technological innovation process.

Third, with prior knowledge about markets, how to serve markets, and customer problems, the costs associated with searching for new products and services to meet the needs of the market are reduced (Katila 2002). In addition, perception of the environment and how to respond to competitors and organize resources are all enhanced (Baum, Locke, and Smith 2001). Hence, a more

efficient way to expand to new technological areas is achieved; the ability to predict the nature of future technological advances is enhanced; and a better understanding of how to appropriately apply novel technological innovations in the new product and service development process is facilitated. On these grounds, an entrepreneur's prior knowledge allows better understanding of how to apply technological innovations to new products and services.

Previous research merely implies a mediating role for technological innovation in the relationship between prior knowledge and new product/service offerings in ways that derive from market selection, how to serve the market, and knowledge of customer problems (Shane 2003). We extend notions about prior knowledge's importance to technological innovation and viable new product and service introductions in the form of a fully mediated relation among these variables.

H2: Distinct firm technological innovations fully mediate the relation between prior knowledge and the number of new product and service introductions.

Method

Sample and Procedure

To generate evidence for testing our hypotheses, we undertook multiple empirical data collection procedures in order to procure an appropriate sample. First, we conducted face-to-face interviews and discussions with eight entrepreneurs in the Southeastern United States in order to guide construction of a survey. Each interview lasted from 40 minutes to an hour to ensure that items in our survey procedure were clear and readily interpretable.

We accessed entrepreneurs (defined as current owners or co-owners who participated in the establishment of their businesses) from three data sources. First, the names and addresses of 500 entrepreneurs were obtained from the *Reference USA* database. We selected those listed as owners (rather than managers) in the contact person category. These entrepreneurs were located in several Southeastern states and operated businesses in various industries. Surveys were then mailed out to all the entrepreneurs with postage-paid return envelopes. Of the 500 entrepreneurs contacted, 67 entrepreneurs returned the surveys. Six of these respondents were eliminated because they were not active in the founding process. Five more respondents were eliminated because cover letters were mistakenly returned instead of surveys. Eventually, 56 usable surveys were generated from the first source. Second, we surveyed entrepreneurs in the database of an entrepreneurship center at a Midwestern university via the center director. An online survey link was included in e-newsletters for two consecutive months. This source generated 62 responses. Nine cases were deleted due to missing information on key variables, yielding 53 complete surveys from the second source. Third, we contacted entrepreneurs on the distribution list maintained by the entrepreneurship center at another university located in the Midwest. The director of the development office contacted these entrepreneurs periodically in conjunction with the entrepreneurship center, and a survey link was included in one of these requests. After eliminating responses with missing values, we retained 49 usable surveys.

Results of *t*-test comparisons of the average firm size (number of current employees) and business tenure (years the respondent has been in the current business) of the three samples revealed no statistical difference ($p > .10$). Similarly, there were no statistical differences in the mean responses for the research variables assessed in the study. With no discernable differences between the

three samples, we combined them into one sample of 158 entrepreneurs. Approximately 80 percent of the sampled respondents were male; and 26.7 percent had graduate degrees or higher. Their firms employed an average number of 52 employees, and the average number of years of business experience of the entrepreneurs was 14.

Measures

We used established measures from prior research and undertook tests to provide evidence for examining their psychometric quality in our study.

Prior Knowledge. The scale for *prior knowledge* was composed of three items following Shane (2000). These items were anchored on five-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree): (1) I have rich knowledge about markets such as supplier relationships, sales techniques, and capital equipment requirements; (2) I know how to serve markets; and (3) I am familiar with customer problems ($\alpha = 0.76$).

Technological Innovation. Following previous research (Katila 2002; Shane 2000), we utilized a continuously valued measure for the mediator variable *technological innovations*. This item asked respondents to provide a number to answer the question: "how many technological innovations has your firm developed in the past five years that could potentially lead to new products or services?" This item was followed immediately by the question that asked for the number of new products and services described below.

New Product and Service Introductions. To operationalize *new product and service introductions*, we followed Katila (2002) and asked the respondents to provide a number to answer the question: "based on the technological innovations that your firm has developed in the past five years, how many new products or services has your firm introduced?" This measure of new product and service offerings has been found to be robust over a wide variety of research settings (Damanpour 1991; Smith, Collins, and Clark 2005).

Control Variables. Demographic (such as age, gender, and education), firm-level (such as firm size and firm age), and industry-level variables were controlled to diminish any unobserved heterogeneity attributable to them and to partial out any potential confounding effects on various indices of innovation-related outcomes. *Age* was measured with five categories: (1) <25, (2) 25–34, (3) 35–44, (4) 45–54, and (5) >55 years old. *Gender* was measured with a dummy variable (female = 0; male = 1). *Education* was coded as "1" for "less than high school degree"; "2" for "high school graduate"; "3" for "some college"; "4" for "4-year college graduate"; and "5" for "some graduate study beyond 4-year college degree."

Firm size was measured by the number of current employees in the firm. As the raw number of employees was skewed (skewness = 4.66), we recoded this variable based on a natural log transformation of the scores. As a result, the skewness statistic of the distribution of these scores was 1.08 and avoided a violation of parametric analysis assumptions. We measured *firm age* by asking the entrepreneurs to provide the year when their business was established. Finally, *industry* was controlled because whether ventures are operating in high technology or low technology, industries can influence firm new product and service offerings (Thornhill 2006). To control for industry, the survey listed 17 categories of industries following North American Industrial Classification code. Next, we categorized the 17 industries as high- or low-technology by employing

Thornhill's (2006) algorithm, which was developed based on the standardized scores for research and development (R&D) intensity and the percentage of knowledge workers in each industry. High-technology industries (e.g., professional, scientific, technical services, manufacturing, and mining) were coded as 1, and low-technology industries (e.g., construction, transportation, and warehousing) were coded as 0.

Analysis and Results

To promote the validity of our analysis and results, we undertook several rigorous tests of assumptions regarding multicollinearity among independent variables, outliers in the distribution of variable scores, and common method variance. We made these checks before testing our hypotheses to ensure our test statistics were appropriate for our sample data. As we report in what follows, we executed these tests using standard authoritative methodologies.

Tests for Multicollinearity and Outliers

We executed multiple analyses to test for multicollinearity and outliers. None of the variance inflation scores exceeded 1.94, and all condition index scores were less than 26.55. Each of these statistics falls well within acceptable ranges (Fox 1997; Neter et al. 1996), suggesting multicollinearity was not a threat to the validity of our main analyses. To assess the threat from outlier scores, we calculated leverage values and DfBetas. These analyses found that no leverage scores exceeded 0.13 and that no standardized DfBetas exceeded an absolute value of 0.76. Again, these scores are well within accepted ranges (Neter et al. 1996; Tabachnick and Fidell 2007) and suggest no outliers.

Tests for Common Method Variance

To check for the presence of common method variance, we entered all of our study variables into an exploratory factor analysis procedure using the principal axis factoring method (Podsakoff et al., 2003). Next, we examined the unrotated factor solution to determine the number of factors that were necessary to account for all variance. Three factors emerged with eigenvalues exceeding 1.0, with the first one explaining 24.97 percent of variance. Therefore, it appears no single factor was dominant and that common method variance was not a threat to findings of our empirical analysis.

As the tests for multicollinearity, outliers, and common method variance indicated no threat to our statistical methods, we deemed our data sample to be appropriate for hypothesis testing.

Tests of Hypotheses

Table 1 reports the means, standard deviations, and correlations of all variables. Overall, the correlations among the independent and dependent variables were as expected.

We used a hierarchical regression analysis to test our hypotheses. Table 2 reports the results. The number of new product and service offerings and technological innovations were entered as the dependent variables. H1 held that prior knowledge leads to more viable new product and service offerings. As shown in Model 4 of Table 2, prior knowledge was positively and significantly related to the number of new product and service offerings ($\beta = 0.19$, $p < .05$), which offers support for the first hypothesis. Adding the prior knowledge variable explained an additional 3 percent of the variance for new product and service offerings.

Our second hypothesis holds that technological innovations mediate the effect of prior knowledge on the number of new product and service offerings. To test for mediation, we adopted the standard procedure of Baron and Kenny (1986). According to

Table 1
Means, Standard Deviations, and Correlations

	Variable	Mean	Standard Deviation	1	2	3	4	5	6	7	8
1.	Entrepreneur Age	3.34	1.24								
2.	Gender	0.81	0.41	−0.11							
3.	Education	4.28	0.86	−0.16*	0.04						
4.	Firm Size[a]	0.97	0.70	0.39**	−0.02	0.00					
5.	Firm Age	10.24	10.38	0.58**	−0.07	−0.17*	0.53**				
6.	Industry	0.18	0.39	−0.02	0.02	0.01	0.06	−0.02			
7.	Prior Knowledge	3.89	0.69	0.27**	−0.02	−0.15*	0.17*	0.32**	−0.02		
8.	Technological Innovation	1.62	1.32	0.29**	−0.01	0.11	0.18*	0.18*	0.00	0.36**	
9.	Number of New Product and Service Introductions[a]	1.71	2.03	0.13	0.07	0.08	0.14	0.09	0.03	0.19*	0.35**

[a]Logarithm.
*$p < .05$
**$p < .01$

Table 2
Results of Regression Analysis Predicting New Product and Service Introductions[a]

Variables	Technological Innovation		Number of New Product and Service Introductions		
	Model 1	Model 2	Model 3	Model 4	Model 5
Entrepreneur Age	0.25*	0.22*	0.09	0.07	0.01
Gender	−0.02	−0.00	0.09	0.10	0.10
Education	0.13	0.15*	0.05	0.07	0.03
Firm Size[b]	0.07	0.06	0.11	0.11	0.09
Firm Age	0.02	−0.05	0.01	−0.03	−0.02
Industry	0.02	0.02	−0.00	−0.00	−0.01
Prior Knowledge		0.30***		0.19*	0.11
Technological Innovation					0.27**
R^2	0.10	0.18	0.04	0.07	0.14
Adjusted R^2	0.06	0.14	0.00	0.03	0.09
ΔR^2	0.10	0.08	0.04	0.03	0.07
ΔF	2.69*	14.74***	1.01	5.38*	11.04**

[a]Standardized regression coefficients are displayed.
[b]Logarithm.
*$p < .05$
**$p < .01$
***$p < .001$

the logic of this procedure, mediation is suggested if (1) the independent variable is a significant predictor of both the dependent variable and the mediator, (2) the mediator is a significant predictor of the dependent variable, and (3) the effects of the independent variable on the dependent variable are reduced when the mediating variable is added to the regression equation. Full mediation is indicated if the effect of the independent variable is no longer significant when the mediating variable is added, whereas partial mediation is suggested if the effect of the independent variable is reduced but still significant. Both kinds of mediation are thus discernable via the same analysis.

Our results show that technological innovation is a full mediator of the relation between prior knowledge and number of new product and service offerings. This result provides support for our second hypothesis. Specifically, as shown in Model 4 of Table 2 (and as just described) prior knowledge is significantly related to the dependent variable (number of new product and service offerings). Furthermore, as Model 2 in Table 2 shows, prior knowledge is significantly related to the mediator (technological innovations; $\beta = 0.30$, $p < .001$). As required by Step 1 of Baron and Kenny's (1986) procedure, the independent variable (prior knowledge) is significantly related both

to the dependent measure and to the proposed mediator. The second step requires that the proposed mediator be significantly related to the dependent variable. As shown in Model 5 of Table 2, technological innovation is significantly related to the number of new product and service offerings ($\beta = 0.27$, $p < .01$). This result fulfills the requirement of Step 2. Finally, when prior knowledge and technological innovation are both included in the regression equation, the result offers clear support for full mediation. As shown in Model 5 of Table 2, the effect of prior knowledge on the number of new product and service offerings is eliminated when technological innovation is added (β is reduced from 0.19, $p < .05$ to .11, not significant). As such, this rigorous test of our data provide evidence that technological innovations fully mediate the relation between entrepreneurs' prior knowledge and firms' number of new product and service offerings.

Although our results meet formal mediation criteria (Baron and Kenny 1986), smaller samples can complicate the evaluation of direct relations between independent and dependent variables (Shrout and Bolger 2002). In order to analyze the data as rigorously as possible, we undertook Sobel tests to examine the statistical significance of the indirect effects of prior knowledge on the number of new product and service offerings through technological innovation (MacKinnon and Dwyer 1993; Sobel 1982). Sobel tests calculate the magnitude of the unstandardized indirect effect and its associated standard error. The ratio of the indirect effect over its standard error is the Sobel statistic, which is then compared with a z-score distribution to determine the significance of the indirect effect. In our data, the Sobel test (2.51, $p < .01$) indicates the indirect effect of prior knowledge on the dependent measure is in the anticipated direction and significant, which provides additional evidence for the validity of our results concerning our second hypothesis.

Discussion

New product and service offering has received much research attention as an important factor of entrepreneurial firm performance. However, several significant gaps germane to theory and practice have stymied further development of this important topic. For example, current research has sometimes used the terms technological innovations and new product and service introductions interchangeably, whereas in fact they represent different stages in the innovation process. In addition, by emphasizing individual characteristics in innovation, research has underestimated how internal, firm-level processes influence new product and service introductions. Our research questions were designed to examine if technological innovations are not only distinct from new product and service introductions, but whether they mediate the impact of prior knowledge on firm new product and service offerings. We explained that though technological innovations concern the generation of breakthrough ideas, new product and service development entails the continuous shaping and development of these breakthrough innovations vis-à-vis external elements. Our survey of 158 entrepreneurial firms found that prior knowledge influences new product and service introductions and that technological innovations fully mediate this linkage. The contribution of our study strengthens some existing conceptual links in entrepreneurship research on the relation between knowledge and innovation (Damanpour 1991).

Our findings offer three general conclusions. First, our findings clarify the structure of firm innovation by distinguishing technological innovations from new product and service introductions. Following the research stream that treats

innovation as a process, we proposed that innovation begins with an invention and ends with a new product or service introduced into the market (Edwards and Gordon 1984). Such a process view of innovation is consistent with Schumpeter's description, cited previously: "The making of the invention and the carrying out of the corresponding innovation are, economically and sociologically, two entirely different things" (Schumpeter 1939, p. 85). According to this long-held perspective on innovation, technological innovations and new product and service introductions represent different firm-level stages of practical importance. Technological innovations derive from insights and ideas, which serve as foundations for new products or services. New products or services, in turn, represent the implementation of commercialization into a market setting. Thus, new product and service introductions are distinct from technological innovations because (1) technological innovations cannot influence firm performance until the ideas have been put into use and introduced to the market;and (2) a technological innovation may lead to multiple new products or services or alternatively, the new product or service developed based on the technological innovation are never introduced to the market.

We reinforce the notion that it is important to distinguish these two constructs very clearly because different firm aspects influence them and each one leads to different consequences (Marino 1982). Although firm technological innovation can be an ongoing activity and span the entire new product and service development process within the firm, the new product or service can be either internally generated from these technological innovations or purchased from outside the firm and thus not related to the firm technological innovation (Damanpour 1991). Our study provides evidence that this occurs in a particular context that is firm level and internal.

Second, our study shows theoretic links between entrepreneurship and other areas of management regarding the relationship between knowledge and innovation (Damanpour 1991). A large body of research indicates that knowledge plays an important role in organizational innovation (Atuahene-Gima 2003; Atuahene-Gima and Li 2004; Deeds, DeCarolis, and Coombs 1999; Katila 2002; Katila and Ahuja 2002; Keller 2001). Applying this research in the entrepreneurship context and focusing on entrepreneurs' prior knowledge (rather than organizational knowledge) clarify the critical role that entrepreneurs play as the driving force behind innovation in firms and the introduction of new products and services. Integrating the extensive body of theory and findings in the organizational context into ongoing research in the field of entrepreneurship contributes to the development of closer conceptual links between these diverse fields.

Third, our study clarifies the combination of individual prior knowledge with firm-level aspects, thus responding to calls for more comprehensive frameworks of opportunity identification (Murphy 2010). Clarifying the mechanisms through which entrepreneurs influence new product and service introductions is an essential task for the field of entrepreneurship (Baron, Tang, and Hmieleski 2011). Much research on new product and service offerings focuses on either the effects of individual level characteristics or organizational characteristics (centralization, formalization, and slack resources). However, those approaches do not effectively capture joint influences of preexisting knowledge bases and firm-level technological innovation development. In our study, we show strong empirical support for "middle-step technological innovations" as mediating the relation between entrepreneurs' prior knowledge and the number of new market offerings, which lends credence to recent pronounce-

ments that opportunities are more than just "single-insight" phenomena (Dimov 2007).

Theoretic and Practical Implications

Our study offers several implications for theory. First, unlike a financial capital perspective, a human capital perspective does not necessarily hold that greater amounts of capital are always better. For example, sometimes, too much experience can mitigate an entrepreneur's ability to see and appreciate utterly novel venture ideas. Beyond a certain threshold, prior knowledge depreciation can reduce the positive effects due to forgetting, lost records, and turnover (Katila 2002). The research is mixed due to the need for advancement in the modest application of human capital theory in entrepreneurial contexts (Dimov and Shepherd 2005). Future research can examine whether prior knowledge is beneficial to entrepreneurial outcomes (such as new product and service offerings) up to a distinct inflection point, and whether any further gains in prior knowledge after that point may be actually detrimental to the viability or number of new product and service offerings.

Second, innovation is a process that encompasses the initiation and implementation stages (Damanpour 1991). As such, future studies should examine how firms innovate over time and how present-day firms employ prior knowledge and technological innovations developed at different points to create future products and services. Some scholars note that firms can and do build on recent technological innovations to enhance new product and service introductions because old ones become obsolete over time and no longer meet the needs of the market (Eisenhardt 1989; Thompson 1967). Still, others have indicated that older and established technological innovations are more reliable and valuable for firms. Moreover, many technological innovations are fusions or novel combinations of ideas discovered at temporally disparate points (Fleming 2001). To address these contradictory accounts, longitudinal designs may allow investigation of how prior knowledge shapes new product and service introductions through past technological innovations.

Third, as noted previously, the current literature depicts types of new products and services along a continuum to indicate how discrepant an offering or process is compared with existing ones (Gaglio 2004; Germain 1996; Mascitelli 2000; Shepherd and DeTienne 2005). For instance, based on the work of Mascitelli (2000), Gaglio (2004) suggests distinctions made in terms of imitative, substitute, incremental, evolutionary, radical, revolutionary, and discontinuous. Future research based on our study will illuminate the continuum and the differing determinants of these different types of new products. Furthermore, recent research has developed a typology of new product and service innovativeness based on alertness and systematic search (Tang and Khan 2007). Future research along the lines of our study can clarify the role of other important factors such as alertness (Tang, Kacmar, and Busenitz 2012) and systematic search (Fiet 2002) with respect to their influence on the novelty of new products and services.

One additional theoretic implication concerns the creation of new products and services for organizations as studied in the knowledge management literature (Schulze and Hoegl 2006). In this area, innovation is sometimes identified with harnessing new knowledge (Nonaka and Takeuchi 1995). However, it has been noted that new technological knowledge coevolves with new product and service development in firms as a way to innovate and respond to market needs (Schulze and Hoegl 2006). In

entrepreneurship research, by contrast, the linkage between prior knowledge and firm capability to generate new knowledge is unclear. Thus, future entrepreneurship studies should focus on the effects of prior knowledge on firm-level new knowledge generation (not just individual-level factors) in the development of technological innovations and new product and service introductions.

Our findings offer several practical implications for the management of entrepreneurial ventures. Whereas few would doubt the notion that innovation activity predicts the release of new products and services firms, our study puts this notion into context and highlights some limits of the relationship. Our findings show that prior knowledge is more strongly associated with technological innovation than with new product and service development. Thus, using human capital to select new employees for entrepreneurial ventures is appropriate for filling internal technological innovation positions. In other words, as noted earlier, the ancillary process of developing innovations into new products and services interfaces with knowledge present in the market environment (Damanpour 1991). Knowledge deriving from the external market shapes and develops technological innovations in ways that the prior knowledge of firm employees cannot. Therefore, entrepreneurs selecting employees based on prior knowledge should limit the application of that knowledge to premarket innovations and institute beta or market testing in order to inform the shaping innovations into products and services.

A mediating role of technological innovation suggests that successful introductions of new products and services in entrepreneurial firms may require careful management and utilization of technological innovation processes. It is particularly important for entrepreneurial firms to realize the utility of firm-level technological innovations because they invest significant human and financial resources in developing new products and services when entering a new market, yet the liability of smallness and newness (Aldrich and Auster 1986; Freeman, Carroll, and Hannan 1983) tends to hinder the potential success of a new product or service. However, as mentioned earlier, some new products and services stem from multiple firm technological innovations as a common source, whereas others derive from just one distinct firm technological innovation (Shane 2003). Thus, it is more beneficial and cost-effective for entrepreneurial firms to focus their limited resources on developing multiple new products and services from just one distinct firm technological innovation.

Another practical implication of our study concerns teams and the structure of entrepreneurial firms. As the new product and service development process spans multiple areas of a firm, our findings suggest that it is useful for specific teams and structural features to be devoted to internal innovation activity, whereas others are devoted to externally oriented market offering development. This management practice will yield more viable new products and services, but it can be a challenge to entrepreneurial ventures with informal, organic structures. If the team responsible for new product development is involved in externally oriented market research activity, concurrent involvement in internal technological innovation can hinder the viability of eventual new products and services. Building on arguments stemming from Kolodny et al. (1996) and Van de Ven et al. (1999), our study offers evidence that an operational structure reflecting sharp differences between internal technological development and the external aspects of new product and service development may be vital to entrepreneurial ventures.

Finally, our study illustrates the importance of coordination and

organization design in entrepreneurial management settings. Technological innovations not ready for application frequently require significant investments of resources before even preliminary external exposure. In turn, nascent versions of new products require careful exposure to external market elements and outside research before formal launch. We posit that the internal firm boundary between these two modes and its ramifications for entrepreneurial firm design and operations deserve greater attention. For entrepreneurial venture managers, our study provides justification for management decisions that acknowledge a full mediating role of technological innovation in the link between prior knowledge and new product and service development.

Limitations

Our findings are best regarded in light of a few limitations. The first one involves the fact that the variables of focal interest were assessed through a single survey. This raises mild concern about common method variance and resulting inflated correlations. To evaluate the potential of such threats, we conducted various tests to check for the presence of multicollinearity, outlier, and common method variance. Our results indicated no significant problems for our study, but future work could minimize these potential problems by designing and administering a survey from multiple sources. As well, two primary variables (technological innovations and new product and service introductions) were measured with single-item scales. Although these measures replicated previous empirical research, future studies could improve measurement by generating and validating multiple-item scales.

A second limitation concerns how intra-firm innovation activities influence new product and service introductions. We focus on technological innovations generated within the firm. However, some firms develop new products and services based on the technological innovations from outside the firm or industry (Damanpour 1991; Katila 2002). Do adopted technological innovations lead to more viable new product or service introductions than internally generated innovations? If firms generate their own technological innovations, can they also rely on externally ones in light of relevant transaction costs? Future research based on our study could investigate the effects of internally versus adopted generated technological innovations.

Third, as noted previously, mechanisms other than technological innovations can influence new product and service introductions. These mechanisms hinge on absorptive capacity, new knowledge creation capability, novelty of offerings, and speed to market. Although these mechanisms have been considered in past research (Atuahene-Gima 2003; Schoonhoven, Eisenhardt, and Lyman 1990; Zahra and George 2002), their effects on prior knowledge and new product and service introductions is worth direct investigation. Whereas we took initial steps toward such an investigation in our study, the more specific processes and linkages beg future research questions based on the implications of our research.

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References

Aldrich, H., and E. Auster (1986). "Even Dwarfs Started Small: Liabilities of Age and Size and Their Strategic Implications," in *Research in Organizational Behavior*, Vol. 8. Eds. L.

Cummings and B. Staw. Greenwich, CT: JAI Press, 165–198.

Amason, A. C., R. C. Shrader, and G. H. Tompson (2006). "Newness and Novelty: Relating Top Management Team Composition to New Venture Performance," *Journal of Business Venturing* 21, 125–148.

Ardichvili, A., R. Cardozo, and S. Ray (2003). "A Theory of Entrepreneurial Opportunity Identification and Development," *Journal of Business Venturing* 18(1), 105–123.

Argote, L. (1999). *Organizational Learning: Creating, Retaining and Transferring Knowledge*. Boston, MA: Kluwer.

Atuahene-Gima, K. (2003). "The Effects of Centrifugal and Centripetal Forces on Product Development Speed and Quality: How Does Problem Solving Matter?," *Academy of Management Journal* 46(3), 359–373.

Atuahene-Gima, K., and H. Li (2004). "Strategic Decision Comprehensiveness and New Product Development Outcomes in New Technology Ventures," *Academy of Management Journal* 47(4), 583–597.

Banbury, C., and W. Mitchell (1995). "The Effect of Introducing Important Incremental Innovations on Market Share and Business Survival," *Strategic Management Journal* 16, 161–182.

Barney, J. (1991). "Firm Resources and Sustained Competitive Advantage," *Journal of Management* 17, 99–121.

Baron, R. A., and J. Tang (2011). "The Role of Entrepreneurs in Firm-Level Innovation: Joint Effects of Positive Affect, Creativity, and Environmental Dynamism," *Journal of Business Venturing* 26, 49–60.

Baron, R. A., J. Tang, and K. M. Hmieleski (2011). The Downside of Being "Up": Entrepreneurs' Dispositional Positive Affect and Firm Performance. *Strategic Entrepreneurship Journal* 5, 101–119.

Baron, R. M., and D. A. Kenny (1986). "The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations," *Journal of Personality and Social Psychology* 51, 1173–1182.

Baum, J. R., E. A. Locke, and K. G. Smith (2001). "A Multidimensional Model of Venture Growth," *Academy of Management Journal* 44, 292–303.

Becker, G. S. (1964). *Human Capital*. Chicago, IL: University of Chicago Press.

Bower, G. H., and E. R. Hilgard (1981). *Theories of Learning*. Engle-Wood Cliffs, NJ: Prentice-Hall.

Brown, S., and K. Eisenhardt (1995). "Product Development: Past Research, Present Findings, and Future Directions," *Academy of Management Review* 20, 343–378.

Burgelman, R. (1991). "Intraorganizational Ecology of Strategy Making and Organizational Adaptation: Theory and Field Research," *Organization Science* 2, 239–262.

Burns, T., and G. M. Stalker (1994). *The Management of Innovation*. London: Oxford University Press.

Casson, M. (1995). *Entrepreneurship and Business Culture*. Aldershot: Edward Elgar.

Chaney, P., and T. Devinney (1992). "New Product Innovations and Stock Price Performance," *Journal of Business Finance and Accounting* 19, 677–695.

Cohen, W. M., and D. A. Levinthal (1990). "Absorptive Capacity: A New Perspective on Learning and Innovation," *Administrative Science Quarterly* 35, 128–152.

Cooper, A. C., J. Gimeno, and C. Woo (1994). "Initial Human and Financial Capital as Predictors of New Venture Performance," *Journal of Business Venturing* 9, 371–395.

Corbett, A. C. (2007). "Learning Asymmetries and the Discovery of Entrepre-

neurial Opportunities," *Journal of Business Venturing* 22(1), 97–118.

Corbett, A. C., H. M. Neck, and D. R. DeTienne (2007). "How Corporate Entrepreneurs Learn from Fledgling Innovation Initiatives: Cognition and the Development of a Termination Script," *Entrepreneurship Theory and Practice* 31(6), 829–852.

Covin, J. G., and D. P. Slevin (1989). "Strategic Management of Small Firms in Hostile and Benign Environments," *Strategic Management Journal* 10(1), 75–87.

Daft, R. L. (1978). "A Dual-Core Model of Organizational Innovation," *Academy of Management Journal* 21, 193–210.

Damanpour, F. (1987). "The Adoption of Technological, Administrative, and Ancillary Innovations: Impact of Organizational Factors," *Journal of Management* 13, 675–688.

——— (1991). "Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators," *Academy of Management Journal* 34, 555–590.

Deeds, D. L., D. DeCarolis, and J. Coombs (1999). "Dynamic Capabilities and New Product Development in High Technology Ventures: An Empirical Analysis of New Biotechnology Firms," *Journal of Business Venturing* 15, 211–229.

Delmar, F., and P. Davidsson (2000). "Where Do They Come From? Prevalence and Characteristics of Nascent Entrepreneurs," *Entrepreneurship and Regional Development* 12, 1–23.

Dewar, R. D., and J. E. Dutton (1986). "The Adoption of Radical and Incremental Innovations: An Empirical Analysis," *Management Science* 32, 1422–1433.

Dimov, D. (2007). "Beyond the Single-Person, Single-Insight Attribution in Understanding Entrepreneurial Opportunities," *Entrepreneurship Theory and Practice* 31(5), 713–732.

Dimov, D. P., and D. A. Shepherd (2005). "Human Capital Theory and Venture Capital Firms: Exploring Human Runs and Strike Outs", *Journal of Business Venturing* 20, 1–21.

Edwards, K. L., and T. J. Gordon (1984). "Characterization of Innovation Introduced on the U.S. Market in 1982," U.S. Small Business Administration.

Eisenhardt, K. (1989). "Making Fast Strategic Decisions in High-Velocity Environments," *Academy of Management Journal* 32, 543–576.

Ettlie, J. E., W. P. Bridges, and R. D. O'Keefe (1984). "Organization Strategy and Structural Differences for Radical versus Incremental Innovation," *Management Science* 30, 682–695.

Evans, D. S., and L. S. Leighton (1989). "Some Empirical Aspects of Entrepreneurship," *American Economic Review* 79, 519–535.

Fiet, J. O. (2002). *The Systematic Search for Entrepreneurial Discoveries*. Westport, CT: Quorum.

Fleming, L. (2001). "Recombinant Uncertainty in Technological Search," *Management Science* 47, 117–132.

Fox, J. (1997). *Applied Regression, Linear Models, and Related Methods*. Thousand Oaks, CA: Sage.

Freeman, J., G. R. Carroll, and M. T. Hannan (1983). "The Liability of Newness: Age Dependence in Organizational Death Rates," *American Sociological Review* 48, 692–710.

Gaglio, C. A. (2004). "So What Is an Entrepreneurial Opportunity?," in *Opportunity Identification and Entrepreneurial Behavior*. Ed. J. E. Butler. Greenwich, CT: Information Age Publishing, 115–134.

Galunic, D. C., and S. Rodan (1998). "Resource Recombinations in the Firm: Knowledge Structures and the Potential for Schumpeterian Innovation," *Strategic Management Journal* 19, 1193–1201.

Germain, R. (1996). "The Role of Context and Structure in Radical and Incremental Logistics Innovation Adoption," *Journal of Business Research* 35, 117–127.

Gimeno, J., T. Folta, A. Cooper, and C. Woo (1997). "Survival of the Fittest? Entrepreneurial Human Capital and the Persistence of Underperforming Firms," *Administrative Science Quarterly* 42, 750–783.

Greve, H. R. (2003). "A Behavioral Theory of R&D Expenditures and Innovations: Evidence from Shipbuilding," *Academy of Management Journal* 46(6), 685–702.

Hitt, M. A., L. Bierman, K. Shimizu, and R. Kochhar (2001). "Direct and Moderating Effects of Human Capital on Strategy and Performance in Professional Service Firms: A Resource-Based Perspective," *Academy of Management Journal* 44(1), 13–28.

Hutchins, E. (1983). "Understanding Micronesian Navigation," in *Mental Models*. Eds. D. Gentner and A. Stevens. Hillsdale, NJ: Erlbaum, 191–225.

Katila, R. (2002). "New Product Search Over Time: Past Ideas in Their Prime?," *Academy of Management Journal* 45(5), 995–1010.

Katila, R., and G. Ahuja (2002). "Something Old, Something New: A Longitudinal Behavior of Search Behavior and New Product Introduction," *Academy of Management Journal* 45(6), 1183–1194.

Katz, J. A., and R. Green (2008). *Entrepreneurial Small Business*, 2nd ed. Irwin: McGraw Hill.

Keller, R. T. (2001). "Cross-Functional Project Groups in Research and New Product Development: Diversity, Communications, Job Stress and Outcomes," *Academy of Management Journal* 44(3), 547–555.

Kimberly, J. R. (1981). "Managerial Innovation," in *Handbook of Organizational Design*, Vol. 1, Eds. P. C. Nystrom and W. H. Starbuck. New York: Oxford University Press, 84–104.

Kimberly, J. R., and M. Evanisko (1981). "Organizational Innovation: The Influence of Individual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations," *Academy of Management Journals* 24, 689–713.

Ko, S., and J. Butler (2006). "Prior Knowledge, Bisociative Model of Thinking and Entrepreneurial Opportunity Identification," *International Journal of Entrepreneurship and Small Business* 3, 3–16.

Kolodny, H., M. Liu, B. Stymne, and H. Denis (1996). "New Technology and the Emerging Organizational Paradigm," *Human Relations* 49(12), 1457–1487.

MacKinnon, D. P., and J. H. Dwyer (1993). "Estimating Mediated Effects in Prevention Studies," *Evaluation Review* 17, 144–158.

March, J. (1991). "Exploration and Exploitation in Organizational Learning," *Organization Science* 2, 71–87.

Marino, K. E. (1982). "Structural Correlations of Affirmative Action Compliance," *Journal of Management* 8, 75–93.

Mascitelli, R. (2000). "From Experience: Harnessing Tacit Knowledge to Achieve Breakthrough Innovation," *Journal of Product Innovation Management* 17, 179–193.

Murphy, P. J. (2010). "A 2x2 Conceptual Foundation for Entrepreneurial Discovery Theory," *Entrepreneurship Theory and Practice* 35(2), 359–374. Wiley InterScience Early View DOI: 10.1111/j.1540-6520.2010.00368.x.

Myers, S., and D. G. Marquis (1969). *Successful Industrial Innovations*. Washington, DC: National Science Foundation.

Neter, J., M. H. Kutner, C. J. Nachtsheim, and W. Wasserman (1996). *Applied Linear Statistical Models*. Chicago, IL: Irwin.

Nonaka, I., and H. Takeuchi (1995). *The Knowledge-Creating Company*. New York: Oxford University Press.

Nord, W. R., and S. Tucker (1987). *Implementing Routine and Radical Innovations*. Lexington, MA: Lexington Books.

Podsakoff, P. M., S. B. MacKenzie, J. Lee, and N. P. Podsakoff (2003). "Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies," *Journal of Applied Psychology* 88, 879–903.

Rao, H., and R. Drazin (2002). "Overcoming Resource Constraints on Product Innovation by Recruiting Talent from Rivals: A Study of the Mutual Fund Industry," *Academy of Management Journal* 45(3), 491–507.

Roberts, P. (1999). "Product Innovation, Product-Market Competition, and Persistent Profitability in the U.S. Pharmaceutical Industry," *Strategic Management Journal* 20, 655–670.

Rosner, M. M. (1968). "Economic Determinants of Organizational Innovation," *Administrative Science Quarterly* 12, 614–625.

Ross, P. R. (1974). "Innovation Adoption by Organizations," *Personnel Psychology* 27, 21–47.

Schoonhoven, C. B., K. M. Eisenhardt, and K. Lyman (1990). "Speeding Products to Market: Waiting Time to First Product Introduction in New Firms," *Administrative Science Quarterly* 35, 177–207.

Schultz, T. (1959). "Investment in Man: An Economist's View," *Social Service Review* 33(2), 69–75.

Schulze, A., and M. Hoegl (2006). "Knowledge Creation in New Product Development Projects," *Journal of Management* 32, 210–236.

Schumpeter, J. A. (1939). *The Theory of Economic Development*. Cambridge, MA: Harvard University Press.

Shane, S. (2000). "Prior Knowledge and the Discovery of Entrepreneurial Opportunities," *Organization Science* 11(4), 448–469.

——— (2003). *A General Theory of Entrepreneurship*. Northampton, MA: Edward Elgar.

Shane, S., and S. Venkataraman (2000). "The Promise of Entrepreneurship as a Field of Research," *Academy of Management Review* 25, 217–226.

Shapiro, C., and H. R. Varian (1999). "Art of Standards Wars," *California Management Review* 41, 8–32.

Shepherd, D. A., and D. R. DeTienne (2005). "The Impact of Prior Knowledge and Financial Reward on the Identification of Opportunities," *Entrepreneurship Theory and Practice* 29(1), 91–112.

Shrout, P. E., and N. Bolger (2002). "Mediation in Experimental and Nonexperimental Studies: New Procedures and Recommendations," *Psychological Methods* 7, 422–445.

Smith, K. G., C. J. Collins, and K. D. Clark (2005). "Existing Knowledge, Knowledge Creation Capability, and the Rate of New Product Introduction in High-Technology Firms," *Academy of Management Journal* 49(2), 346–357.

Sobel, M. E. (1982). "Asymptotic Confidence Intervals for Indirect Effects in Structural Equations Models," in *Sociological Methodology*. Ed. S. Leinhart. San Francisco, CA: Jossey-Bass, 290–312.

Tabachnick, B. G., and L. S. Fidell (2007). *Using Multivariate Statistics*, 5th ed. Boston, MA: Allyn and Bacon.

Tang, J., M. Kacmar, and L. Busenitz (2012, In press). "Alertness in the Pursuit of New Opportunities," *Journal of Business Venturing*.

Tang, J., and S. A. Khan (2007). "Dynamic Interactions between Alertness and Systematic Search: A Yin and Yang Perspective on Opportunity Recognition and Innovation," *International Journal of Entrepreneurship and Innovation* 8(3), 175–187.

Thompson, J. (1967). *Organizations in Action*. New York: McGraw Hill.

Thompson, V. A. (1965). "Bureaucracy and Innovation," *Administrative Science Quarterly* 10, 1–20.

Thornhill, S. (2006). "Knowledge, Innovation, and Firm Performance in High- and Low-Technology Regimes," *Journal of Business Venturing* 21, 687–803.

Van de Ven, A. H. (1986). "Central Problems in the Management of Innovation," *Management Science* 32, 590–607.

Van de Ven, A. H., D. E. Polley, R. Garud, and S. Venkataraman (1999). *The Innovation Journey*. New York: Oxford University Press.

Van de Ven, A. H., and E. M. Rogers (1988). "Innovation and Organizations—Critical Perspectives," *Communication Research* 15, 632–651.

Weber, R. (1980). "Some Characteristics of Free Recall of Computer Controls by EDP Auditors," *Journal of Accounting Research* 18, 214–241.

Zahra, S. A., and G. George (2002). "Absorptive Capacity: A Review, Reconceptualization, and Extension," *Academy of Management Review* 27, 185–203.

Zmud, R. W. (1982). "Diffusion of Modern Software Practices: Influence of Centralization and Formalization," *Management Science* 30, 727–738.