

Entrepreneurial Discovery as Constrained, Systematic Search

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ABSTRACT. This research uses a randomized, two-sample, post-test experiment to pit the alertness perspective against a new approach for searching systematically for venture ideas to create new wealth. The new approach uses self-selected consideration sets to constrain an entrepreneur's search domain, which makes it possible to maximize the search results. The constrained domain conforms to the behavior of repeat entrepreneurs who do not search the whole world for venture ideas. Subjects in the treatment group were successful 60% of the time compared with 6.25% success rate for the control group. Fourteen percent of control group emulated the treatment group without receiving instructions to do so.

KEYWORDS: entrepreneurship, experimental economics, systematic search, entrepreneurial discovery

JEL CLASSIFICATIONS: L26, M13, O31

One should hardly have to tell entrepreneurship researchers that information is a valuable resource: knowledge is power. And yet it occupies a slum dwelling in the modern town of entrepreneurship. Mostly it is ignored. They generally have assumed that entrepreneurs were incapable of searching systematically in a serendipitous world.

Paraphrased from Stigler (1961)

1. Introduction

Despite the neglect of most entrepreneurship researchers (Demsetz, 1983), for more than 60 years there has been an on-going conversation among economists who have examined the

relationship between entrepreneurs and information. This conversation is important because it provides clues about how to find discoveries. We use the term *discovery* to refer to an idea for launching a venture that has the potential to create new wealth, such as the founding of a new firm, the creation of a new product line, the development of an innovative technology, the satisfaction of an ephemeral market need through arbitrage, or the like.

This conversation among economists has rarely if ever included discovery; especially under equilibrium conditions, even though the study of other economic behaviors has become increasingly important. This omission is unfortunate because, arguably, discovery is what distinguishes entrepreneurs from other economic actors. It is even more unfortunate because until recently traditional entrepreneurship scholars have also neglected discovery. Even the recent attempts of entrepreneurship scholars have been generally restricted to either describing discovery or attempting to explain it theoretically.

Experimental economics has focused on collecting data on economic behavior in highly controlled environments, typically in laboratory settings (Roth, 1995, 2002; Smith, 1976, 1989, 1994). Economic experiments explain how agents make choices from a given set of preferences (Camerer, 2002; Davis and Holt, 2003). Much of the work in this field has focused on studying game theory, experimental finance, market processes etc (Kagel and Roth, 1995). However, only limited efforts have been made in the field of entrepreneurship to harness the potential of experimental economics (c.f., Acs and Audretsch, 2003). To our knowledge, experimental economics has never pitted competing approaches to discovery against each other.

This article is the first known attempt to question the comparative effectiveness of

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opportunity recognition as predicted by two economic theories – informational economics and the Austrian alertness approach. This research is important, not only because of the question that it addresses, but also because it may serve as a bridge connecting the well-established field of experimental economics to the many settings for conducting such research in the field of entrepreneurship research.

Our analysis of the discovery process will proceed in the following manner. First, we discuss information as a requirement for discovery. In addition, we contrast systematic search with entrepreneurial alertness, two approaches for finding profit opportunities. Next, we discuss informational economics as the underlying rationale for systematic search. We then develop and test hypotheses pitting two mentioned approaches against each other. The testing of hypotheses includes an evaluation of the role of experimental economics in these tests. Afterwards, we discuss the implications of informational economics as explored here for entrepreneurs, students and future research. Finally, we assess opportunities for experimental economists

2. Information

Discovery cannot occur without information. *Information* is a collection of facts from which conclusions may be drawn. No new wealth could be created without information unless one were lucky. If one were to remove information from entrepreneurship, not much else would matter except the role of luck. The only remaining debates would treat how entrepreneurs can utilize information to find new wealth, which we introduce later in this section

2.1. *The developing role of information in entrepreneurship*

In 1945, Hayek argued that the most valuable type of information for gaining a competitive advantage was related to an entrepreneur's uniqueness in time and space. Stigler (1961) considered how entrepreneurs could search for such an advantage. His work marked a distinct departure from received economic theory by

allowing information asymmetries to exist in a world at equilibrium.

In 1971, Hirshleifer discussed the private and social value of information and how to reward inventive behavior. Later, Hirshleifer (1973) was the first to refer to this burgeoning area of study as the economics of information. In particular, Hirshleifer (1973) emphasized that given asymmetric information that signaling can serve as an implicit guarantee of a seller's intentions, which can decrease risk and increase profit potential.

In 1980, MacMin discussed the relationship between search and market equilibrium in those cases where it exists. Stiglitz (1985) demonstrated that the central consequence of imperfect information is that markets will not be characterized by perfect competition, which makes possible the earning of entrepreneurial profits. Arrow (1989) lectured on the economics of information as an under-appreciated aspect of economics as it pertains to the creation of new wealth.

In 1996, Fiet distinguished between specific information and general information to demonstrate that discoveries of profit opportunities are most likely to be identified using specific information. Furthermore Fiet (1996) argued that the acquisition of specific information was an investment decision with uncertain rewards and some risk attached to it. Fiet et al. (2005) illustrated that systematic search for discoveries are mathematically possible in an asymmetric world provided a search domain is finite.

Until now, informational economics has relied on conceptual arguments and mathematical models to establish its basic premises. Although the progress achieved by this earlier work has been notable for its rigor and elegance, it has provided few clues about how an entrepreneur could find entrepreneurial discoveries.

2.2. *Alertness versus systematic search*

Many studies of opportunity recognition have concluded that it is impossible to search systematically for unknown discoveries, which leaves alertness as the only alternative for aspiring entrepreneurs (c.f., Kaish and Gilad, 1991; Kirzner, 1973, 1979, 1985, 1992, 1997;

1973, Shane, 2000; Shane and Venkatraman, 2000, among others). This view has been adopted by traditional entrepreneurship researchers who argue correctly that most discoveries are found while not searching. They argue against the feasibility of systematic search by assuming that a search domain is unknown, which effectively makes it unbounded. Their skepticism of systematic search probably explains why they do not study it. These skeptics are also correct to point out that no optimal solution exists for searching an unbounded domain. However, proponents of alertness fail to account for the observation that novice entrepreneurs scan widely while trying to make a discovery, whereas repeat entrepreneurs narrow their search efforts to known domains (Bar-Hillel and Falk, 1982; Baumol, 1993; Fiet et al., 2004; Gaglio, 1997; Gilad et al., 1988). Received theory offers no explanation for their switch in search tactics.

2.3. Resolving search questions

Scholars can resolve questions concerning systematic search, as well as questions about why repeat entrepreneurs can narrow their search as they gain experience by replacing *the scanning for unknown venture ideas* (i.e., being alert to them) with the *search of known information channels* (Fiet, in press). An *information channel* is a low-cost source of frequent venture ideas. Information channels can exist due to imperfections in the markets for information in which they are found. If all markets for information were perfectly efficient, there would be no information channels carrying unique information about venture ideas. Examples of possible information channels are an entrepreneur's inner circle of friends and confidants, business associates, a patent office, trade publications, trade shows, golfing buddies or the like. Information channels provide entrepreneurs with an option to acquire, not a particular message, but a set of messages with some probability distribution.

The next section extends the economics of information as it relates to discovery. Specifically, it lays out the theory that we will test in the remainder of this article.

3. Extending the informational economics of discovery

Informational economics theorizes that differences exist in the capacity of signals to enable entrepreneurs to discern discoveries (Fiet, 1996; Hayek, 1945; Hirschleifer, 1971; MacMinn, 1980; Stigler, 1961; Stiglitz, 1985). A *signal* is new information that changes our understanding of the future. Differences in signals could only exist if they consisted of *specific information*, which informs us about people, places, special circumstances, timing and technology relating to particular business opportunities (Hayek, 1945; Fiet, 1996). Jovanovic (1982) emphasizes differences in market information, technical information and information about the capacity of individuals. In Jovanovic's (1982) schema, technical information and information about individual capacity are equivalent to specific information. With regard to any other opportunity, specific information would have little or no value. In contrast, *general information* can be reduced to rules or procedures that can be reproduced and disseminated (Jensen and Meckling, 1992; Stiglitz, 1985). Because general information can be widely disseminated it cannot be an indicator of unknown opportunities because it attracts competitors who themselves compete for economic gains.

As individuals, we possess two types of prior experience: experience consisting of specific knowledge and experience consisting of general knowledge. *Knowledge* is information that can be stored and recalled (Dreyfus and Dreyfus, 1986; Palich and Bagby, 1995). The challenge for entrepreneurs is to capitalize on specific knowledge while spending as little time and money as possible in identifying general information. Several researchers have suggested that paying attention to one's prior experience is a useful way of finding discoveries (Venkataraman, 1997), however such a focus tends to obscure the difference between specific and general information (Fiet and Samuelsson, 2000). Fiet (1996) highlighted the dilemma facing entrepreneurs – they must not only distinguish between these two types of information; they must also trade off the risks and benefits of investing in specific

information with almost no help in knowing how to evaluate this tradeoff.

3.1. *The traditional boundary of the economics of information*

Recognizing differences in the informational capacity of signals has until now marked the boundary of the economics of information story. This research extends this reasoning by suggesting where to find relevant signals, which reduces their acquisition cost. It also advances our understanding by examining the sources of specific signals and then theorizing how an entrepreneur could search among these sources.

Because markets for information are often inefficient, some informational spaces within these markets are more promising than others for finding signals (MacMinn, 1980). As mentioned earlier, we refer to an informational space that is a frequent, low-cost source of signals as an *information channel*. This leads us to the proposition that the best place to look for signals are in an information channel. However, for an entrepreneur to make a discovery, a signal must be related to an entrepreneur's prior, specific knowledge. Entrepreneurs are not equally qualified to discover and exploit a signal because of differences in their prior knowledge (Shane and Eckhardt, 2003).

3.2. *Introducing a new construct to informational economics*

Recognizing that the discovery of valuable signals is contingent on an entrepreneur's prior specific knowledge, this research utilizes a relatively new construct – the consideration set (Fiet, in press; Fiet et al., 2005). A *consideration set* is a particular group of information channels selected by an entrepreneur because they fit his or her prior, specific knowledge. It is quite possible there could be discovery opportunities outside of a consideration set for someone else. However, an entrepreneur's particular consideration set circumscribes the most promising information channels that an entrepreneur is qualified to exploit.

This research uses consideration sets to focus attention on information channels that may emit signals related to an entrepreneur's prior knowledge. Focusing on specific signals can improve the exploitability of the signals that are found (c.f., Hirshleifer, 1971). In a sense, working from known, specific information reduces the investment costs of acquiring clues to new discoveries. Not only could selected channels be sources of discoveries, but they could also be sources of information for updating the composition of information channels within a consideration set. Moreover, an entrepreneur's consideration set would probably be unique based on idiosyncratic, prior knowledge and ongoing feedback signals from previously selected channels.

A picture is beginning to emerge of repeatedly successful entrepreneurs, which portrays them as utilizing constrained systematic search very similar in nature to consideration sets (Fiet et al., 2004). However, the utility of this research does not depend on their use by entrepreneurs. Nor does this research attempt to describe what non-repeat entrepreneurs do when they search. Instead, it tests informational economics theory, which suggests how entrepreneurs could make discoveries. Thus, this research is prescriptive, not descriptive, and partially derives its legitimacy from the long history of experimental economics (Smith, 1976, 1994), which includes a recent Nobel Prize.¹ The question addressed by this research is, does constrained, systematic search within a consideration set improve results compared with random alertness?

Someone could protest that limiting search to known channels is too high a price to pay in missed discoveries that could lie outside a consideration set. Such criticism assumes that entrepreneurs are equally qualified to exploit all venture ideas that they encounter when scholars know that they vary in their competence, depending on their prior knowledge (Fiet and Samuelsson, 2000; Shane, 2000). Entrepreneurs do not forego discoveries that are not a reflection of their prior knowledge because they are not qualified to exploit them. Nor can rapid cramming with new information substitute very often for prior knowledge due to the ephemeral

nature of venture ideas, which is what may create windows of opportunity during which venture ideas are most discoverable.

The primary benefit to aspiring entrepreneurs of using this new informational economics approach to guide their searching is that it offers them a choice – they can either exploit a venture idea using knowledge from previous experience or they can continue searching for more related, informative signals (Fiet, 1996; Hayek, 1945; Hirschleifer, 1970; March, 1991).² Because searching for information within a consideration set surely would be less costly (due to economies of scope) and risky than actually launching a venture, this recognition offers them a chance to leverage their resources even if they are minimal (March, 1991; Pfeffer and Salancik, 1978). Using this approach, entrepreneurs with fewer resources may be able to compete with those who are more richly endowed.

3.3. Occupational experience

Discovery depends on a fit between an entrepreneur's prior knowledge and a particular venture idea. The most commonly researched form of prior knowledge is occupational experience (Shane, 2000; Venkatraman, 1997). Search can payoff with a discovery because not all knowledge is equally valuable or accessible. Whether prior knowledge can lead to discoveries is a testable hypothesis.

We focus specifically on an entrepreneur's use of prior knowledge obtained through occupational experience. It is more likely that the alertness group would use a random scanning process than would the consideration set-based group, which could occur, as suggested by Kirzner (1997) while they were engaged in something other than a systematic search. In contrast, the consideration set-based group would be more likely to use its occupational experience to guide its searching.

Hypothesis 1: The consideration set-based group will focus more on situations identified through the use of occupational experience than will the alertness group.

3.4. Specific knowledge and information

The most pertinent knowledge for making a discovery consists of specific information that is not readily available to potential competitors. As entrepreneurs become more competent, they become more knowledgeable about how to profit from particular discoveries. When entrepreneurs acquire specific information, its specificity increases its cost and risk of acquisition because it has little or no value for unintended purposes. Because general information is widely available and has many applications, its acquisition is less costly and risky than specific information. Typical sources of general information are the Internet, textbooks and newspapers.

Subjects trained in the use of consideration sets should search more using the higher-cost, but more informative, specific knowledge than would subjects in the alertness group. Subjects in the alertness-based control group should tend to notice ideas based more on lower-cost, general knowledge than specific knowledge. Thus, subjects in the alertness group, which serves as a pseudo control group because the paradigm assumes randomized scanning, will submit more ideas for evaluation, not necessarily ideas with more potential, than the treatment group. The control group subjects would not emphasize informational differences in the signal cues, which are widely available to them in the form of general information. Without making such a distinction, its lower-cost would lead the alertness group to search for more ideas, regardless of their lower potential for generating new wealth.

Hypothesis 2: The consideration set-based group will utilize specific knowledge more in making discoveries than will the alertness group.

Hypothesis 3: The alertness group will submit more ideas for evaluation than the systematic search group.

3.5. Wealth-generating ideas

Consider the wealth created by two entrepreneurs. Even if each of them faces similar environmental opportunities and threats, one of them is still likely to create more wealth than the

other. In this research, we assume that the ideas exploited by entrepreneurs play an important role in determining their differential success. Two of the most important attributes of a venture idea are whether it can be efficiently *imitated* by others or *conveyed* to them. Together, these attributes refer to an idea's *inalienability* (Jensen and Meckling, 1992). These attributes largely determine whether competitors can appropriate the value of an idea without having to invest in the cost of its discovery. To protect themselves against competitive appropriation, entrepreneurs who succeed in generating new wealth probably base their strategies on ideas with inalienable attributes. When a discovery's attributes are inalienable and entrepreneurs possess the specific knowledge to exploit the discovery, they can create a sustainable competitive advantage as well as substantial new wealth. We draw on the resource-based literature (c.f., Barney, 2001, chapter 5), as well as literature on entrepreneurial competence (Fiet, 2000), to call attention to some of the special attributes of venture ideas that could be used to generate a sustainable competitive advantage.

There are four attributes to consider that collectively determine the potential of venture ideas to be exploited for competitive advantage and wealth creation (Fiet, in press). The first attribute, and perhaps the most critical to consider, is *fit*. Does an entrepreneur or an entrepreneurial team already possess the requisite prior specific knowledge to discover and exploit an idea? We assume that an entrepreneur does not have the luxury of learning as he or she encounters new opportunities, but must proceed on the basis of what he or she already knows. Thus, it is critical that a person's prior, specific knowledge match the patterns found in any new opportunity (Schank, 1975; Waterman and Hayes-Roth, 1978). Without such a fit, an analyst (whether an entrepreneur, a team or third-party observer) would not possess the knowledge to evaluate the other three attributes. Because founders vary in their knowledge-based competencies, they are not equally competent to discover and exploit all ideas, which may be the implicit reason that venture capitalists pay so much attention to the

experience of an entrepreneurial team when evaluating a business plan.

The second attribute is the *value* of an idea. If appropriately exploited, does it have the potential to create or increase a venture's revenues or decrease its costs? The third attribute is *rarity*. Are there so many current or potential competitors threatening the market for an idea that there is little chance that it could be exploited for an economic profit? The fourth attribute is *inimitability*. Would potential competitors be at a cost disadvantage if they attempted to use it to pursue a similar strategy?

Hereafter we refer collectively to these four attributes as FVRI. An idea that can score well on each of these attributes has the potential to be used for the creation of a sustainable competitive advantage, leading to the creation of substantial new wealth, particularly if the potential market is quite large. It is not sufficient to score well on only one or two attributes. These attributes must be considered in sequence as well as collectively. The most promising ideas would be characterized by all of these attributes. This research applies these attribution criteria to evaluate an idea's potential for generating new wealth.

It would be quite unlikely that an entrepreneur could stumble very often across an idea that possessed these four attributes. Very few ideas would possess them, and if they did, someone else might have already exploited them. Yet, it is unlikely that an entrepreneur will be able to exploit any idea to create new wealth that does not possess these four attributes. We list indicators of these attributes in Appendix 1.

Based on the arguments underlying this extension of informational economics, it is more likely that aspiring entrepreneurs using constrained systematic search could discover more ideas that qualified as wealth-creators than when using an alertness approach.

Hypothesis 4: The group using consideration sets will identify more venture ideas that can lead to the creation of new wealth and a sustainable competitive advantage than will the alertness group, which relies on alertness.

4. Methodology

We selected 52 graduate students in entrepreneurship to participate in two experimental groups, one intended to train subjects to search systematically using consideration sets, the other intended to have subjects staying alert for discoveries. The test procedure was a randomized, two-sample, post-test experiment (Rosenthal and Rosnow, 1991; Shadish et al., 2002). The randomization controlled for differences in subjects assigned to either the treatment or control groups. The design also avoided introducing, any pre-test bias. Our purpose in selecting this design was to ensure that any differences between these two groups were due to the experimental treatment to and not to some other extraneous factor.

Our purpose was to test whether systematic search increased the number of ideas found with the potential to generate new wealth. This test required determining whether occupational experience and specific knowledge had any effect on the number of ideas identified by each group. It was also necessary to compare the groups, not the ideas from each group. To ensure credible results, we had to make sure that occupational experience and specific knowledge were not concentrated in one group, or else, a group's outcome might be due to these other factors, rather than the treatment. By randomly assigning the subjects, we controlled for specific knowledge and occupational experience.

We could not evaluate ideas quantitatively. However, we could order them according to their wealth generating potential. Hence, the dependent variable was ordinal. When an idea complied with all four FVRI criteria, we scored it as a one. When an idea did not, we scored it as a zero. These scores indicate the order in the levels of the response.

In addition, we could not make any assumptions about the distribution or variance of the dependent variable. Considering the ordinal nature of the data and its unknown distribution, we concluded that it was appropriate to use non-parametric tests.

Although the sample was a convenience sample, the subjects were well chosen because they were entrepreneurship students who were

willing to learn how to become entrepreneurs, which enabled us to test the pedagogical implications of the research on precisely the population of most interest. The task of the treatment group was to learn how to use a consideration set-based approach whereas the control group's task was to learn about alertness as an approach for making discoveries. To conserve journal space, we do not describe the treatments here. However, they can be obtained from the authors or from Fiet (2002).

Trainers met weekly for 8 weeks with both teams to ensure that they understood their tasks and purpose, which was to discover venture ideas that they could exploit to create new wealth. Each trainer conducted the sessions using a detailed script to ensure that the subjects received the intended training. There was a specific regimen for each session that reinforced particular aspects of the underlying theory for the treatment and control groups.

All subjects were required to complete assignments between each training session. Because the assignments were time-consuming and participation was necessarily voluntary, only 31 of the 52 initial subjects completed the experiment. Sixteen of the remaining subjects were from the control group and 15 from the treatment group.

Although the foregoing experimental design adhered to conventional experimental design protocol (Shadish et al., 2002), certain key experimental economics' methodological requirements were also taken into account. Specifically, full experimental instructions (Fehr and Gächter, 2000) were provided to the participants while avoiding a specific or concrete context (Friedman and Sunder, 1994). In addition, the treatment and the control group were trained according to respective theories, thus avoiding the possibility of deception (Roth, 1988).

The next sections discuss the instructions that formed the basis of the manipulation received by each group.

4.1. Instructions for the treatment group using consideration sets

The instructions for the treatment group on how to use consideration sets to search consisted of

the following elements: First, they were to identify and categorize their prior knowledge. We used a series of activities over a three-week period to uncover knowledge areas.³ Second, they were to select information channels to search based on their prior knowledge. Third, they were to determine an order for searching their channels, which depends on their search costs and prospects for discovering an idea in each of them. Fourth, they were to update the composition of their consideration set in response to learning while searching. Fifth and finally, they were to record journal entries to explain their search experiences.

In addition, the treatment group was exposed to the rationale that entrepreneurs are only fit to discover and exploit venture ideas for which they possess specifically relevant prior knowledge. Thus, ideas not encountered within a person's consideration set could probably not be either discovered or exploited, which we explained to them was an implicit proposition of the research to be tested. The purpose of the weekly treatment sessions was to ensure that each subject understood how to use a consideration set-based approach to improve his or her chances of making a discovery to create new wealth. After six training sessions, each of the subjects could select information channels that fit their competencies. They also knew how to update and search their consideration sets.

4.2. Instructions for the control group using entrepreneurial alertness

The control group received a comparable amount of training in staying alert over the same eight-week period. The alertness perspective argues that it is impossible to conduct an optimal search because the object of search would be unknown. Accordingly, there is little, if anything, that an entrepreneur can do to increase his or her odds of success. This raised concerns that the subjects would begin to realize that they were in the control group, which might have lessened their motivation to stay alert.⁴ Therefore, we developed a cover story.

The cover story acknowledged that most discoveries by average entrepreneurs are accidental. We supported this acknowledgement by

sharing some findings from previous research projects that supported this view. Nevertheless, we argued that the alertness perspective, if left unchallenged, could be devastating to entrepreneurship education because it would mean that it was unlikely that the discovery process could be taught. To prove that alertness could be taught, the subjects were asked to collect a real-time sample of alertness-based discoveries from which a theory could be induced that had more promising pedagogical implications. We speculated with the subjects that the theory could be based on underlying cognitive processes, which were unknown.⁵ The control group subjects enthusiastically engaged in the experiment because they believed that discovery could be taught, probably because they were mostly graduate students studying entrepreneurship. Their task was to provide a sample of discoveries while they recorded their efforts several times a week in a journal, which they turned in at the end of the experiment.

In addition, we exposed the control group subjects to the assertions of those who argue that scholars cannot teach entrepreneurs either to be lucky or to search systematically. Still, one of entrepreneurship education's basic assumptions is that educators can improve student performance, and if they cannot actually do it, the intellectual foundation of what they espouse to be able to teach suddenly becomes less stable.

During the course of the eight-week experiment, all subjects recorded their efforts in journals. Their journals contained information about their successes, their frustrations, as well as descriptions of their venture ideas. Three raters independently classified venture ideas, together with journal entries, survey responses, and explanations of accomplishments as indicators of prior knowledge. There were nearly no disagreements among raters (Cronbach's alpha was 0.95).

5. Results

Three raters analyzed journal entries and concluded that there were 59 venture ideas with enough data to analyze. Ten of these 59 useable ideas, which were generated by 31 subjects, were also fit, valuable, rare and inimitable. In other words, we judged 10 of the 59 ideas to have the

potential to generate new wealth. If an idea scored on one or more of the criteria but not all four, it was still considered lacking in wealth generating potential and was scored a zero. If an idea met all four criteria, it was scored as a one.

No subject in either group identified more than one idea with wealth generating potential. If one subject in the treatment group had identified most of the ideas, the experiment could have been rendered useless.

The idea raters were selected on the basis of their familiarity with industries in which the ideas were found. Confidentiality agreements required by the university institutional review board prevent either the identification of the subjects or the disclosure of specific ideas in this article.

Using 2-sample *t* tests, there were no statistically significant differences between the treatment and control groups on average in their age (31 years; *P*-value = 0.45), gender (2/3 of whom were male; *P*-value = 0.11), income (\$41,216; *P*-value = 0.33), or the income of their immediate family (\$64,730; *P*-value = 0.43). Nor were there any differences between groups in their educational or occupational backgrounds. Most of the randomly assigned subjects had no previous start-up experience (93%; *P*-value = 0.07); however 14% of the subjects in the control group did have previous start-up experience compared with 3% of the subjects in the treatment group, which could have assisted the control group. Again, these differences in previous start-up experience were generated by random assignment of subjects. Subjects were employed and/or educated in finance/accounting (15.3%), marketing/sales (18.6%), business-other (28.8%), engineering (22.0%), student only (6.8%), medicine (3.4%) and information technology (5.1%). The overall, *P*-value for occupational type was 0.27, indicating that no single occupation was over-represented.

Hypothesis 1 was not supported. A simple regression test on the continuous independent variable (years of occupational experience) and the continuous dependent variable (number of ideas) showed that there was no significant difference between the groups in their reliance on occupational experience to find discoveries (*P* = 0.81). Note that Hypothesis 1 focused only on the number of ideas identified and not

whether those ideas met the criteria established for wealth creating potential.

Hypothesis 2 tested the joint and independent effects of group membership (alertness versus systematic search) on a subject's possession of specific knowledge related to a particular discovery on the number of ideas discovered. Given the categorical nature of the independent variables and the continuous nature of the dependent variable (number of ideas), we used a two-way ANOVA experiment to test Hypothesis 2. Group membership (*P* = 0.01) and specific knowledge (*P* = 0.02) significantly impacted finding venture ideas. Furthermore, the interaction effect of group membership and specific knowledge was also significant (*P* = 0.02). In other words, the treatment group used specific knowledge significantly more than did the control group, and using consideration sets in conjunction with specific knowledge led to identification of more venture ideas.

Hypothesis 3 tested the effect of group membership (categorical variable) on the number of ideas identified. A one-way ANOVA for hypothesis 3, as predicted, showed that the control group submitted more ideas for evaluation than did the treatment group (*P* = 0.00). In addition, this finding was corroborated by a 2-sample *t*-test (*P* = 0.009) (see Table I).

Hypothesis 4 tested if group membership significantly impacted the identification of ideas with wealth creating potential. Given the ordinal nature of the dependent variable, we used a Mann-Whitney rank sum test. The treatment

TABLE I
Potential of ideas identified by treatment and control groups

Group	Not valid	F	FV	FVR	FVRI	Total ideas per group
Systematic search	6	5	2	2	9	24
Alertness	10	3	15	6	1	35
Total ideas per criteria	16	8	17	8	10	59

FVRI is an acronym for fit, value, rarity and inimitability. Meeting all four of these criteria are necessary to demonstrate that an idea can be exploited to create new wealth. Hypothesis 3 tested the total ideas by group. Hypothesis 4 compared the FVRI column against the other 3 columns.

group identified significantly more ideas (mean rank = 20.30 and sum rank = 304.50) that could lead to the creation of new wealth than did the control group (mean rank = 11.97 and sum rank = 191.50; $P = 0.00$), which suggests that the treatment was effective for training aspiring entrepreneurs to search for discoveries.

6. Limitations

The results of this research should be interpreted with caution because some limitations were not accommodated in the research design. First, we had concern about the reliability of indicators for the four criteria for wealth creation. This difficulty did not relate to their internal validity; rather they had not been fully described in the literature and so we were left to speculate as to how best to measure them. Second, the sample frame was students, so the results are not widely generalizable. Nevertheless, the sample was a conservative test of the role of specific knowledge, which is generally lower among students than it would be among practicing entrepreneurs. In addition, the student frame provided a direct test of the pedagogical implications of the study. In fact, using students was our first choice because we wanted to test whether this informational economics approach could potentially improve our teaching of discovery. Finally, perhaps the results of this research could have been even more robust if we would have been allowed to provide monetary incentives to the subjects. However, due to institutional review board restrictions, we were unable to do so, as recommended typically by experimental economics protocol (Ochs and Roth, 1989). Nevertheless, the results of the hypothesis testing were clear enough to have many interesting implications.

7. Discussion

This research is a rare attempt to test informational economics arguments with regard to the discovery of wealth-generating ideas. To our knowledge, it is also the first application of experimental economics protocols to test competing approaches to discovery. It does not describe the choices or behavior of everyday entrepreneurs, most of whom unexpectedly discontinue their efforts. To its advantage, this

study's findings are not subject to many of the limitations of studies that attempt description, such as being (1) cross-sectional; (2) conducted among convenience samples that do not distinguish between entrepreneurs who create new wealth from their ideas and those who unexpectedly discontinue their efforts; (3) retrospective in that they tend to examine ventures after stochastic effects have already predetermined outcomes and (4) uninterested in the role of luck. On this last point, it is important to realize that we cannot learn much about how to teach aspiring entrepreneurs from studying past successes if we cannot control for the role of luck, which few scholars attempt to do.

7.1. Interpretation of findings

The most important finding of this research is that training graduate students in how to use consideration sets can significantly enhance the potential of the ideas that they discover. That is, they discovered more ideas that conformed to their particular entrepreneurial competence, which were also valuable, rare and inimitable. As noted earlier, these four criteria determine whether an idea could be exploited to provide an entrepreneur with a sustainable competitive advantage, as well as an opportunity to create new wealth. The treatment group found nine times as many ideas with wealth creating generating potential than did the control group.

One interesting difference that we discovered by comparing the journal entries of the treatment and control groups was that the treatment group tended to recognize a problem that existed in the market as a first step in making a discovery. In addition, the treatment group tended to consider ideas that were an extension of an existing product or service. In contrast, subjects in the control group tended to recognize a problem that they personally encountered as a first step in finding an idea. Although the control group found more ideas based on personal problems, they tended not to be market-driven. Perhaps the reason that the control group found more ideas is that its subjects did not need to be as discriminating. In addition, the control group subjects were motivated by problems in their personal experience.

Another important finding is that knowledge specificity is an important correlate of the potential of ideas, whereas previous occupational experience was a statistically insignificant source of high potential venture ideas. This is important because received theory suggests that a person's occupation is an important source of prior knowledge. Clearly, though, a person's occupation was not the determining factor in whether he or she discovered a high potential idea. Instead, it appears to have been the specificity of prior knowledge. Ninety-two percent of the treatment group used specific knowledge to make a discovery compared with eight percent of the control group.

One of the study's more interesting findings is that 14% of the control group narrowed its search to specific domains in accordance with instructions given to the treatment group, although control group members never received instructions about narrowing their search domain. This narrowing occurred spontaneously and without any encouragement from the investigator.

7.2. Pedagogical implications

Entrepreneurs may be heroes in the eyes of some scholars and the popular business press, however, most entrepreneurs discontinue their ventures without attaining their goals, which suggests that they have quite a bit to learn about how to search for and exploit venture ideas. With these facts in mind, educators may want to be cautious in suggesting that aspiring entrepreneurs emulate the practices of those who have succeeded because their success might have been idiosyncratic. Nor is it clear yet that educators have materially improved our students' chances of success, which suggests that they also may have quite a bit to learn about how to help students.

Part of the task of educators is to ensure that students are more successful than they would be otherwise without sitting in classrooms. Because entrepreneurs often do not achieve their objectives, it may be problematic to hold them up as exemplars or to educate aspiring entrepreneurs entirely by exposing them to what entrepreneurs actually do. Although research attempting to

describe entrepreneurial behavior has certainly been informative, it may be time to consider other research designs that can control for luck and failure. Studying repeatedly successful entrepreneurs would be one way to control for luck and failure.

This study provides some encouragement that educators may be able to teach a consideration set-based approach to entrepreneurial discovery as one way to show students how to search more systematically for discoveries. Subjects in the treatment group were nine times as likely to discover an exploitable venture idea as those in the control group, which mirrors received theory.

7.3. Implications for future research

Future researchers may want to address some of the following limitations of current research about discovering venture ideas: (1) cross-sectional designs that do not address causality nor control for spurious effects, (2) conducting research among convenience samples that do not distinguish between entrepreneurs who create new wealth from their ideas and those who unexpectedly discontinue their efforts, (3) retrospective studies of single events that tend to examine ventures after stochastic forces may have already determined their outcomes and (4) studies that ignore the role of luck. On this last point, it is important to realize that scholars cannot learn much about how to teach aspiring entrepreneurs from studying past successes if they cannot control for the role of luck, which few of them attempt to do.

Controlling for luck is where the techniques in this research design, which were influenced by experimental economics, become more important. In the future scholars may wish to consider using randomized experimental designs that control for the above problems because they offer great promise for adding to our understanding of entrepreneurial discovery. One of their advantages is that they can enable investigators to study discoveries as they occur, which can provide opportunities for subjects to document not only what they do as they search, but what they are thinking. This additional source of data can control for biased findings due to common method variance.

A misunderstanding about randomized designs is that they suffer from lack of realism. Although this initial study chose students as a sample, there is no reason that we had to choose them. We chose students as subjects because we were particularly interested in the pedagogical implications of teaching graduate students. We reasoned that if it worked among subjects who were students, it might work later with students who were not subjects. Of course, there is an opportunity for other researchers to replicate this research design among other populations.

An area of tremendous promise for future research is the influence of specific information on the systematic search for discoveries. Studying the role of specific information has both public policy and pedagogical implications. For example, can different social groups draw on private sources of information for making discoveries, which have not been recognized to date? Do economically disadvantaged groups have an unknown informational advantage that they could exploit to create a sustainable competitive advantage? It is not likely that education that provides exposure to general information will make disadvantaged groups extraordinarily successful as entrepreneurs. However, teaching them how to exploit the specific and perhaps private information that they already possess may have a surprisingly beneficial impact.

Research designs that compare the discoveries of different groups are the best way to control for spurious effects, including luck. Studying each of the following groups promises to add to our theoretical understanding of what we can teach students. First, repeat entrepreneurs may already recognize the advantages of searching domains that are an extension of their prior knowledge, in the same way that 14% of the subjects in control group narrowed their search. Second, we would expect that technologically trained employees who possess high levels of specific knowledge would be especially effective in discovering ideas that they could readily exploit. Third, economically disadvantaged groups may be able to substitute their presumed lack of formal education for their possession of deal-specific prior knowl-

edge, which could enable them to create new wealth. Fourth, it would be important to compare aspiring entrepreneurs with 10 years or more of business experience to determine the differential effect of consideration sets on their performance. Fifth, and finally, scholars need to do additional research with students who aspire to become entrepreneurs because they are part of their professional mandate. Scholars simply must learn how to teach them more effectively by improving our theoretical understanding of how entrepreneurs can search for high potential venture ideas and exploit them more effectively.

Finally, this research provides an implicit invitation for experimental economists to join with traditional entrepreneurship scholars to study how entrepreneurs can discover lucrative opportunities that others miss. Clearly, the techniques of the former can contribute to what can be known about how aspiring entrepreneurs can improve their odds. For this reason, if for no other, we hope that many of them will accept this invitation.

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Appendix I

Explanation of Four Criteria used by Raters to Evaluate Wealth-Generating Potential of Venture Ideas⁶

1. Fit

- a. Ideas were matched with the background information of the discoverer, which explains

why this criterion had to be saved for last—the blind review aspect would have been jeopardized. What is the relevance of the connection?

- b. Skills from previous start-ups were compared with skills required for a venture idea.
- c. Were there any significant gaps in anticipated skill requirements?

2. Value

- a. Does an idea facilitate a venture either increasing its revenue or decreasing its costs?
 - i. Does the idea add significant value to the customer and not just represent a functional, process improvement to existing an business?
 - ii. Would a consumer be willing to pay a premium?
 - iii. Is there a robust market?
- b. Evaluation of the business model—from where will come the revenues; how will expenses be incurred? Are there substantial and early free cash flows? (When details of the business model were not included with a submission, raters made inferences based on the information supplied, coupled with their own knowledge of business development.)

3. Rarity

- a. Are there fewer than the number of competitors necessary to generate perfect competition, typically fewer than twelve competitors?
- b. An idea's industry was analyzed according to four levels of competition (i.e., no competition, competition avoidance, hyper-competition, and perfect competition.) The first two types of competition permit the existence of rare ideas, whereas the last two do not allow them.

4. Inimitable

- a. Would potential imitators of an idea face a cost disadvantage?

- iv. Were any of the following isolating mechanisms present to prevent imitation:

- v. *Information impactedness*—knowledge gained through the successful operation of a previous venture.

1. Tacit knowledge acquired by participating in an activity would be a more effective protection against imitation than explicit knowledge.
2. Specific knowledge would be more costly to acquire than general information.

- vi. *Response lags*—competitors can be slowed in responding to early movers.
- vii. *Economies of scale*—occur when the minimum efficient scale of a business is comparable to the size of the market.
- viii. *Buyer switching costs*—provide advantage to first mover.
- ix. *Reputation*—in the case of experience goods, many buyers base their purchases on reputation.
- x. *Communication goods effects*—products increase in value with the number of adopters.
- xi. *Buyer evaluation costs*—when they are high, buyers may free ride on the presumed analysis of market leader.
- xii. *Advertising and channel crowding*—early entrants find it less costly to disseminate their message and product.
- xiii. *Legal protections, such as patents*—substitute for quasi-property rights because they can be enforced in court.

Notes

¹ The Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel 2002 was awarded to Vernon L. Smith “for having established laboratory experiments as a tool in empirical economic analysis, especially in the study of alternative market mechanisms.”

² Searching within a consideration set never eliminates all possible uncertainty about making a discovery. Ultimately, it remains a matching process over which an entrepreneur cannot exercise total control. Thus, to an extent, an entrepreneur still must remain “alert” to possible matches. The value of a consideration set-based search is that search can theoretically be directed on the basis of prior knowledge,

which should greatly improve the odds of being alert to a discovery.

³ It should be noted that for nearly one-half the total time for the experiment, that the treatment group was not searching for discoveries, whereas the control group was busy searching for discoveries.

⁴ It is interesting to consider if students in actual classrooms feel as though the discovery of an idea using alertness only is some sort of a game that depends on them being lucky. In fact, during debriefing, some subjects in the control group revealed that even using the cover story that they felt that they were in the control group, which has very important implications for how the traditional teaching of alertness could be reducing the motivation of students to make discoveries.

⁵ All of the subjects had previously signed consent letters in which they were alerted that might receive some misleading information for experimental purposes but that all subjects would be completely debriefed at the conclusion of the experiment, which was done. None of the subjects reacted negatively to the debriefing and were in fact very supportive of the experimental procedures.

⁶ Raters graded submissions blindly and in random order. For each criterion, a rating of 1–5 (low to high) was given, and if the average score exceeded 3 (the midway point on the scale) the raters assigned full credit for having satisfied that criterion. The Cronbach's alpha for the three raters was 0.95.

References

- Acs, Z. J. and D. B. Audretsch, 2003, *Handbook of Entrepreneurship Research*, Boston: Academic Publishers.
- Arrow, K. J., 1989, Economics of Information, Public lecture, reproduced in first report to March 1989, Indira Gandhi Institute of Development Research, Bombay: 41.
- Bar-Hillel, M. and R. Faulk, 1982, 'Some Teasers Concerning Conditional Probabilities', *Cognition* **11**, 109–122.
- Barney, J. B., 2001, *Gaining and Sustaining Competitive Advantage*, 2nd Edition Englewood Cliffs, NJ: Prentice-Hall.
- Baumol, W. J., 1993, 'Formal Entrepreneurship Theory in Economics: Existence and Bounds', *Journal of Business Venturing* **8**, 197–210.
- Camerer, C., 2002, *Behavioral Game Theory*, Princeton, NJ: Princeton University Press.
- Davis, D. D. and C. A. Holt, 2003, *Experimental Economics*, Princeton, NJ: Princeton University Press.
- Demsetz, H., 1983, 'The Neglect of the Entrepreneur', in J. Ronen (eds.), *Entrepreneurship*, Lexington, MA: Lexington Books.
- Dreyfus, H. L. and S. E. Dreyfus, 1986, *Mind Over Machine*, Oxford, United Kingdom: Basil Blackwell, Ltd.
- Fehr, E. and S. Gächter, 2000, 'Cooperation and Punishment in Public Goods Experiments', *American Economic Review* **90**(4), 980–994.
- Fiet, J. O., 1996, 'The Informational Basis for Entrepreneurial Discovery', *Small Business Economics* **8**, 419–430.
- Fiet, J. O., 2000, Entrepreneurial Competence as Knowledge. This paper was presented at the annual meeting of the Entrepreneurship Division of the Academy of Management, Toronto, Canada.
- Fiet, J. O., 'A Prescriptive Analysis of Search and Discovery', *Journal of Management Studies* (in press).
- Fiet, J. O., 2002, *Systematic Search for Entrepreneurial Discoveries*, Westport, CN: Praeger.
- Fiet, J. O., V. Clouse and W. Norton, 2004, 'Systematic Search by Repeat Entrepreneurs', in E. John Butler (eds.), *Opportunity Identification and Entrepreneurial Behavior*, Connecticut: Greenwich, 1–28.
- Fiet, J. O., A. Piskounov and P. C. Patel, 2005, 'Still Searching (Systematically) for Entrepreneurial Discoveries', *Small Business Economics* **25**, 489–504.
- Fiet, J. O. and M. Samuelsson, 2000, 'Knowledge-Based Competencies as a Platform for Firm Formation', in *Frontiers of Entrepreneurship Research*, Wellesley, MA: Babson College, 166–178.
- Friedman, D. and S. Sunder, 1994, *Experimental Methods*, Cambridge University Press, Chapters 1 and 2.
- Gaglio, C. M., 1997, 'Opportunity Identification: Review, Critique and Suggested Research Directions', in J. Katz (ed.), *Advances in Entrepreneurship, Firm Emergence and Growth*, 3: 139–202.
- Gilad, B., S. Kaish and J. Ronen, 1988, 'The Entrepreneurial Way with Information', in S. Maital (eds.), *Applied Behavioral Economics*, Brighton, England: Wheatsheaf Books, Ltd, 480–503.
- Hammonds, K. H., 2001, *Michael Porter's Big Ideas*, Boston: Fast Company.
- Hayek, F. A., 1945, 'The Use of Knowledge in Society', *American Economic Review* **35**, 519–530.
- Hirschleifer, J., 1970, *Investment, Interest, and Capital*, Englewood Cliffs, NJ: Prentice-Hall.
- Hirschleifer, J., 1971, 'The Private and Social Value of Information and the Reward to Innovative Behavior', *American Economic Review* **61**(4), 561–574.
- Hirschleifer, J., 1973, 'Where Are We in the Theory of Information?', *American Economic Review* **63**(2), 31–39.
- Jensen, M. C. and W. H. Meckling, 1992, 'Specific and General Knowledge and Organizational Structure', in L. Werin and H. Wijkander (eds.), *Contract Economics*, Cambridge, MA: Blackwell Publishers.
- Jovanovic, B., 1982, 'Truthful Disclosure of Information', *Bell Journal of Economics* **Spring**, 36–44.
- Kagel, J. H. and A. H. Roth (eds.), 1995, *The Handbook of Experimental Economics*, Princeton, NJ: Princeton University Press.
- Kaish, S. and B. Gilad, 1991, 'Characteristics of Opportunities Search of Entrepreneurs Versus Executives: Sources, Interests, General Alertness', *Journal of Business Venturing* **6**, 45–61.
- Kirzner, I., 1973, *Competition and Entrepreneurship*, Chicago: University of Chicago Press 67–68.
- Kirzner, I., 1979, *Perception, Opportunity, and Profit: Studies in the Theory of Entrepreneurship*, Chicago: University of Chicago Press 142–143.

- Kirzner, I., 1985, *Discovery and the Capitalist Process*, Chicago: University of Chicago Press.
- Kirzner, I., 1992, *The Meaning of Market Process: Essays in the Development of Modern Austrian Economics*, London, NY: Routledge.
- Kirzner, I., 1997, 'Entrepreneurial Discovery and the Competitive Market Process: An Austrian Approach', *Journal of Economic Literature* **35**, 60–85.
- MacMin, R. D., 1980, 'Search and Market Equilibrium', *Journal of Political Economy* **88**(2), 308–327.
- March, J. G., 1991, 'Exploration and Exploitation in Organizational Learning', *Organization Science* **2**(1), 71–87.
- Ochs, J. and A. E. Roth, 1989, 'An Experimental Study of Sequential Bargaining', *American Economic Review* **79**, 355–384.
- Palich, L. and R. Bagby, 1995, 'Using Cognitive Theory to Explain Entrepreneurial Risk Taking: Challenging Conventional Wisdom', *Journal of Business Venturing* **10**, 425–438.
- Pfeffer, J. and G. Salancik, 1978, *The External Control of Organizations: Resource Dependence Perspective*, New York: Harper & Row.
- Rosenthal, R. and R. Rosnow, 1991, *Essentials of Behavioral Research*, Boston, Massachusetts: McGraw Hill.
- Roth, A. E., 1988, 'Laboratory Experimentation in Economics: A Methodological Overview', *Economic Journal* **98**, 974–1031.
- Roth, A. E., 1995, 'Introduction to Experimental Economics', in J. H. Kagel and A. E. Roth (eds.), *The Handbook of Experimental Economics*, Princeton: Princeton University Press, 3–109.
- Roth, A. E., 2002, 'The Economist as Engineer: Game Theory, Experimentation, and Computation as Tools for Design Economics', *Econometrica* **70**, 1341–1378.
- Schank, R. C., 1975, *Conceptual Information Processing*, New York: American Elsevier.
- Shadish, W., T. Cook and D. Campbell, 2002, *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*, Boston, Massachusetts: Houghton Mifflin Co.
- Shane, S., 2000, 'Prior Knowledge and the Discovery of Entrepreneurial Opportunity', *Organization Science* **11**, 448–469.
- Shane, S. and J. Eckhardt, 2003, 'The Individual-Opportunity Nexus', in Zoltan Acs and David Audretsch (eds.), *Handbook of Entrepreneurship Research*, Boston: Kluwer Academic Publishers.
- Shane, S. and S. Venkataraman, 2000, 'The Promise of Entrepreneurship as a Field of Research', *Academy of Management Review* **25**, 217–226.
- Smith, V. L., 1976, 'Experimental Economics: Induced Value Theory', *American Economic Review* **66**, 274–279.
- Smith, V. L., 1989, 'Theory, Experiment and Economic', *Journal of Economic Perspectives* **3**(1), 151–169.
- Smith, V. L., 1994, 'Economics in the Laboratory', *Journal of Economic Perspectives* **8**(1), 113–131.
- Stigler, G. J., 1961, 'The Economics of Information', *Journal of Political Economy* **69**(3), 213–225.
- Stiglitz, J. E., 1985, 'Information and Economic Analysis: A Perspective', *Economic Journal* **95**, 21–41.
- Venkataraman, S., 1997, 'The Distinctive Domain of Entrepreneurship: An Editor's Perspective', in J. Katz and R. Brockhaus (eds.), *Advances in Entrepreneurship, Firm Emergence and Growth*, New York: JAI Press.
- Waterman, D. and F. Hayes-Roth, 1978, *Pattern-Directed Inference Systems*, New York: Academic Press.

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