

THE OPPORTUNITY-BASED APPROACH TO ENTREPRENEURIAL DISCOVERY RESEARCH

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It is probable that many things should happen contrary to probability.
—Aristotle (*Poetics*, ch. 18)

It is almost a truism in entrepreneurship research that the entrepreneurial process begins most basically with the discovery of opportunities (Shane & Venkataraman, 2000). Entrepreneurship scholars have also noted that opportunities have distinctive conceptual properties (Venkataraman, 1997). Even so, it has gone almost unnoticed that the basic and distinctive nature of opportunities calls for a novel research approach (Eckhardt & Shane, 2003). Most of the entrepreneurship research emphasizing opportunities relies heavily on theory and method from other content areas in the social sciences and the domain of business studies. Opportunities elude the usual theoretic structures in those areas, which has hindered unique theoretic advancements. In this chapter, we articulate underpinnings of a distinct theoretic direction for entrepreneurial discovery research. Our undertaking constitutes an introduction to what we call the opportunity-based approach (OBA).

Though the entrepreneurial process begins with opportunities, it entails other important elements. Such elements include assembling resources, managing a going concern, growing a business venture, and others. The OBA is not intended to apply to those elements, which entail different kinds of phenomena, but only to opportunities in nascent stages. As such, the approach we articulate can lead to hypotheses about opportunities, but it cannot represent a paradigm for all entrepreneurship research. We intend it to be a middle-range theory (Merton, 1967, p. 39) circumscribed to entrepreneurial discovery. We will emphasize

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methodological aspects because empirical considerations follow directly from theoretic foundations (Cook & Campbell, 1979, p. 23). It is also worth noting that our contribution is not intended to be exhaustive. Rather, it is intended to guide future studies that develop the OBA further and help distinguish entrepreneurship as an area of research.

This chapter comes in three major sections. In the first major section, we review past work and conceptualize opportunity as a construct. We explain episodic knowledge as a principal element of opportunities that transcends person and environment. We also explain the knowledge problem—a serious obstacle to entrepreneurship research that the OBA is designed to help clear. Next, we explain the empirical nature of the opportunity construct with a conceptual description, mathematical illustration, and practical example. In the second major section, we describe the character of empirical studies based on the OBA. There we develop three propositions for OBA research pertaining to variable operationalization, levels of analysis, and nonparametric versus parametric statistics. In the third and final major section, we discuss general implications of the OBA.

Entrepreneurship Theory and Opportunities

Entrepreneurship research addresses the discovery, evaluation, and utilization of future goods and services (Venkataraman, 1997). Its definition does not necessarily include or exclude the creation of an organization, and it does not require the same person or firm to engage in all parts of the entrepreneurial process (Eckhardt & Shane, 2003). The definition indicates that entrepreneurship begins with opportunities. Opportunities are new means—ends frameworks, whereby a variety of new goods, services, raw materials, markets, and organizing methods can be introduced and implemented in a market system (Casson, 1982; Shane & Venkataraman, 2000). The process requires growth: only one or few individuals tend to participate in a nascent opportunity, but the ramifications can generate value for many individuals.

Opportunities have been examined in entrepreneurship research assuming the most basic tenets from psychology, sociology, economics, marketing, and other fields. Whereas incremental advancements have been made along these lines, theories and methods from other fields are not liable to make novel contributions (Venkataraman, 1997). For instance, recognized opportunities have an objective and autonomous aspect that can evolve beyond their discoverers. That feature is outside the boundary conditions of typical models from economics (Baumol, 1993) and psychology (Low & Macmillan, 1988). As well, person-centric research that casts individuals as the principal unit of analysis, as in psychology, is known to mistakenly attribute opportunity-based variance to individuals instead (Shane, 2000). Such limitations underline the need for a distinct theoretic direction when explaining the emergence and existence of opportunities.

Research emphasizing opportunities assumes that the set of empirical factors in entrepreneurial discovery events rotates more evenly around opportunities than around people or firms (Kirzner, 1997). Person-centric research is strained here because opportunities derive unitarily from micro and macro factors. Studies are increasingly acknowledging this aspect (Dimov, 2003; Eckhardt & Shane, 2003; Murphy, Liao, & Welsch, 2006; Shane & Venkataraman, 2000). The theoretic importance of opportunities is increasing on these grounds but there is still no paradigmatic approach (McMullan & Shepherd, 2006). We present underpinnings for such an approach beginning with the role of episodic knowledge in entrepreneurial discovery (Jacobson, 1992).

Episodic Knowledge

Episodic knowledge is a core element of the OBA. It heralds information about particular circumstances of eventual time and place. It emerges and exists irregularly. It is possessed by one or many individuals and is dispersed idiosyncratically in a market system with validity that is tentative. Episodic knowledge is unpredictable and the entrepreneurial discovery outcomes to which it leads cannot be calculated *a priori* (Kirzner, 1997). Rather, the means-ends linkages are only comprehensible *a posteriori*, which is unfortunately when theory can become redundant and predictions can become *retrodictions*. Because episodic knowledge is empirically discontinuous, studies require a logic less frustrated by breakouts from limits imposed by the unknown. The challenge here for entrepreneurship research is not only to use an approach compatible with such breakouts but to also employ methodologies reflecting that compatibility. Otherwise, entrepreneurship research will be hard-pressed to make contributions that research in other areas cannot offer already.

Episodic knowledge helps account for why common research designs do not explain entrepreneurship very well (Venkataraman, 1997). Simply put, episodic knowledge data are not amenable to laws or norms. It is impossible to operationalize them with reliable scales because they indicate particular circumstances germane to short-term events and long-term stretches of time (Hayek, 1945; Kirzner, 1997). They elude static models and are abstruse to normative research approaches because they do not vary by degree. Instead, they vary categorically and idiosyncratically. Such essential change across cases presents researchers with a conundrum that has been described as the knowledge problem (Yates, 2000).

The Knowledge Problem

Entrepreneurship theory must take steps to conceptualize how knowledge outside the purview of an entrepreneur can contribute meaningfully to opportunities (Kirzner, 1984). Such data manifest themselves episodically in a

variety of forms. They can emerge unexpectedly from chance relations with potential customers or partners (Von Hippel, 1986). They can also stem from unpredictable but purposeful activities in an organizational field (Freeman, 1982). As well, they can exist based on information possessed by a friend or colleague rather than the entrepreneur (Zimmer & Aldrich, 1987). Indeed, the total stock of knowledge contributing to any opportunity includes knowledge possessed by the discoverer and others. Therefore, it transcends the entrepreneur. Entrepreneurship theory has attempted to engage this issue by combining individual motivation with a psychological willingness to bear uncertainty (McMullan & Shepherd, 2006).

Entrepreneurship theory emphasizing entrepreneurs is valuable but misses a key principle of social and economic systems. Namely, market actors create new data through purposeful action, which affect how other actors perceive their own circumstances on the most basic level (Hayek, 1948, p. 38). This mechanism raises the knowledge problem in entrepreneurial contexts because the external actions of others bear directly on an entrepreneur's episodic knowledge. Indeed, entrepreneurship research is frustrated uniquely by the knowledge problem, more so than other areas of business research (Kirzner, 1997). For example, firm-level marketing research influenced by Simon (1957) describes imperfect procedural rationality and appropriate deliberation by firms as means to deal with uncertainty and limited knowledge (Dickson, 1992; Hunt & Morgan, 1995). The probabilistic decision making of these theories is volatile when it comes to opportunities because of the centrality of unforeseen episodic knowledge. Thus, entrepreneurs are thought to utilize alertness and second-order probability distributions based on awareness that the right factors may align and circumstances may eventually yield an opportunity (Yates, 2000). Even so, they still remain substantially unaware because of the discontinuity of knowledge about those factors and circumstances (Kirzner, 1973). This discontinuity is the source of opportunity variance. It is out of bounds for person-centric theory, even if an opportunity is recognized.

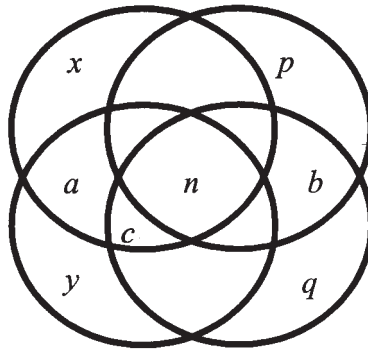
The Nature of Opportunities

Opportunities cannot be conceptualized as a set of factors that recur reliably across cases, because variance in them obfuscates normative research. The scores that derive from opportunity variance can rarely be aggregated meaningfully. Thus, normative entrepreneurship research that emphasizes static aspects of individuals cannot delineate reliable dimensions because the antecedents rarely influence discovery in the same way (Carroll & Mosakowski, 1987). The OBA explains opportunities based on convergences of episodic knowledge of particular spatial and temporal circumstances (Drucker, 1985, p. 111; Hayek, 1945; Kirzner, 1984). The approach is not person-centric but admits

that knowledge logically accompanies expectations about the future (Hayek, 1948, p. 51; Popper, 1990, p. 32). Episodic knowledge thus pertains to expected place and time. This logic holds important implications for the OBA. In this section we examine the logic and implications with a conceptual illustration, mathematical proof, and practical example.

The spatial and temporal convergences of factors that make up an opportunity are indicated empirically by espoused episodic knowledge of them. The factors can include price differentials, plans and activities of competitors, consumer trends, evolving technologies, projected market trends, training in new skills, prior experience, key relationships, means for resource acquisition, and many any other kinds of factors. Because social and market systems evolve, a convergence of the right factors in the right place at the right time implies potential generation of future value and market importance (Drucker, 1985, p. 111). Figure 1 illustrates this logic in a simplified Venn diagram. The opportunity construct is a nexus (n) of four convergent factors: x , y , p , and q . Without any given factor, n does not exist. Two-factor interactions (such as x and y or p and q) constitute other convergences (such as a or b), whereas three-factor interactions (such as x , y , and q) constitute still other convergences (such as c). Those convergences are distinct from the opportunity of interest (n) and not currently viable. Joint consideration of a , b , and c conveys the empirical challenge facing any study of n . Only a research design incorporating all concomitant factors can effectively operationalize the holistic nexus. To the degree x , y , p , and q represent different levels of analysis (person versus environment), that challenge is exacerbated by empirical asymmetry.

Figure 1
Opportunity Construct: Nexus and Convergent Factors



Another aspect of the challenge can be illustrated mathematically. Proof n is based on Miller's (1975) and Popper's (1973) work on the accuracy of predictions in research examining holistic phenomena. The proof,

$$\begin{aligned} \text{(a)} \quad & x = q - 2p \\ & y = 2q - 3p \\ \text{(n)} \quad & \\ \text{(b)} \quad & p = y - 2x \\ & q = 2y - 3x \end{aligned}$$

exemplifies structural relations underlying a convergence of factors x , y , p , and q as illustrated in Figure 1. Let the true value of $x = 0$, $y = 1$, $p = 1$, and $q = 2$. All four equations are solvable by the true values. Further, the two equations in (a) combine to yield $x + y = 3q - 5p$ and the two in (b) combine to yield $p + q = 3y - 5x$, which are both solvable by the true values. Removing any factor renders proof n unsolvable and substitution shows subsets (a) and (b) to be mutually deducible, as

$$\begin{aligned} x &= q - 2p \\ x &= q - 2(y - 2x) \\ x &= q - 2y + 4x \\ x &= (2y - 3x) - 2y + 4x \\ x &= x \end{aligned}$$

and

$$\begin{aligned} y &= 2q - 3p \\ y &= 2(2y - 3x) - 3p \\ y &= 4y - 6x - 3(y - 2x) \\ y &= 4y - 6x - 3y + 6x \\ y &= y. \end{aligned}$$

Identical solutions apply to p and q as they entail the same function. The proof thus describes an ideally holistic phenomenon.

Normative research examines holistic phenomena by delineating reliable composite factors and interrelations. Of course, such approaches are rarely able to incorporate all the factors into one design, so their validity depends on reliability. For example, a sociological approach cannot jointly measure individual-level psychological and macroeconomic factors when explaining entrepreneurial discovery. Instead, such approaches measure a subset of all composite factors and generalize to the whole. In this example, assume x and y are measurable by a certain research paradigm (P_1). Given precedent of past research, studies in P_1 begin to generate similar findings. The community of researchers who embrace P_1 do not know the true values given above, but assume P_1 produces a theory claiming $x = .10$ and $y = 1.00$. It is known that P_1 analyzes

only part of n (i.e., not p and q), but as findings recur reliably the researchers extrapolate p and q and generalize their model to the whole phenomenon. In time, another paradigm (P_2) emerges and claims that $x = .15$ and $y = 1.225$. Initially P_2 appears less correct than P_1 and, importantly, we can see that its purported values for x and y are further from the true values than those of P_1 . However, if all researchers in both paradigms knew the true values of p and q , a surprising result would be revealed. As P_2 yields $p = .925$ and $q = 2.0$, it is actually more valid than P_1 , which yields $p = .80$ and $q = 1.70$. P_2 models the whole phenomenon better with an overall deviation of .45 from the set of true values, versus .60 for P_1 .

This error is a particular threat to traditional entrepreneurial discovery research that emphasizes types of individuals or environments. Put simply, all the convergent factors (e.g., p and q) are not observable and can undermine systematic observations (e.g., of x and y) arbitrarily. The error persists even when unobservable factors relate lawfully to observed factors. Cook and Campbell (1979: 296) explain this error as pernicious in traditional research examining causal linkages of holistic phenomena like entrepreneurial discovery. The effect certainly is a threat to entrepreneurial discovery theory that is person-centric.

The practical ramifications of Figure 1 and proof n can be conveyed by an example. Consider the discovery of an opportunity to start a residential construction business on the west coast of the United States. Aside from knowing potential customers, venture partners, etc., technical knowledge of how to build homes is one factor of this opportunity. Such knowledge could come from technical manuals or past experience. There are many other necessary episodic factors, such knowing the best place to procure start-up funding and having current knowledge of building codes. One factor of episodic knowledge is how to acquire and use sheetrock, the gypsum material used for walling. There may be still other kinds of episodic knowledge required, such as how to install state of the art electrical wiring, pour a concrete foundation, or construct the framing of the house. These and other necessary factors may be indicated by x , y , p , and q , etc. as in the prior two examples, and they can be seen to converge (n) in the right place at the right time in this opportunity. To illustrate the effect of episodic knowledge on the opportunity, consider that sheetrock was widely available in the 1940s–1950s. However, there is now an increasing shortage of the gypsum required to produce sheetrock. The decreasing availability diminishes an episodic knowledge factor pertaining to the application of existing resources in this example. Current knowledge about a diminishing existing resource is germane to the overall opportunity, as a full convergence does not exist without sheetrock or a viable alternative. Despite the presence of all the other factors, the convergence of episodic knowledge factors is incomplete. As such, there is no opportunity because there is no way to put walls in the constructed homes. However, alternatives to sheetrock-based walling have emerged and more will emerge in the future (e.g., FibeRock©,

a mixture of gypsum and cellulose). As such, episodic knowledge of those emergent factors is part of the opportunity. Drucker (1985, p. 114) describes this process in terms of entrepreneurial discoveries not able to occur without a convergence of necessary factors.

The challenge for entrepreneurial discovery research is to not be confounded by the discontinuous effects deriving from dwindling gypsum and emerging FibeRock. Those effects are not lawful; although they can be forecasted somewhat generally, they are empirically unpredictable and episodic. That volatility logically deposes the reliability traditional empirical methods require before they can generate valid results. The OBA is intended to be more amenable to such volatility by regarding opportunities themselves as research constructs. The next section presents the logic behind this view.

Clarifying Opportunities As Research Constructs

Any empirical element in social science research can be organized in terms of three classifications (Popper, 1979: 154). The framework is useful for understanding opportunities conceptually and characterizing the OBA. The first classification consists of actual things, such as physical resources or material objects. These items are autonomous because their existence is separate from that of any individuals who may perceive them. They are objective because more than one individual can perceive or utilize such items similarly. In entrepreneurship research, this empirical classification refers to workspaces, physical properties, equipment, financial capital, etc. Such resources are physical and can influence entrepreneurial discovery.

The second classification includes mental states such as attitudes, character traits, plans, or expectations, which all depend on cognitive structures and perceptions. These items are measurable but they are not objective because their existence relies on the mind perceiving them. They are not autonomous because mental states cannot exist apart from the mind that bears them. In entrepreneurship research, this empirical classification refers to levels of alertness, attitudes regarding risk, personality traits, beliefs, and outlooks on the future. These items have received much attention in the entrepreneurship field (Arenius & Minnit, 2005; Brockhaus, 1980; Gupta, MacMillan, & Surie, 2004; Stanley & Gilad, 1991). The first two classifications reflect social realist (objective existence) and social constructionist (existence based on beliefs and social arrangements) ontologies, which have been used to describe theory development in entrepreneurship (McMullen & Shepherd, 2006). Items in both classifications can participate in entrepreneurial discovery. However, neither of these two classifications (singly or jointly) adequately describes the conceptual nature of opportunities.

The third classification includes items such as systems of meaning (e.g., languages), articulated theories (e.g., the theory of prime numbers or twin primes), or developed technologies (e.g., software programs). Such items have

immaterial aspects unlike the material items of the first classification. They are also objective, unlike the mental items of the second classification. These items are empirically peculiar and their autonomous nature makes them indescribable by the previous two classifications. Like the first two classifications, these items are created by subjective human thought. However, these items also lead to consequences and new items that are wholly objective. Opportunities fit this classification as they give rise to new opportunities that were previously impossible (Kirzner, 1997; Shane & Venkataraman, 2000). Those ancillary opportunities exhibit the same autonomy as the ones from which they derived.¹ By characterizing opportunities in terms of this classification, the OBA goes beyond descriptions based on realism versus social constructionism (McMullan & Shepherd, 2006) and articulates a conceptual middle ground not described by those ontologies. The distinct conceptualization calls for certain kinds of methodological approaches.

The OBA acknowledges that empirical research analyzing dynamic phenomena will lead to inductive reasoning quandaries if it seeks reliable interrelations among composite factors (Hume, 1739; Kant, 1781). The logic reflects tenets of early theory about methodology in the social sciences. Popper (1979) explains that the view of knowledge as objective derives from Baldwin (1887), Morgan (1903), and Jennings (1935). Morgan (1923) describes the convergence logic of episodic knowledge as “emergent evolution” and Popper (1973) and Campbell (1974) describe it as “evolutionary epistemology.” Contemporary entrepreneurship research and theory have not drawn effectively from these important contributions and stand to benefit immensely from incorporating their logic when describing emergent phenomena. Drucker (1985) reflects this perspective unmistakably. We now discuss how the OBA incorporates the same logic.

The Empirical Study of Opportunities

Entrepreneurship scholars have called explicitly for more appropriate empirical methods for almost twenty years (Bygrave & Hofer, 1991; Eckhardt & Shane, 2003; Robinson & Hofer, 1997; Fiet, 2002, p. 222; Low & MacMillan, 1988; Robinson & McDougall, 1998). These scholars cite the peculiar nature of entrepreneurial discovery, implying the need for a new research paradigm. Framing an opportunity as a study outcome and explaining variance in it requires distinct methodological considerations. Accordingly, the OBA is not intended to apply to other areas in the domain of business studies, nor does it apply to other stages of the entrepreneurial process. Formation rates and new venture performance levels, to be sure, are outside its theoretic boundary conditions. The OBA is based on theory and it thus requires data for generating evidence for the validity of its logic and explanations. Empirical observations, to be sure, are always theory-laden (Cook & Campbell, 1979, p. 23). As such, appropriate empirical methods follow directly from conceptual foundations. The OBA

assumes opportunities can be operationalized and we offer three implications for empirical studies of them.

First, because opportunities have objective aspects, they are more fitting as units of analysis than people or firms (Shane, 2000). Further, as they are conceptually distinct, they call for a novel kind of operationalization. Second, because the episodic knowledge constituting opportunities transcends individuals and environments, OBA studies are best undertaken via an approach logically admitting opportunities to derive from all the empirical levels of an economic or social system (Venkataraman & Sarasvathy, 2001). Third, because opportunities are dynamic and not reliable, the OBA is intended to not be frustrated disequilibrium conditions, discontinuous emergence, or categorical variance (Robinson & Hofer, 1997). The OBA is, therefore, more amenable to nonparametric statistical methods that do not assume homogenous variances and are not confounded by non-normal score distributions. Next, we expand on these three notions and develop three corresponding propositions about their implications for the OBA.

Operationalizing Episodic Knowledge

When entrepreneurs articulate and espouse what they know about their circumstances, it indicates possessed episodic knowledge. Such propositions about acquired knowledge by market actors have been described explicitly as the most meaningful empirical elements in a market system (Hayek, 1948: 33). This premise underlies a tenet of the OBA as it leads to a meaningful way to operationalize episodic knowledge. The OBA research uses definite statements about episodic knowledge from entrepreneurs or direct observations about what is clearly known to them to explain entrepreneurial discovery. This kind of datum represents a different empirical element than that generated by scaled variables designed to control for random error and operationalize the “essence” of a construct.

Methodological research and theory in the social sciences has long illustrated that indicators of an actual object yield important information about outcomes (Popper, 1957, p. iii). Similarly, entrepreneurship scholars such as Fiet and Kosnick (1995) have speculated that the best way to measure dynamic entrepreneurial factors is to collect data based on direct indicators of them. Empirical approaches like the OBA that measure direct proxies or indicators of dynamic phenomena have been described sciences of the artificial (Sarasvathy, 2003). We use the term “direct indicators” to highlight differences between directly reported data and data generated from scaled survey items that aggregate across cases in normative research. The differences may seem conceptually insignificant, but the empirical ramifications are profound. Direct indicators contain many accidental features of no interest to a normative approach. Yet, the OBA emphasizes the value of those features. As such, OBA research must

avoid the assumption that information is largely known across actors. Rather, it must logically reflect that the data are partial to the specificity of each actor (Hayek, 1948, p. 39; Yates, 2000).

Despite uncertain circumstances, entrepreneurs do make specific statements about current and expected events based on unique understandings and definitions. The empirical ramifications are clear when considering settings in which multiple people possess idiosyncratic knowledge that they believe is valid (Hayek, 1948, p. 60). In those cases, each person defines reality differently, based on novel beliefs and episodic knowledge, regardless of whether anyone else concurs. The situation describes entrepreneurial discovery contexts and differs markedly from other situations where individuals share common knowledge. In settings where knowledge is more consistent, it underlies a higher-level empirical factor to which the uniqueness of individual's definition can be compared. That higher-level construct is seen as measurable and just as worthy of investigation as the individuals themselves (Popper, 1957, p. 28). Normative research is designed to measure such constructs and thus logically requires shared knowledge across cases. Such approaches generate valid findings in many management research contexts. However, episodic knowledge data confounds the implicit logic of those approaches.

Empirical reliability and norms do not work well for describing entrepreneurs and their activity (Venkataraman, 1997). Person-centric research, designed to identify types of individuals and environments, fails empirically because opportunity data cannot be aggregated meaningfully. The variance is not normative or degreed; it is idiosyncratic. Episodic knowledge is operationalized via direct categorical indicators. Such data can be captured via embedded case study designs in which the opportunity is the unit of analysis (Shane, 2000). They can be captured in larger-scale empirical studies that operationalize episodic knowledge as frequency data via categorical checkboxes or large item checklists. Large scale OBA efforts do not define the content of episodic knowledge. Rather, they indicate the kinds of episodic knowledge relevant to a given discovery. Therefore, the OBA regards opportunity data as nominal, not ordinal or degreed, and not amenable to reliable measurement scales.

Proposition 1: Empirical research using measurement scales or similar normative approaches does not explain opportunity variance reliably. Opportunities vary categorically across cases of entrepreneurial discovery based on dynamic convergences of idiosyncratic episodic knowledge. They are indicated directly by categorical frequency data.

Levels of Analysis

Even if unfamiliar with Lewin's (1935) original introduction of a dynamic theory of personality and its person-situation interactionist paradigm, almost all researchers in the contemporary social sciences take it for granted. The paradigm assumes a functional relation,

$$B = f(P, E)$$

to explain variance in behavior (B) based on systematic interactions between different kinds of people (P) in different kinds of environments (E). When variables are operationalized in empirical research reflecting this framework, the logical interaction requires that studies take special care not to violate theoretic assumptions about empirical levels of analysis. The Lewinian paradigm is ingrained in the social sciences and much entrepreneurship research reflects its logic. Unfortunately, despite its heuristic value in many areas of study, it is an example of a theoretic structure that has “not worked very well for explaining entrepreneurship” (Venkataraman, 1997).

The logic of the OBA extends outside the theoretic boundary conditions of the Lewinian paradigm. The antecedents and consequences of episodic knowledge convergences are not explicable based on reliable interactions between persons and environments (Murphy et al., 2006). Episodic knowledge transcends the interactionist model whenever system-level information combines wholly with possessed knowledge (including experience and skills) to constitute an objective discovery with promise for evolving into a new venture (Fiet, 1996). Whereas person-centric approaches in the Lewinian tradition describe opportunities as outcomes of an almost deliberate learning process, the OBA views opportunities more broadly. Indeed, the OBA holds that opportunities reflect a logic that frustrates the Lewinian paradigm: (1) *a priori* unpredictable, (2) *ad hoc* surprising (i.e., the “eureka effect”), yet (3) *a posteriori* rational.

An opportunity is a nexus in which many individual and environmental-level factors participate (Venkataraman, 1997). Opportunities emerge from all levels of an economy and are traceable across entrepreneurs, firms, industries, and systems (Venkataraman & Sarasvathy, 2001). Therefore, whereas entrepreneurship enjoys a plurality of multidisciplinary perspectives, the complementary² nature of those perspectives has created conceptual stratifications based on perspective and level of analysis (Low & Macmillan, 1988). Though understanding has increased within these lines of research, irrelevancies, and inconsistencies have increased across them (Herron, Sapienza, & Smith-Cook, 1991, 1992). This trend has led to striking divisions in the literature (Bull & Willard, 1993: 184). Entrepreneurship research at one level of analysis can be seen as contradictory to other research targeting the same phenomenon (Gartner, 1988). Whereas variables associated with uncertainty at the individual level are congruous with one another (e.g., alertness, attitudes about risk) those variables are immaterial to ones operationalized in studies of uncertainty at the firm level (e.g., slack resources, appropriate deliberation) despite targeting the same construct (Gartner, 1988). The effect is individual-level entrepreneurship research borrowing from system-level approaches with asymmetric logics (Kaish & Gilad, 1991). The outcome is the generation of theoretic models that are incomplete when applied to real world settings (McMullen & Shepherd, 2006).

An effective synthesis of distinct theoretic perspectives is required to understand the nature of entrepreneurial events (Schoonhoven, Eisenhardt, & Lyman, 1990). Without a new approach, consistent theoretic boundaries are not logically possible. Opportunities transcend the boundary conditions between macro perspectives on firm formation or market characteristics (Aldrich, 1990; Reynolds, 1991) and micro perspectives on the psychological underpinnings of decision-making (Gaglio & Katz, 2001). Therefore, neither accounts for the other's empirical findings, nor for those of firm-level research on entrepreneurial orientation (Covin & Slevin, 1991; Lumpkin & Dess, 1996). The empirical divergence is so impairing that two opportunities, seen as different at a micro perspective (e.g., one remedies an inefficiency and the other builds on a technological innovation) can seem similar at a macro perspective (Gartner, 1988).

The OBA does not fit into the standard levels of analysis assumed by most social science research in the person–situation interactionist paradigm. With opportunities as units of analysis, the OBA holds promise for avoiding some noted puzzles facing person-centric research. For example, it helps admit inexplicable alterations of plans based on idiosyncratic perceptions of common external events (Pearce & Herron, 1987). By not seeking consistency across individuals, it helps capture the effects of unique entrepreneurial expectations (Arrow, 1974a). Unlike traditional management research explaining decision-making in terms of levels of efficiency maximization or uncertainty, it allows a broader range for what entrepreneurs actually experience (Jacobson, 1992). The OBA helps reframe these phenomena by operationalizing opportunities as empirical objects that transcend persons and environments.

Proposition 2: Episodic knowledge and entrepreneurial opportunities transcend multiple empirical levels. Thus, entrepreneurial discovery research requires an empirical approach not delimited explicitly by individuals, firms, and environments as levels of analysis. Opportunities are a unit of analysis instrumental to meeting this requirement.

Parametric and Nonparametric Statistics

It is common for entrepreneurial discoveries to reflect uncommon aspects when they are observed empirically. It is not possible, as such, to analyze opportunities reliably because the composite factors are not reliable. When probability and improbability are confounded as such, distinct statistical research methodologies are required in order to parse data and error. The OBA does not seek to analyze opportunities into reliable sub-dimensions in order to achieve statistical prediction. The nature of opportunities confounds such approaches. Rather, the OBA assumes a theoretic model of resource emergence that goes beyond new combinations of elements that already exist (Schumpeter, 1934).

Any entrepreneurial discovery entails a convergence of elements that may have never been seen before and might never be seen again. Opportunities,

thus, go somewhat beyond new combinations because the convergence creates something inherently new. Opportunities vary discontinuously, unlike the reliable constructs found in other areas of business study. For example, management research of organizational citizenship behavior (Van Dyne, Graham, & Dienesch, 1994) and perceived organizational support (Wayne, Shore, & Liden, 1997) can be indexed effectively via the same set of dimensions, across cases, with reliable measurement scales. The variance across cases is by degree. Categorical variance complicates the application of methods designed to measure continuous variance based on the parameters of a model, as with ordinary least squares regression or MANOVA. Opportunity data violate the assumptions of parametric analyses, putting them at the risk of misapplication in empirical research on entrepreneurial discovery.³

The linkages between content and method can wield pernicious effects on empirical research. Parametric analyses are designed to estimate functional forms and reliable relations between variables based on population distribution assumptions (Hardle, 1994, p. 8). These methods are static and they do not easily describe spurious variance. As they require a level of reliability in the data to generate validity, they are too restrictive for entrepreneurial discovery research. Indeed, violations of parametric analysis assumptions bear directly on the validity of results and have been cited as especially relevant to entrepreneurship due to the volatile nature of the data (Robinson & Hofer, 1997). For instance, those approaches require special treatment of outliers, which are actually extreme cases that describe novel opportunities almost by definition. Indeed, scores based on opportunity variance can be several standard deviations above the mean of a large sample distribution (Murphy, Kickul, Barbosa, & Titus, 2007). Such extreme values can be meaningful to entrepreneurial phenomena but frustrate model parameters. Missing data also can cause problems, even if the missing data are based on meaningful categorical variance. Methodologies such as non-parametric curve estimation and regression analysis are more appropriate for empirical research of data with these characteristics (Hardle, 1994).

Distribution free or non-parametric statistics such as chi-square, logit, or multiway frequency analysis offer some means for avoiding violations of parametric analysis assumptions in entrepreneurial discovery research (Murphy & Shrader, 2004; Robinson, 1996). Approaches such as nonlinear regression are more flexible because they do not assume a functional form based on population-derived score distributions (Siegel & Castellan, 1988: 3). Instead, they utilize multinomial distributions and forecast membership in theoretically-derived categories. Although nonparametric approaches do not carry the same kind of predictive power as parametric approaches, the assumptions are not violated nearly as frequently (Hardle, 1994: 4).

Nonparametric statistics are amenable to the kind of frequency data examined in OBA research. For example, using the natural logarithm (\ln) based on the irrational integer $e = 2.718281828 \dots$ nonparametric analyses allow

additive frequency data to be treated as multiplicative [$\ln(X) + \ln(Y) = \ln(X*Y)$]. The utilization of e also allows calculation of the odds ratio (OR) of a logit model, via

$$OR = e^{2\lambda}$$

where λ indicates the loglinear parameter estimate generated by most statistical software packages (Tabachnik & Fidell, 1996, p. 282). This ratio is the same as that derived by calculation of the cross-product ratio of the values in the cells of a 2x2 frequency table. Whereas such analyses will not lead to the prediction functions generated by least squares regression using more reliable scores, analysis of nominal data can lead to forecasts of outcomes in large data samples (Cook & Campbell, 1979, p. 297). OBA empirical research using these methods can generate findings indicating the statistical likelihood that an entrepreneurial discovery event will occur given a particular constellation of episodic knowledge indicators (Murphy, 2004).

Future empirical studies on opportunity data can promote valid results by ensuring the strict assumptions of parametric statistics are not violated by the data (Robinson & Hofer, 1997). Whether or not those assumptions are violated, moving away from parametric approaches in empirical research on opportunities will also serve to enhance validity in those studies (Eckhardt & Shane, 2003). The OBA offers a theory-based justification and direction for encouraging the use of non-parametric statistical analyses.

Proposition 3: The empirical consistency required by normative empirical research does not exist among instances of entrepreneurial opportunity. Empirical research on entrepreneurial discovery is not readily amenable to linear or parametric statistical methods because the data tend to violate the assumptions of those methods.

The OBA represents a paradigm shift in entrepreneurial discovery research. It offers means to achieve greater understanding of holistic opportunities with distinct theory and a view toward appropriate research methodology. It is intended to help overcome the empirical challenges incurred by studies of entrepreneurial discovery and make a contribution to distinguishing the entrepreneurship field from other areas of research. The OBA has implications pertaining to variable operationalization, analysis level, and statistical methodology. These implications follow from the tenets, based on the nature of episodic knowledge and opportunities. In the final section, we digest these implications into a description of the character of future studies reflecting the OBA.

Discussion

For sixty years, business research has observed that dynamic empirical data strain equilibrium-based research designs and frustrate normative research ap-

proaches (Hayek, 1948: 126). Though entrepreneurship is a new area of research, it offers the strongest example of this principle in the domain of business studies. Opportunities are holistic constructs containing a quantum balance, which makes analytic research of them fallible. Even so, questions about implementing OBA research remain unanswered. We discuss aspects of execution here and cite some areas for future development. Our discussion is meant to give direction to future work that will both observe and clarify OBA tenets.

Directions for Future Research

In empirical research contexts, opportunities are nominal and highly irregular. They are not essentialist constructs, which are denoted by identifying empirically what a large sample of cases has in common (Cook & Campbell, 1979, p. 14; Popper, 1957, p. 26; Russell, 1959). The nominalist versus essentialist distinction is manifested in social science as idiographic versus nomothetic research (Nunally, 1978, p. 547). The concept derives from the problem of universals described in Books VI and VII of the Republic in Plato's theory of ideas. Popper (1957) and Russell (1959) also examine the distinction in detail. It is worth stressing in future research and theory that every opportunity has a unique structure—a particular newness based on dynamic resource convergences, entailing resources that may also not be new. Indeed, it is one thing to talk about entrepreneurial opportunities conceptually or in theoretic terms. However, it is another thing to treat opportunities as research constructs and operationalize them empirically. In those empirical settings, the particular nature of opportunities has an influence that cannot be avoided.

We note explicitly, for the sake of clarity, that Russell (1959, p. 93) uses the example of proper nouns (e.g., Lake Michigan, Chicago) to illustrate particular items. There is merely one instance of such items; each is unique. By contrast, he uses the example of regular nouns (e.g., lake, city), adjectives (e.g., big, cold), and verbs (e.g., swim, reside) to illustrate essentialist items. Opportunities are more partial to the former category than other research constructs, and this difference matters greatly when it comes to empirical studies of them. Further, non-parametric research logic is amenable to data of the former classification and parametric research logic is amenable to data of the latter one (Hardle, 1994). Such research does not seek to delineate the essential factors or a common structure across instances (Popper, 1957, p. 29). The approach has been described as a science of the specific (Jacobson, 1992). As such, in OBA research, categorical item checklists that generate frequency data, open-ended qualitative data, and rigorous case studies are examples of appropriate empirical procedures. Reliable measurement scales, ordinary least squares regression, and bivariate correlation calculations are examples of empirical procedures not generally amenable to the OBA.

OBA research seeks to preserve episodic knowledge as it is observed directly by researchers or, more preferably, as it is reported directly by entrepreneurs. It does not emphasize data as *inferred* by researchers, via methods designed to eliminate accidental aspects and promote reliability. The empirical emphasis of the OBA is on preserving the uniqueness of each datum. That logic is anathematic to most normative methods. As we noted above, in large sample research, nonparametric methods can utilize frequency analysis to forecast outcomes statistically. In small sample research, nonparametric methods admit rigorous case study designs that uncover linkages underlying the logic of entrepreneurial discovery (Shane, 2000). Rather than delineate a lawful factorial structure of opportunities, the OBA delineates how opportunities relate lawfully to other factors, such as technology or firms.

OBA research questions are different than those asked in normative research. The directions of inquiry must emphasize exogenous aspects and effects because of the holistic nature of opportunities (Popper, 1957, p. 29). A traditional approach asks questions such as, “What is an opportunity?” or, “What is the essential structure of opportunities?” Instead, OBA studies are guided by different kinds of questions such as, “How do entrepreneurial opportunities behave?” or, “How do opportunities change in the presence of firm incorporation or technological innovations?”

Because entrepreneurial opportunities are tentative, the OBA tends toward deductive logic. The results of empirical examinations of dynamic data are highly tentative (Popper, 1959). To the degree entrepreneurs are like social scientists making tentative hypotheses, they are anything but normal scientists solving the puzzles of normal science activity (Kuhn, 1962). Rather, the discoveries of entrepreneurs are frequently outliers by definition. The OBA, thus, eschews the inductive logic reflected in normative research. The logic of parametric statistics, which includes inferences about a population using induction, does not apply. Rather, it is almost an axiom that, “An entrepreneur can’t be defined, but you’ll know one when you see one” (Nelson & Bell, 2004, p. ix). With little that is common or measured the same way across opportunities, a deductive logic is suitable in empirical research of them. Deduction leads to narrowing of the range of possible outcomes to forecast results. It does not lead to prediction based on the assumption that something will happen again because it happened previously. Rather, deductive logic holds that no amount empirical evidence can prove a conjecture; it can only refute it (Popper, 1973, p. 101). Nonparametric statistical analyses reflect deductive logic by not statistically relating samples to populations based on assumptions that the data are reliable.

Implications for Entrepreneurs

From a practical perspective, the logic of the OBA follows the high-failure rates and discounting behaviors of entrepreneurs and financiers as they evalu-

ate opportunities via trial and error. Those entrepreneurial activities illustrate that it is easier to avoid opportunities that will not be successful than to select ones that will be successful. Thus, OBA studies hold promise for providing information about what indicators tend to accompany discovery on a large scale. As opportunities come to be associated with certain technologies and social changes, greater perspective is offered on the holism of entrepreneurial discovery across individuals and environments. The findings of such research could be used to help make policy decisions that promote entrepreneurial discovery in community or incubator settings where entrepreneurship is intended to occur. These findings would also be instrumental to professional training and development initiatives that cover entrepreneurial discovery and innovation, as well as similar pedagogical activity in university classrooms. As such, the OBA is predisposed to opportunity recognition and innovation phenomena on theoretic and practical grounds.

OBA research holds promise for identifying certain classes of indicators pertaining to technological information, experiences, market or customer data, expert mentoring, or other kinds of categories. The OBA does not index the specific content of such indicator data, because the content is unique to each entrepreneurial instance. Indicators are easily procured via direct reports from entrepreneurs or other individuals associated with a discovery event. These studies could identify the indicators that most frequently accompany discoveries based on shifts in technology versus regulatory guidelines and policies or socially purposeful concerns versus traditional market indexes. Industry sector may be a relevant factor, whereby certain classes of episodic knowledge are reported more frequently as associated with opportunities. Such findings are expected to offer practical relevance to development of policy and regulatory guidelines promoting particular kinds entrepreneurial discoveries.

Limitations

Though the OBA does offer a new direction for research on entrepreneurial discovery, it is important to be circumspect in application and development. One reason for caution is that whereas opportunities can be operationalized in empirical research, they only account for part of the entrepreneurial process. As noted, the OBA is a middle-range theory that is complementary to existing research and theory, especially about other aspects of the entrepreneurial process. It is a very basic conceptual approach, as opportunities are a fundamental part of the entrepreneurial equation. As such, the OBA should not be developed in a vacuum, but in concert with other theories. Other approaches such as the resource-based view or entrepreneurial orientation apply to other aspects of the entrepreneurial process and make their own unique contributions to those aspects.

Conclusion

Entrepreneurial discovery is a specific topic for research in the field of entrepreneurship; a distinct area in the domain of business studies. The OBA is intended to help spur studies of entrepreneurial discovery with a new paradigm that helps distinguish the entrepreneurship field and also raise understanding of how opportunities emerge and exist. Its logic offers a way to study a complex social phenomenon with the benefit of distinct theory. We have introduced the OBA in order to help meet the daunting challenges facing entrepreneurship theory and research. However, as we noted at the outset, this undertaking is not intended to be exhaustive. It is instead our hope that entrepreneurship researchers will build on these foundations with scholarly contributions that develop the OBA as a means to help define the entrepreneurship field.

References

- Aldrich, H. (1990). Using an ecological perspective to study organizational founding rates. *Entrepreneurship Theory and Practice*, 14 (3), 7–24.
- Arenius, P., & Minnit, M. (2005). Perceptual variables and nascent entrepreneurship. *Small Business Economics*, 24, 233–255.
- Arrow, K. (1974a). Limited knowledge and economic analysis. *American economic review*, 64, 1–10.
- Arrow, K. (1974b). General economic equilibrium: Purpose, analytic techniques, collective choice. *American Economic Review*, 64, 253–272.
- Baldwin, J. M. (1887). Postulates of physiological psychology. *Presbyterian Review*, 8, 427–440.
- Baumol, W. (1993). Formal entrepreneurship theory in economics: Existence and bounds. *Journal of Business Venturing*, 8, 197–210.
- Bohr, N. (1949). Discussion with Einstein on Epistemological Problems in Atomic Physics. In P. A. Schilpp (Ed.), *Albert Einstein: Philosopher–scientist. The library of living philosophers* (Vol. 7, pp. 201–241). LaSalle, IL: Open Court Press.
- Brockhaus, R. (1980). Risk taking propensity of entrepreneurs. *Academy of Management Journal*, 23, 509–520.
- Bull, I., & Willard, G. E. (1993). Toward a theory of entrepreneurship. *Journal of Business Venturing*, 8, 183–196.
- Bygrave, W. D., & Hofer, C. (1991). Theorizing about entrepreneurship. *Entrepreneurship Theory and Practice*, 16 (2), 13–22.
- Campbell, D. T. (1974). Evolutionary epistemology. In P. A. Schilpp (Ed.), *The philosophy of Karl Popper. The library of living philosophers* (Vol. 14, pp. 413–463). LaSalle, IL: Open Court Press.
- Carroll, G., & Mosakowski, E. (1987). The career dynamics of self-employment. *Administrative Science Quarterly*, 32, 570–589.
- Casson, M. C. (1982). *The entrepreneur: An economic theory*. Totowa, NJ: Barnes and Noble.
- Chandler, G. N., DiTienne, D., & Lyon, D. W. (2003). Outcome implications of opportunity creation / discovery processes. In W. D. Bygrave, C. Brush, P. Davidsson, J. Fiet, P. G. Greene, R. T. Harrison, M. Lerner, G. D. Meyer, J. Sohl, & A. Zacharakis (Eds.), *Frontiers of entrepreneurship research* (pp. 398–409). Wellesley, MA: Babson College Press.

- Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design and analysis issues for field setting*. Boston, MA: Houghton-Mifflin.
- Covin, J. G., & Slevin, D. P. (1991). A conceptual model of entrepreneurship as firm behavior. *Entrepreneurship Theory and Practice*, 16 (1), 7–23.
- Dickson, P. R. (1992). Toward a general theory of competitive rationality. *Journal of Marketing*, 56, 69–83.
- Dimov, D. (2003). The nexus of individual and opportunity: Opportunity recognition as a learning process. In W. D. Bygrave, C. Brush, P. Davidsson, J. Fiet, P. G. Greene, R. T. Harrison, M. Lerner, G. D. Meyer, J. Sohl, & A. Zacharakis (Eds.), *Frontiers of entrepreneurship research* (pp. 410–421). Wellesley, MA: Babson College Press.
- Drucker, P. F. (1985). *Innovation and entrepreneurship*. New York: Harper & Row.
- Eckhardt, J. T., & Shane, S. A. (2003). Opportunities and entrepreneurship. *Journal of Management*, 29, 333–349.
- Fiet, J., & Kosnick, R. D. (1995). Antecedents of executive compensation: The use of covariance structural modeling. *Journal of Managerial Finance*, 21 (2), 42–58.
- Fiet, J. O. (1996). The information basis of entrepreneurial discovery. *Small Business Economics*, 8, 419–430.
- Fiet, J. O. (2002). *The systematic search for entrepreneurial discoveries*. Westport, CT: Quorum Books.
- Freeman, J. (1982). Organizational life cycles and natural selection processes. *Research in Organizational Behavior*, 4, 1–32.
- Gaglio, C. M., & Katz, J. A. (2001). The psychological basis of opportunity recognition: Entrepreneurial alertness. *Journal of Small Business Economics*, 16, 95–111.
- Gartner, W. (1988). Who is the entrepreneur? Is the wrong question. *American Journal of Small Business*, 12, 11–32.
- Gupta, V., MacMillan, I., & Surie, G. (2004). Entrepreneurial leadership: Developing and measuring a cross-cultural construct. *Journal of Business Venturing*, 19, 241–260.
- Hardle, W. (1994). Applied nonparametric regression. London: Cambridge University Press.
- Hayek, F. A. (1945). The use of knowledge in society. *American Economic Review*, 35 (4), 519–530.
- Hayek, F. A. (1948). *Individualism and economic order*. Chicago, IL: Henry Regnery.
- Herron, L., Sapienza, H. J., & Smith-Cook, D. (1991). Entrepreneurship theory from an interdisciplinary perspective (Vol. I.) *Entrepreneurship Theory and Practice*, 16 (2), 7–12.
- Herron, L., Sapienza, H. J., & Smith-Cook, D. (1992). Entrepreneurship theory from an interdisciplinary perspective (Vol. II.) *Entrepreneurship Theory and Practice*, 16 (3), 5–11.
- Hills, G. E. (1995). Opportunity recognition by successful entrepreneurs: A pilot study. *Frontiers of entrepreneurship research* (pp. 105–117). Wellesley, MA: Babson College Press.
- Hume, D. (1739). *A treatise of human nature*. (reprinted 1888). Oxford: Clarendon Press.
- Hunt, S. D., & Morgan, R. M. (1995). The comparative advantage theory of competition. *Journal of Marketing*, 59, 1–15.
- Jacobson, R. (1990). Unobservable effects and business performance. *Marketing Science*, 9 (1): 74–85.
- Jacobson, R. (1992). The “Austrian” school of strategy. *Academy of Management Review*, 17, 782–807.

- Jennings, H. S. (1935). *Genetic variations in relation to evolution: A critical inquiry into the observed types of inherited variation, in relation to evolutionary change*. Princeton, NJ: Princeton University Press.
- Kaish, S., & Gilad, B. (1991). Characteristics of opportunities search of entrepreneurs versus executives: Resources, interest, and general alertness. *Journal of Business Venturing*, 6, 45–61.
- Kant, I. (1781). *The critique of pure reason*. (trans N. K. Smith 1929). New York: St Martin's Press.
- Kirzner, I. (1973). *Competition and entrepreneurship*. Chicago: University of Chicago Press.
- Kirzner, I. (1997). Entrepreneurial discovery and the competitive market process: An Austrian approach. *Journal of Economic Literature*, 35 (1), 60–85.
- Kirzner, I. M. (1984, July). *The role of the entrepreneur in the economic system*. The Inaugural John Bonython Lecture delivered to The Centre for Independent Studies, University of Adelaide. Adelaide, Australia.
- Kuhn, T. S. (1962). *The structure of scientific revolutions*. Chicago: University of Chicago Press.
- Lewin, K. (1935). *A dynamic theory of personality*. New York: Harper & Row.
- Low, M. B., & MacMillan, I. C. (1988). Entrepreneurship: Past research and future challenges. *Journal of Management*, 14, 139–161.
- Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of Management Review*, 21, 135–172.
- McMullan, J. S., & Shepherd, D. A. (2006). Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur. *Academy of Management Review*, 31, 132–152.
- Merton, R. K. (1967). *On theoretical sociology. Five essays, old and new*. New York: Free Press.
- Miller, D. W. (1975). The accuracy of predictions. *Synthese*, 30, 159–191.
- Morgan, C. L. (1903). *An introduction to comparative psychology*. London: Walter Scott.
- Morgan, C. L. (1923). *Emergent evolution*. London: Williams and Northgate.
- Murphy, P. J. (2004). A logic for entrepreneurial discovery. *Digital dissertations*, 65 (3), 1026. (UMI No. 3126461).
- Murphy, P. J., & Shrader, R. C. (2004, August). *Entrepreneurial discovery and prediction: Knowledge-based shadow options for research efforts*. Paper presented at the 64th annual meeting of the Academy of Management, New Orleans, LA.
- Murphy, P. J., Kickul, J., Barbosa, S. D., Titus, L. (2007). Expert capital and perceived legitimacy: Female-run entrepreneurial venture signaling and performance. *International Journal of Entrepreneurship and Innovation*, 8 (2), 127–138.
- Murphy, P. J., Liao, J., & Welsch, H. P. (2006). A conceptual history of entrepreneurial thought. *Journal of Management History*, 12 (1), 12–35.
- Murphy, P. J., Liao, J., & Welsch, H. P. (2005). A conceptual history of entrepreneurial thought. *Academy of Management best papers proceedings*, A1–A6 (AN 18779543).
- Nelson, D. C., & Bell, J. D. (Eds.). (2004). *Profiles in entrepreneurship: Leaving more than footsteps*. Mason, OH: Southwestern/Thompson Learning.
- Nunnally, J. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.
- Pearce, J., & Herron, L. (1987). Making strategy work. *Academy of Management Review*, 12, 753–756.
- Popper, K. R. (1957). *The poverty of historicism*. London: Routledge.
- Popper, K. R. (1959). *The logic of scientific discovery*. London: Hutchinson Press.

- Popper, K. R. (1973). Evolutionary epistemology. In D. Miller (Ed.), *Popper selections* (pp. 78–86). Princeton, NJ: Princeton University Press.
- Popper, K. R. (1979). *Objective knowledge: An evolutionary approach*. Oxford: Clarendon Press.
- Popper, K. R. (1990). *A world of propensities*. Bristol, UK: Thoemes.
- Reynolds, P. D. (1991). Sociology and entrepreneurship: Concepts and contributions. *Entrepreneurship Theory and Practice*, 16 (2), 47–70.
- Robinson, K. C. (1996). *Measures of entrepreneurial value creation: An investigation of the impact of strategy and industry structure on the economic performance of independent new ventures*. Unpublished doctoral dissertation, Georgia State University.
- Robinson, K. C., & Hofer, C. W. (1997). A methodological investigation of the validity and usefulness of parametric and nonparametric statistical data analysis techniques for new venture research. In P. R. Reynolds, W. D. Bygrave, N. M. Carter, P. Davidsson, W. B. Gartner, C. M. Mason, & P. P. McDougall (Eds.), *Frontiers of entrepreneurship* (pp. 692–705). Wellesley, MA: Babson College Press.
- Robinson, K. C., & McDougall, P. P. (1998). The impact of alternative operationalizations of industry structural elements on measures of performance for entrepreneurial manufacturing ventures. *Strategic Management Journal*, 19, 1079–1100.
- Russell, B. (1959). *The problems of philosophy*. New York: Oxford University Press.
- Sarasvathy, S. D. (2003). Entrepreneurship as a science of the artificial. *Journal of Economic Psychology*, 24, 203–220.
- Schoonhoven, C. B., Eisenhardt, K. M., & Lyman, K. (1990). Speeding products to market: Waiting time to first product introduction in new firms. *Administrative Science Quarterly*, 35, 177–208.
- Schumpeter, J. A. (1934). *The theory of economic development*. Cambridge, MA: Harvard University Press.
- Shane, S. (2000). Prior knowledge and the discovery of entrepreneurial opportunities. *Organization Science*, 11, 448–469.
- Shane, S. & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *Academy of Management Review*, 25, 217–226.
- Siegel, S., & Castellan, N. J., Jr. (1988). *Nonparametric statistics for the behavioral sciences* (2nd ed.). Boston, MA: McGraw-Hill.
- Simon, H. A. (1957). *Administrative behavior* (2nd ed.). New York: Macmillan.
- Stanley, K. & Gilad, B. (1991). Characteristics of opportunities search of entrepreneurs vs. executives: Sources, interests, general alertness. *Journal of Business Venturing*, 6, 45–62.
- Tabachnik, B. G., & Fidell, L. S. (1996). *Using multivariate statistics* (3rd ed.). New York: HarperCollins College.
- Van Dyne, L., Graham, J. W., & Dienesch, R. M. (1994). Organizational citizenship behavior: Construct redefinition, measurement, and validation. *Academy of Management Journal*, 37, 765–802.
- Venkataraman, S. (1997). The distinctive domain of entrepreneurship. In J. A. Katz (Ed.), *Advances in entrepreneurship: Firm emergence and growth* (Vol. 3, pp. 119–138). Greenwich, CT: JAI Press.
- Venkataraman, S., & Sarasvathy, S. D. (2001). Strategy and entrepreneurship: Outlines of an untold story. In M. Hitt, R. E. Freeman, & J. Harrison (Eds.), *Handbook of strategic management* (pp. 650–668). Oxford: Blackwell.
- Von Hippel, E. (1986). Lead users: A source of novel product concepts. *Management Science*, 32, 791–805.
- Wayne, S. J., Shore, L. M., & Liden, R. C. (1997). Perceived organizational support and leader–member exchange: A social exchange perspective. *Academy of Management Journal*, 40, 82–111.

- Yates, A. J. (2000). The knowledge problem, entrepreneurial discovery, and Austrian market process theory. *Journal of Economic Theory*, 91, 59–85.
- Zimmer, C., & Aldrich, H. (1987). Resource mobilization through ethnic networks: Kinship and friendship ties of shopkeepers in England. *Sociological Perspectives*, 30, 422–455.

Notes

1. The natural number system exemplifies this notion (Popper, 1979, p. 160). Although originated by humankind, it has led to the discovery of ancillary discoveries unintended by its originators (e.g., number theory, the concept of infinity, sequences of prime numbers, the existence of twin primes). Error in the natural number system (e.g., not being able to solve certain equations), has also led to new discoveries, such as imaginary or complex numbers.
2. We define complementary the same as Bohr (1949, p. 224) and Popper (1957 p. 90), who describe complementary research factors as (a) complementary in the usual sense but also (b) mutually exclusive of each other such that to the degree the first is adopted it precludes adoption of the second.
3. For a detailed assessment of the greater suitability of non-parametric versus parametric statistical methodologies in entrepreneurship research, see Robinson (1996). The dissertation won the Heizer Award for outstanding research awarded by the Academy of Management's Entrepreneurship Division.