

# Opportunity Recognition as Pattern Recognition: How Entrepreneurs “Connect the Dots” to Identify New Business Opportunities

by Robert A. Baron\*

## Executive Overview

How do entrepreneurs identify opportunities for new business ventures? One possibility, suggested by research on human cognition, is that they do so by using cognitive frameworks they have acquired through experience to perceive connections between seemingly unrelated events or trends in the external world. In other words, they use cognitive frameworks they possess to “connect the dots” between changes in technology, demographics, markets, government policies, and other factors. The patterns they then perceive in these events or trends suggest ideas for new products or services—ideas that can potentially serve as the basis for new ventures. This pattern recognition perspective on opportunity identification is useful in several respects. First, it helps integrate into one basic framework three factors that have been found to play an important role in opportunity recognition: engaging in an active search for opportunities; alertness to them; and prior knowledge of an industry or market. In addition, it also helps explain interrelations between these factors (e.g., the fact that active search may not be required when alertness is very high). Second, a pattern recognition perspective helps explain why some persons, but not others, identify specific opportunities. Third, a pattern recognition framework suggests specific ways in which current or would-be entrepreneurs can be trained to be better at recognizing opportunities. Future directions for research on a pattern recognition perspective are described, and its practical implications for entrepreneurship education are examined.

*“There is a tide in the affairs of men  
Which, taken at the flood, leads on to fortune;  
Omitted, all the voyage of their life  
Is bound in shallows and in miseries.”*

—William Shakespeare

The field of entrepreneurship strongly concurs with Shakespeare’s words about the importance of recognizing, and acting upon, opportunities. Indeed, opportunity recognition is widely viewed as a key step in the entrepreneurial process—one from which, in many cases, all else follows.<sup>1</sup> For this reason, opportunity recognition has been the subject of much research in the field of entrepreneurship.<sup>2</sup>

Previous work has examined many different factors that play a role in the recognition of opportunities for new business ventures.<sup>3</sup> Among these, however, three have been identified as es-

pecially important and received most attention: engaging in an active search for opportunities; alertness to opportunities (the capacity to recognize them when they emerge); and prior knowledge of a market, industry, or customers as a basis for recognizing new opportunities in these areas. Past research suggests that all three are indeed important. For instance, with respect to an active search for opportunities, many studies indicate that access to appropriate information plays a key role in opportunity recognition.<sup>4</sup> Similarly, additional findings indicate that entrepreneurs are more likely than managers to engage in active search for opportunities and potential but untapped sources of profit.<sup>5</sup> Further confirming the importance of active search is the finding, reported in one intriguing study, that entrepreneurs

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belonging to the Chicago area Entrepreneurship Hall of Fame were found to be less likely to identify their opportunities from public information such as magazines, newspapers, and trade publications; rather, they actively sought such information in more unique sources, such as personal contacts and more specialized publications.<sup>6</sup> These and other findings indicate that actively searching for information is an important factor in the recognition of many opportunities by entrepreneurs although, as noted by several authors, such searches must be carefully directed to succeed<sup>7</sup> and in some cases, searches can proceed in a relatively “automatic” manner rather than in a conscious and carefully directed one.<sup>8</sup>

Alertness, in contrast, emphasizes the fact that opportunities can sometimes be recognized by individuals who are not actively searching for them, but who possess “a unique preparedness to recognize them. . .” when they appear (Gilad, note 5, p. 48). Kirzner,<sup>9</sup> who first introduced this term into the entrepreneurship literature, defined it as “alertness to changed conditions or to overlooked possibilities.” This definition suggests that opportunities can be noticed even by persons who are not actively seeking them; indeed, when alertness is high, entrepreneurs may engage in what has been termed “passive search,” a state in which they are receptive to opportunities, but do not engage in a formal, systematic search for them.<sup>10</sup> What are the foundations of entrepreneurial alertness? It has been suggested that alertness rests, at least in part, on cognitive capacities possessed by individuals—capacities such as high intelligence and creativity.<sup>11</sup> These capacities help entrepreneurs to identify new solutions to market and customer needs in existing information, and to imagine new products and services that do not currently exist.<sup>12</sup> For instance, consider Lorraine Santoli, inventor of a useful new product. When Ms. Santoli grew tired of trying to locate facial tissues while driving, she came up with the idea of putting them into a cup-shaped container—one that would fit neatly into the cup-holders found in virtually all vehicles. She was not actively or systematically searching for this idea, but because of her personal creativity, was alert to this oppor-

tunity and proceeded to develop it. More formal evidence for the importance of cognitive processes in entrepreneurial alertness has been obtained in many studies. For instance, intelligence has been found, in several investigations, to be linked to founding new ventures.<sup>13</sup> Creativity, another aspect of cognition, has also been found to play a role in alertness; for instance, entrepreneurs tend to score higher on various tests of creativity than other persons.<sup>14</sup> Additional findings indicate that other personal characteristics, too, may play a role in promoting alertness. For instance, optimism—the belief that events will generally result in favorable outcomes—has been positively linked to opportunity recognition.<sup>15</sup> And perceptions of risk also may be important, since individuals who perceive high levels of risk in many situations may be reluctant to view almost any idea as a *bona fide* opportunity.<sup>16</sup>

Finally, turning to the third factor mentioned above, prior knowledge, a wealth of evidence indicates that information gathered through rich and varied life experience (especially, through varied business and work experience) can be a major “plus” for entrepreneurs in terms of recognizing potentially profitable opportunities. For example, it has been found that prior knowledge of customer needs and ways to meet them greatly enhances entrepreneurs’ ability to provide innovative solutions to these problems—in other words, to identify potentially valuable business opportunities.<sup>17</sup> One recent study on the importance of prior knowledge<sup>18</sup> compared two high-tech start up companies—one that was highly successful and one that failed. Results indicated that the failing company (which designed anti-theft devices for personal computers and was known as Handsoff) did not keep abreast of current developments in its potential market. For instance, it continued to design anti-theft devices even as the price of personal computers dropped drastically, thus greatly reducing demand for such products. In contrast, the start-up that succeeded (Buyonet), continued to gather pertinent information about its potential markets and in fact, expanded these greatly as such knowledge was obtained. The company began by setting up Internet “stores” for its own products, but quickly

expanded into setting up such operations for other companies. The result? Major financial success. In short, knowledge—especially knowledge concerning specific markets or industries—often provides a solid base for opportunity recognition, and the broader this foundation, the more opportunities present themselves, and the higher the quality of such opportunities entrepreneurs will tend to recognize.

This is just a small part of the evidence suggesting that these factors (active or passive search, alertness, and prior knowledge) play a key role in opportunity recognition, so there seem to be strong grounds for assuming that they are indeed important. To date, however, they have been studied separately and viewed as largely independent aspects of opportunity recognition. In other words, no framework for integrating these factors—for understanding how they might operate together or for understanding how they influence opportunity recognition—has been developed. As noted below, such integration is important both for understanding the basic nature of opportunity recognition and for identifying ways of helping entrepreneurs to be more proficient at this task. It is suggested here that such integration can be provided by a basic cognitive process long studied in the field of cognitive science—pattern recognition.

Pattern recognition is the process through which specific persons perceive complex and seemingly unrelated events as constituting identifiable patterns.<sup>19</sup> In essence, it involves recognition of links between apparently unrelated trends, changes, and events—links suggestive of patterns connecting them together. The patterns suggested by these links or connections then become figures instead of undifferentiated (and often overlooked) ground. In essence, then, pattern recognition, as applied to opportunity recognition, involves instances in which specific individuals “connect the dots”—perceive links between seemingly unrelated events and changes. The patterns they perceive then become the basis for identifying new business opportunities.

Several lines of evidence suggest that pattern recognition may indeed play a key role in opportunity recognition. First, it is clear that many

opportunities exist for years before they are noticed and developed. For instance, consider wheeled luggage of the type that is now used by a large majority of all air travelers. Such luggage was used for decades by air flight crews before it was introduced into the market for general sale. Why? Perhaps because no one “connected the dots” between several pertinent trends: a large increase in the number of passengers, growing problems with checked luggage, expansion in the size of airports, and so on. Once these trends were seen as connected, the benefits of wheeled luggage became apparent, and this product soon came to dominate the market.

Second, there is a large body of evidence in cognitive science suggesting that pattern recognition is a basic aspect of our efforts to understand the world around us. That is, we do indeed expend considerable effort searching for patterns among various events or trends in the external world.<sup>20</sup> To the extent that opportunity recognition also involves perceiving links or connections between seemingly independent events or trends, it may be closely related to this basic perceptual process.

Finally, recent findings point to the conclusion that pattern recognition is indeed closely related to opportunity recognition by entrepreneurs. For instance, in one revealing study, experienced (repeat) entrepreneurs were asked to describe the process involved in the identification of the opportunities they pursued.<sup>21</sup> Findings indicated that these highly experienced entrepreneurs (they had started more than four ventures each), uniformly mentioned engaging in an active search, and also in restricting these searches for opportunities to areas in which they already possessed considerable knowledge. In other words, they reported engaging in a process very similar to that involved in pattern recognition—a process in which they employed their existing cognitive frameworks and knowledge to notice connections between diverse events and trends. Indeed, many stated explicitly that they had recognized opportunities by combining a number of external factors into a meaningful pattern. Findings such as these suggest that pattern recognition may indeed play an important role in the identification of new business opportunities.

In order to clarify the potential value of a pattern recognition perspective for understanding opportunity recognition, the remainder of this paper will proceed as follows. First, because relating opportunity recognition to models of pattern recognition requires certain assumptions about the nature of opportunities and the process of opportunity recognition itself, these assumptions, stated in the form of propositions, are presented first. Next, two models of pattern recognition that appear to be directly related to opportunity recognition are described. Third, specific ways in which these models help to integrate the factors discussed earlier (active search, alertness, prior knowledge) into a single framework are examined. Fourth, directions for future research on this model are briefly described. Finally, implications of this model for entrepreneurship education and practice are considered.

### **Opportunities and Opportunity Recognition: Some Basic Propositions**

While many definitions of the term opportunity have been proposed,<sup>22</sup> most include references to three central characteristics: potential economic value (i.e., the capacity to generate profit), newness (i.e., some product, service, or technology that did not exist previously), and perceived desirability (e.g., moral and legal acceptability of the new product or service in society). For purposes of this paper, then, **opportunity** will be defined as a perceived means of generating economic value (i.e., profit) that previously has not been exploited and is not currently being exploited by others.

If opportunity is defined in this manner, then **opportunity recognition** can, in turn, be defined as the cognitive process (or processes) through which individuals conclude that they have identified an opportunity. It is important to note, as emphasized recently by several authors,<sup>23</sup> that opportunity recognition is only the initial step in a continuing process, and is distinct both from detailed evaluation of the feasibility and potential economic value of identified opportunities and from active steps to develop them through new ventures. It should also be noted that the focus

here is on what have been described as innovative opportunities—ones that truly break new ground rather than merely expand or repeat existing business models, such as, for instance, opening a new Italian restaurant in a neighborhood that does not currently have one.<sup>24</sup>

### **Propositions Concerning the Nature of Opportunities and Opportunity Recognition.**

In order to apply models of pattern recognition to the process of opportunity recognition, two basic assumptions are required. These assumptions, stated as propositions, are as follows.

***Proposition 1: Opportunities emerge from a complex pattern of changing conditions—changes in technology, economic, political, social, and demographic conditions. They come into existence at a given point in time because of a juxtaposition or confluence of conditions which did not exist previously but is now present.***

Perhaps a concrete example will be helpful in illustrating this point. In recent years, the number of people getting married who have been married before has increased dramatically. Further, because these people tend to be older than those marrying for the first time, they often have greater financial resources. Another, seemingly unrelated trend is that older persons in many societies seem increasingly willing to “indulge” themselves—they do not want to miss out on experiences simply because they are in their 40s or 50s instead of their 20s and 30s. While these trends and changes seem, at first glance, to be unrelated, two entrepreneurs—Cheryl and Bill Brown—have recently recognized that they suggest the need for a service to help such persons plan a large wedding.<sup>25</sup> The company they founded—Second Time Around—has experienced rapid growth as word of its existence spread among people contemplating marriage for the second or third time. In contrast, other existing wedding services are specifically geared to young persons getting married for the first time. This new business provides a clear illustration of how a confluence of events or trends can lead to the emergence of a new and potentially profitable business opportunity. It is

suggested here that recognizing the links or connections between various events, trends, or changes is a key step in recognizing such opportunities.

***Proposition 2: Recognition of opportunities depends, in part, on cognitive structures possessed by individuals—frameworks developed through their previous life experience. These frameworks, which serve to organize information stored in memory in ways useful for the persons who possess them, serve as “templates” that enable specific individuals to perceive connections between seemingly unrelated changes or events. In other words, they provide the cognitive basis for “connecting the dots” into patterns suggestive of new business opportunities.***

The models of pattern recognition to be discussed in the next section of this paper focus on these cognitive structures, suggesting that they provide the basis for recognizing connections between seemingly unrelated events or changes. In other words, these models propose that one reason why specific persons (and not others) perceive such patterns is that they possess the cognitive frameworks that permit them to do so. In contrast, this “equipment” is lacking or less well-developed in persons who do not perceive these patterns. Perhaps even before describing these models of pattern recognition, a concrete example of how this process operates will be helpful.

Imagine an individual who has worked for several years as a firefighter. As a result of this experience, she or he has encountered many instances in which a member of the fire fighting team has entered a burning structure and for some period of time is out of touch with other firefighters. This, in turn, results in considerable danger for the “missing” person or persons, who cannot be readily helped if they encounter difficulties. Now, further imagine that this former firefighter is taking engineering and computer science courses at a technological university and learns that small signaling devices capable of pinpointing a firefighter’s exact location now exist, as does software capable of representing these locations accurately

on a computer screen. Because of his or her work experience as a fire fighter, this person now perceives these technological developments as connected, and as suggesting a means of continuously locating each member of the fire fighting team. As a result, he or she perceives an opportunity for a new product that is both useful and potentially profitable—a small device that can be worn by fire fighters that indicates their exact location at all times. The entrepreneur reasons that every fire department would want this equipment because, if it works well, it would save many lives. How did the person involved recognize this opportunity? By “connecting the dots”—perceiving patterns among seemingly unrelated events; and these connections were evident to this person because of his or her past experience as a firefighter—experience that equipped this particular entrepreneur with the appropriate cognitive frameworks needed for perceiving such links. (In fact, precisely such events have occurred, and a start-up company, Tiercent Inc., has been founded by entrepreneurs who were formerly firefighters to develop such products.).

Now that these basic propositions have been offered, two models of pattern recognition that seem to offer important insights into precisely how opportunity recognition occurs are described in the next section.

### **Models of Pattern Recognition: How Individuals “Connect The Dots” into Meaningful Patterns**

If opportunity recognition is indeed a cognitive process that involves recognition of complex patterns, then the following basic question arises: How does recognition of such patterns actually occur? In other words, how do specific persons perceive connections among unrelated and diverse events, and from these connections, derive specific business opportunities? A compelling answer is offered by models of pattern recognition.

### **Models of Pattern Recognition: Opportunities as Emergent, Noticeable Patterns**

Many different models of pattern recognition exist, but all agree on the following basic point:

individuals notice various events in the external world (e.g., changes in technology, markets, government policies) and then utilize cognitive frameworks they have developed through experience to determine whether these events are related in any way—whether, in short, they form a discernible pattern. Different models focus on distinct kinds of cognitive frameworks, but the process is much the same in all of them.

### **Prototype Models.**

One widely accepted model of pattern recognition suggests that individuals employ prototypes as a basis for recognizing patterns. Prototypes are idealized representations of the most typical member of a category (a class of objects or events that seem to belong together).<sup>26</sup> Basically, newly encountered events or trends are compared with existing prototypes to determine whether they belong to specific categories or can be seen as being connected in some manner. For instance, most people possess a prototype for “house.” This mental framework is broad enough so that everything from a huge mansion to a simple cottage can be recognized as a house, while other objects that do not match this prototype well (e.g., tents, skyscrapers, shopping malls) are excluded. Prototypes represent the modal or most frequently experienced combination of attributes associated with an object or pattern. For example, the prototype of “house” would include such attributes as doors; windows; rooms in which to sleep, eat, and wash; a roof or other protection from the elements; and so on.

Applying prototype models to opportunity recognition, entrepreneurs may use prototypes as a means for identifying patterns among seemingly unrelated events or trends. For instance, consider a physician engaged in medical research. Because of extensive on-the-job experience, this individual has a clearly developed prototype for “effective treatment” of various diseases (e.g., the treatment is safe, it can be used ethically with patients, it enhances recovery from the illness, etc.). Further, this prototype may be especially clear for illnesses in which the physician specializes—ones with which she or he has had considerable experience. Now, imagine that this physician reads an article

about a new advance in scientific knowledge concerning some basic physiological process—a process that is suspected to play a role in certain diseases. In addition, the physician knows from actual experience that existing treatments for these diseases have major side effects. Using her prototype of “effective treatment” and perhaps other prototypes as well (e.g., prototypes concerning the nature of a given disease and how it develops), she now recognizes potential links between the new scientific advance and potential treatments for a specific illness. In other words, her prototypes help her to perceive an emergent pattern in these diverse events. She also realizes that if these perceived links are confirmed, this will suggest ways of developing new drugs effective in treating this illness. In short, she has noticed this possibility (this opportunity) because prototypes she possesses have helped her to do so—to notice an emergent pattern among seemingly diverse and independent events.

Much evidence suggests that individuals do indeed form prototypes and that once they exist, these cognitive frameworks are employed in many ways. For instance, individuals often use them for perceiving patterns in diverse and seemingly unrelated events or trends.<sup>27</sup> Used in this manner, prototypes may well play an important role in opportunity recognition.

### **Exemplar Models.**

A very different model of pattern recognition emphasizes the importance of specific knowledge rather than idealized prototypes. Such exemplar models<sup>28</sup> suggest that as individuals encounter new events or stimuli, they compare them with specific examples (exemplars) of relevant concepts already stored in memory. For instance, a physician’s concept of “effective treatment” for a given kind of disease would not consist solely of an idealized representation of the most typical “effective treatment” she or he can imagine (a prototype); rather, it would also include numerous examples of “effective treatments” the physician has actually encountered, exemplars that vary in many respects (e.g., exemplars of excellent treatments with few negative side effects and exemplars of very poor ones that are not highly effective).

tive and that do involve negative side effects). Exemplar models seem especially relevant to opportunity recognition because they do not require the construction of prototypes. Rather, individuals simply compare newly encountered events or stimuli with examples of a given concept already present in memory. This fits well with entrepreneurs' reports that they ". . . just know a good opportunity when they see it," and do not have to engage in complex processing to reach this conclusion (as would be required for the development of prototypes). Moreover, exemplar models fit with recent findings indicating that experienced, repeat entrepreneurs generally search for opportunities in areas or industries where they are already knowledgeable—where, in short, they have many exemplars stored in memory.<sup>29</sup>

Overall, research in cognitive science suggests that both prototype and exemplar models may be necessary to fully understand how individuals notice emergent patterns in diverse and apparently unrelated events or changes.<sup>30</sup> For example, some findings suggest that initially, before they gain expertise in a specific area, individuals may rely on prototypes and on comparing newly encountered stimuli and events with these idealized representations. As they gain expertise in a given domain, however, they may shift to greater reliance on exemplars, which allows them to perform the process of identifying complex patterns in a less effortful, more automatic manner.<sup>31</sup> Further, and perhaps even more intriguing, it appears that prototypes and exemplars may be represented (and processed) in different regions of the brain. Specifically, prototypes appear to be stored and processed in the left cerebral hemisphere while exemplars are stored and processed in the right cerebral hemisphere.<sup>32</sup> Together, these findings suggest that opportunity recognition may well involve both prototypes and exemplars. In addition, other cognitive frameworks may also be involved (e.g., schemas).<sup>33</sup> The key point is that these frameworks, built up through experience, may play an important role in the recognition of emergent patterns, and hence in identification of new business opportunities. The implications of these processes for understanding opportunity recognition and for integrating the effects of the three

factors described earlier—active search, alertness, and prior knowledge—will now be examined. First, however, an important point about the nature of opportunity recognition will be clarified.

### **Opportunity Recognition as a Repeated Search for Patterns**

Thus far, the discussion seems to suggest that opportunity recognition occurs in a single step: entrepreneurs observe various events or changes, and upon examining them, recognize links or connections between them that then suggest new business opportunities. While this may be true in some instances, basic research on pattern recognition suggests that often the process is one involving many steps and repeated efforts to recognize emergent patterns.<sup>34</sup> Initially, individuals may notice that two or more variables are related, but this in itself does not yield a clear-cut pattern. Rather, it may only suggest that there is "something there," and that additional information is required to examine it more closely. As this input is obtained, the overall pattern may begin to take shape, and the possibility of a new business opportunity to emerge.<sup>35</sup> For instance, consider how Expedia.com and other online travel services were developed. A number of changes and events paved the way for this opportunity: a huge increase in the number of individuals who owned personal computers; development of software that could track literally thousands of flights and provide information on thousands of hotels; plus techniques for conducting secure financial transactions over the Internet. Did the founders of companies such as Expedia.com notice, in a single step, that these events and trends formed a pattern suggestive of a new business opportunity? Not at all. Rather, this idea took shape in a more gradual manner, the entrepreneurs recognizing first one portion of the overall pattern and then another. For instance, early on, they recognized that people were dissatisfied with making airline reservations by phone and that this could be handled faster and more efficiently online. They also noted that many people were unhappy about huge variations in ticket prices; for instance, the person sitting next to them on a given flight might have paid much less than they did. This suggested the pos-

sibility of offering customers the lowest possible prices when they made reservations online. Later, the entrepreneurs realized that many travelers needed hotel and car reservations, too, so they expanded the scope of their business to include these aspects of travel. It is probably reasonable to say that they did not, during early stages, have a fully-formed vision of the business they actually developed. Rather, it unfolded one step at a time as they gradually perceived more connections between the relevant factors and ways in which these could be used to develop a profitable business.

In many cases, this is precisely how new ventures take form; their founders do not initially recognize all aspects of an opportunity. Rather, they notice some aspects and proceed with these. Then, as they obtain experience and information, their view of the opportunity is expanded and refined. In a sense, the process is never completed; rather it evolves just as growing businesses do. The idea that opportunity recognition often develops in a gradual manner is consistent with the fact that venture capitalists rarely expect new ventures to take precisely the form presented in business plans. On the contrary, they realize that opportunities—even very good ones—will almost certainly develop in new and initially unforeseen ways. Reflecting this fact, venture capitalists value very highly founders' abilities to adapt and change, and often seek entrepreneurs who demonstrate these characteristics.

Overall, then, it should be emphasized that the process of opportunity recognition is not a simple one in which entrepreneurs perceive all links between relevant variables at once and start with a fully-formed idea of the opportunities they will ultimately pursue. Rather, during early stages, (and perhaps later ones, too), opportunity recognition involves repeated steps in which entrepreneurs perceive the opportunities they are developing with increasing clarity, and adjust their business models and goals to reflect these changes.

Having said that, it is important to note that the process of searching for connections between various changes and trends in the external world, identifying emergent patterns in these connections, and then using such patterns as the basis for

identifying new business opportunities, remains essentially the same. In short, while opportunity recognition does indeed often involve repeated efforts to identify patterns in seemingly independent events or trends, the search for these patterns remains an essential part of the process well beyond the point at which new ventures are actually launched.

### **Models of Pattern Recognition: How They Help to Integrate the Effects of Search, Alertness, and Knowledge**

Earlier in this paper, it was noted that there is a large amount of evidence suggesting that opportunity recognition is strongly influenced by active search for opportunities, alertness to opportunities, and prior knowledge. One key advantage of models of pattern recognition is that they provide a means of integrating these factors within a single perspective. First, consider active search. In the context of pattern recognition, this would involve searching for links or connections between seemingly unrelated events and trends. In essence, the task is actually twofold in nature: first, key changes, trends, and events would be identified. Second—and much more challenging—a search for potential links between them would be instituted. Again, a concrete example may be helpful.

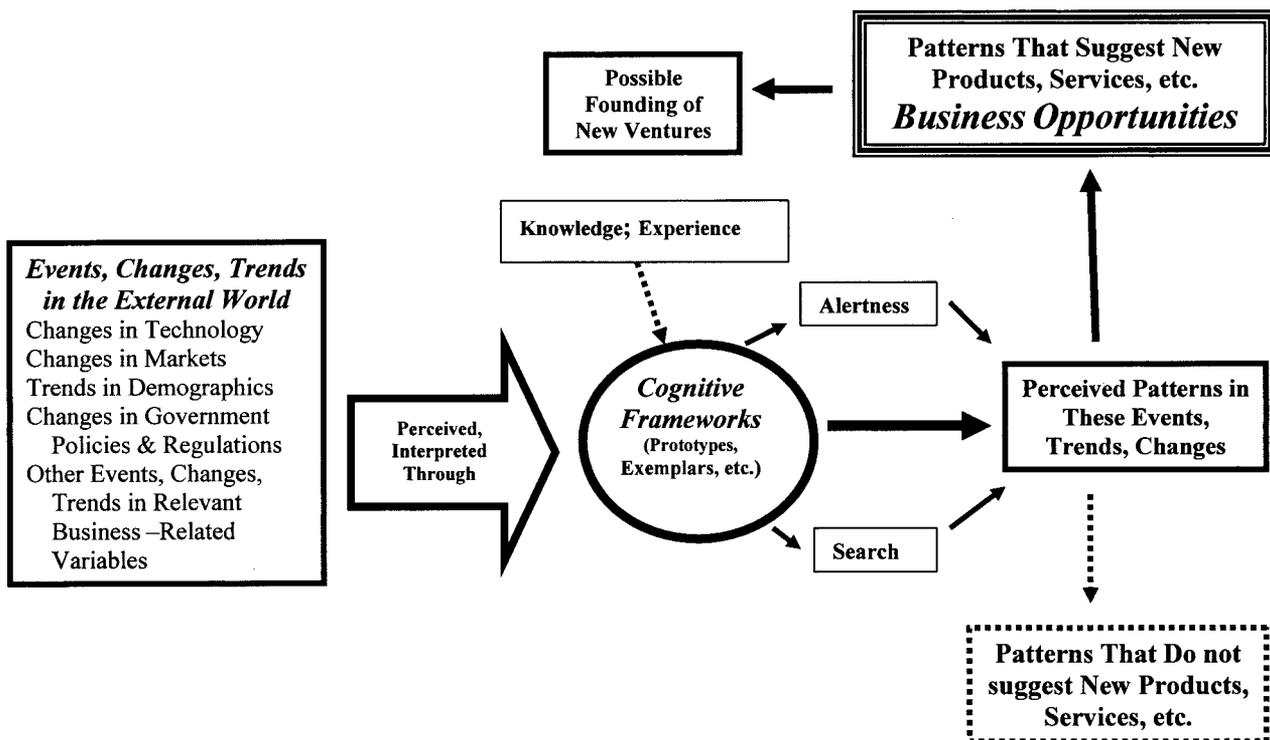
In recent years, the proportion of babies born to parents in their thirties and even forties has increased greatly. These persons, many of whom hold college and advanced degrees, believe strongly (one might say passionately!) that exposing their infants to an intellectually enriched environment will help them develop high intelligence and other desirable cognitive capacities. While these trends might seem, at first glance, to be unrelated, one entrepreneur—Judy Aigner-Clark—recognized that in fact they can be combined to suggest an excellent business opportunity: a company that would specialize in producing toys, games, and DVDs designed to provide the kind of intellectual stimulation highly-educated parents seek for their children. As she describes it, she founded the Baby Einstein Company when she discovered that there were no age-appropriate products available to help her share her love of art, classical music, language, and

poetry with her new daughter. Recognizing this fact, she combined music and colorful, real world images into the first Baby Einstein video—and was soon on her way to success. Why did she recognize this opportunity for a new family of products when many other persons did not? In part because she had extensive experience as a teacher, and this supplied her with the prototypes she needed to connect seemingly independent trends into an exciting new business opportunity.

Alertness, too, can be understood within the context of pattern recognition. Alertness refers to the capacity to recognize opportunities when they exist—when they have emerged from changes in technology, markets, government policies, competition, and so on. In turn, this capacity may rest, as models of pattern recognition suggest, on possessing the appropriate cognitive structures—prototypes or exemplars. These structures help specific persons to perceive connections between divergent events and trends, and these connections, in turn, suggest new business opportunities to them. In other words, “connecting the dots” depends on having appropriate cognitive frameworks that facilitate this task.

Finally, turning to prior knowledge, this, too, can be seen as closely related to pattern recognition. Knowledge of a particular market, industry, or group of customers, for instance, would help entrepreneurs know where to search for new patterns that suggest business opportunities. Further, knowledge is the “raw material” from which prototypes and exemplars are constructed. Individuals with a broad range of work experience will have greater knowledge about particular industries, markets, technologies, government regulations, and competition than will persons with more limited experience. This knowledge will enable them to develop more accurate and appropriate prototypes and a broader range of exemplars. These cognitive frameworks, in turn, can facilitate the identification of new opportunities. These suggestions, and the potential role of pattern recognition in opportunity recognition, are summarized in Figure 1.

At this point, it should be noted that these three factors—search for opportunities, alertness, and prior knowledge—may be interrelated.<sup>36</sup> For instance, it appears that when alertness is very high, active searches for opportunities may not be



**Figure 1**  
**The Potential Role of Pattern Recognition in Opportunity Recognition**

necessary; entrepreneurs are so sensitive to them that they do not have to engage in formal, systematic search processes. Similarly, high levels of prior knowledge may reduce the necessity for active searches. A cognitive perspective can readily explain these relationships. Within this perspective, high alertness implies well-developed cognitive frameworks useful for perceiving meaningful patterns in diverse events or trends. To the extent these frameworks exist, an active search for opportunities may not be necessary because such frameworks permit highly efficient interpretation and processing of new information. Similarly, a large store of prior knowledge may contribute to the formation of broad and richly-connected cognitive frameworks, again rendering participation in formal search activities less crucial. In short, yet another advantage of a pattern recognition perspective is that it can help explain interrelationships between search, alertness, and prior knowledge, thus clarifying the effects of these three important factors.

Two additional points are also worth noting. First, in addition to search, alertness, and prior knowledge, another factor—the breadth of entrepreneurs' social networks—has recently received growing attention, and also appears to play an important role in opportunity recognition. Specifically, the findings of several studies<sup>37</sup> indicate that the broader entrepreneurs' social networks (the more people they know and with whom they have relationships), the more opportunities they identify. This finding, too, is consistent with a pattern recognition perspective. Social networks are an important source of information for entrepreneurs, information that may contribute to the richness of their store of knowledge and the development of their cognitive frameworks. Further, social networks may be especially helpful to entrepreneurs in terms of honing or refining these frameworks (prototypes, exemplars). For instance, by discussing opportunities they have recognized with family, friends, and others, entrepreneurs may form more accurate and useful prototypes for identifying opportunities—cognitive frameworks helpful in determining whether ideas for new products or services are practical and potentially valuable rather than merely interesting or novel.

In short, the benefits of an extended social network, too, can be understood within a pattern recognition framework.

Second, as the model in Figure 1 suggests, not all patterns connecting diverse events, changes, or trends perceived by entrepreneurs serve as the basis for founding new ventures. Such patterns lead to new ventures only when they suggest new products or services that seem, on initial examination, to be feasible. If emergent patterns do not point to products or services that appear to be feasible, they will often be discarded by current or potential entrepreneurs.

In sum, three factors that have been found to play important roles in opportunity recognition by entrepreneurs are search, alertness, and prior knowledge. These factors and others can all be understood within the context of pattern recognition. Integrating them in this manner provides increased insight into the basic nature of opportunity recognition. Further, as will be explained in more detail below, understanding the effects of these variables within a single framework suggests practical steps for enhancing entrepreneurs' ability to recognize opportunities. Since assisting entrepreneurs in every way possible is a key goal of entrepreneurship education, this appears to be a very beneficial outcome.

### **Assessing the Accuracy of a Pattern Recognition Approach: Directions for Future Research**

**A**s noted in earlier sections of this paper, several lines of evidence converge to suggest that pattern recognition may indeed play a key role in the identification of new business opportunities. However, most of this evidence is somewhat indirect in nature. There is certainly a need for more direct tests of this framework. One way to proceed involves comparing novice and highly experienced entrepreneurs in certain relevant respects. As noted earlier, a cognitive perspective such as the one adopted here suggests that repeat entrepreneurs, as a result of their considerable experience in starting new ventures, may acquire relatively rich, well-developed, and accurate cognitive frameworks useful in identifying new oppor-

tunities. Basic research on pattern recognition suggests that as individuals gain experience in a particular domain, their prototypes and other cognitive frameworks do indeed become more clearly defined, richer in content, and more focused on key attributes of that content domain. This suggests, for instance, that the “business opportunity” prototypes of repeat and novice entrepreneurs would differ in several observable respects (e.g., they would be richer and more fully developed.)

These predictions have been investigated in one recent study that compared the business opportunity prototypes of novice and repeat entrepreneurs.<sup>38</sup> The two groups were as closely matched in age as possible, since age is often highly correlated with work experience and interest in the study was focused specifically on the effects of prior experience in starting new ventures. Results indicated that highly experienced (repeat) entrepreneurs do indeed possess clearer and richer prototypes of “business opportunity,” and that, moreover, these prototypes more closely reflect factors that have been found to influence the success of new ventures (e.g., cash flow, meeting customers’ needs) than is true for the prototypes of novice entrepreneurs. To put it succinctly, experienced entrepreneurs appear to focus, in their efforts to identify opportunities, on factors likely to influence success, while novice entrepreneurs tend to become fascinated with sheer newness or novelty. These findings suggest that opportunity recognition may indeed be closely linked, in some respects, to pattern recognition—to perceiving identifiable patterns in arrays of seemingly unrelated events.

Future research can obtain additional evidence concerning the accuracy of a pattern recognition approach by comparing novice and repeat entrepreneurs in other ways. For instance, do these groups use different search strategies with, perhaps, novice entrepreneurs employing more active approaches, while experienced entrepreneurs because of their higher alertness and knowledge, adopt more passive methods? Similarly, are the searches of novice entrepreneurs relatively unfocused while those of experienced entrepreneurs, who, in a sense, “know what they know,” are more directed to areas in which the entrepreneurs al-

ready have considerable knowledge and expertise? These and related possibilities can be readily examined in future studies.

Finally, not all repeat entrepreneurs are highly successful. Some do indeed start one successful new venture after another, while others start several new ventures that generate mediocre economic outcomes at best. A pattern recognition perspective suggests that the cognitive frameworks of successful repeat entrepreneurs would be more focused on key business-related factors such as cash flow and manageable risk while those of less successful repeat entrepreneurs might be relatively similar to those of novice entrepreneurs, suggesting, in a sense, that they have not benefited greatly from their experience.

Many other procedures for testing the pattern recognition perspective offered here exist. For instance, research on expertise suggests that growing experience in a domain does not necessarily result in improved performance. On the contrary, the relationship between growing experience in a particular field and performance in it may be curvilinear rather than linear in nature.<sup>39</sup> Up to a point, growing expertise contributes to improved performance. Beyond some level, however, performance may actually decline as expertise continues to rise. For instance, research findings indicate that the success of venture capitalists (VCs) in choosing new ventures that ultimately become profitable seems to increase and then to actually decrease as the VCs gain in years of experience.<sup>40</sup> The decline in their performance may stem from the fact that highly expert individuals, who have extremely well-developed cognitive frameworks, rely increasingly on them and on relatively automatic modes of thought. As a result, their performance declines. Would this be true for repeat entrepreneurs? It seems possible that they, too, can become “locked in” by their own cognitive frameworks (e.g., prototypes) if these become too strong or well-established. Comparing repeat entrepreneurs who have started many new ventures with ones who have started just a few could provide intriguing data—and further insights into the potential value of a pattern recognition approach. In sum, several means of investigating the useful-

ness of this framework exist, and can be readily pursued in future research.

### **Practical Implications of a "Connect The Dots" Perspective**

Currently, there is widespread agreement that entrepreneurs play a major role in fostering economic growth and job creation in their communities—and perhaps in their entire societies as well.<sup>41</sup> If entrepreneurs do indeed make these contributions, then efforts to understand the nature of opportunity recognition are well justified, because although not all new ventures proceed from entrepreneurs' beliefs that they have recognized a business opportunity, many certainly do.<sup>42</sup> Assuming this is the case, it is reasonable to ask: What does a pattern recognition or "connect the dots" perspective offer in this respect? How does it increase our understanding of this important but complex process? One way to evaluate this contribution is to ask whether a pattern recognition perspective helps us to answer basic questions about the process of opportunity recognition—questions with important practical implications. Among these, two have been posed over and over again, and it appears that a "connect the dots" perspective can shed new light on both: 1) Why do certain persons, but not others, identify specific opportunities? and 2) Can individuals be trained to be more proficient at performing this task?

### **Pattern Recognition and the Identification of Opportunities by Specific Persons**

The first question refers to what is, in one respect, a very puzzling state of affairs: hundreds, thousands, or even millions of persons are exposed to the same events, changes, or trends in the external world, but only a very few of these individuals recognize links or connections between these events, and hence the new business opportunities they suggest. For instance, by the 1980s, many millions of persons in the U.S. had eaten bagels (generally in large cities of the Northeast). Yet, few, if any of them, recognized the opportunity of producing and selling this form of bread nationwide. When this opportunity was recognized and developed (initially by Bruegger's Bagels

Inc.), bagels quickly became very popular across the U.S. This example is relevant to the basic question of interest here: "Why do so many people 'miss' opportunities that literally stare them in the face, while a few do recognize them?" A pattern recognition perspective offers several possible answers.

First, specific individuals may recognize specific opportunities that many others overlook because they possess the cognitive frameworks (e.g., prototypes, exemplars) needed to perceive patterns among seemingly unrelated trends or events. For instance, consider Chester Carlson, the individual credited with inventing the modern copy machine. At the time he invented (or rather, adapted) the basic process used in copy machines (and in laser printers, too), there was a clear need for better means of making copies, especially in business and educational settings. During the 1940s and 1950s, many products for making copies had been invented, but none seemed to meet this basic need very well. How, then, did Carlson perceive the opportunity that led to the first of a long line of successful copiers—the Xerox 914? One possibility involves the fact that he held both a law degree and a technical degree. As a result, he understood both the strong need for improved means of making copies and several of the technical processes that might be used to meet this need. Further, once he decided to try to solve this problem, he restricted his efforts (i.e., search) to technologies and processes he understood well.<sup>43</sup> By focusing on processes for which he already had well-developed prototypes and exemplars, he enhanced his own ability to perceive the emergent pattern that suggested to him an effective way of making dry, permanent copies. In a sense, he possessed the cognitive frameworks necessary for combining various technological advances, changes in the nature of business, and other trends, and the result was a product that has, in many ways, revolutionized office routines—not to mention education and many other fields.

A pattern recognition perspective suggests additional reasons why specific persons, but not others, recognize particular opportunities. Because their life experiences are unique, different persons may possess prototypes for a given domain that

differ in terms of clarity or degree of development. For instance, an individual who has worked for years in a given industry may have well-developed prototypes and exemplars relevant to that industry—prototypes for customer needs, for what would constitute a really good product or service in this industry, for what technologies and means of production are currently available, and so on. These prototypes, in turn, may help this person recognize opportunities deriving from changes in any of these factors—changes in technologies, markets, and so on. In contrast, another person, who has worked in a very different industry or at a very different set of jobs would be equipped with different cognitive frameworks (e.g., prototypes), and so might be less likely to “connect the dots” between several events or trends and less likely to recognize opportunities deriving from them. In short, specific persons recognize specific opportunities because they possess cognitive frameworks useful for doing so; others, who lack such “cognitive equipment” or possess it to a smaller degree, are less likely to recognize these opportunities.

In sum, a pattern recognition perspective suggests several reasons why specific persons recognize opportunities that others overlook. Moreover, this framework suggests that in recognizing opportunities, active searches, alertness, and prior knowledge operate together, and by doing so, may provide an important “edge” to specific persons with respect to identifying new business opportunities.

### **Can Individuals Be Trained to Be More Proficient at Identifying Opportunities? Implications for Entrepreneurship and Business Education**

Another basic question relating to opportunity recognition—and one with important implications both for entrepreneurs and entrepreneurship educators—is the following: “Can individuals be trained to be more proficient at this task?” In other words, can current or would-be entrepreneurs learn to be more successful at recognizing opportunities that have emerged from changes in the external world? A pattern recognition perspective suggests that in fact, this is a very feasible goal, one that can be reached through several different steps.

First and foremost, the “connect the dots” perspective offered here suggests that individuals can be trained to be more proficient at recognizing opportunities by teaching them not merely to be “alert” to opportunities or to search actively for them, but rather, to search in the best places and in the best ways. Specifically, they should focus their efforts on identifying changes in technology, demographics, markets, and other pertinent factors that play an important role in the success of almost any business. Second, while engaging in such searches, they should also focus on actively seeking to identify ways in which these trends and changes are linked or connected; in other words, they should search for emergent patterns. The framework offered here suggests that recognizing such patterns is often a key initial step in the process of identifying new business opportunities. Can individuals really learn to notice such patterns? Basic research on pattern recognition and recent research in the field of entrepreneurship<sup>44</sup> suggests that they can. When individuals focus their attention on pertinent factors and also attempt to perceive ways in which these may be related, the likelihood that they will perceive (recognize) emergent patterns is increased.<sup>45</sup>

This, in turn, suggests that the likelihood that current or would-be entrepreneurs will recognize opportunities in specific domains (industries, markets, etc.) can be increased by training them to focus on the most relevant factors and to search for connections between these variables or changes. Consider an entrepreneur with strong interests in the restaurant business. This individual might be encouraged to focus on such factors as changing technology (e.g., technology that assists in food preparation or storage), changing demographics (which might indicate that certain kinds of restaurants serving specific kinds of food will be more likely to thrive than others), and shifts in government policies concerning safety and working conditions. Through careful attention to these and other relevant sources of information, the would-be entrepreneur might realize that opportunities for certain kinds of restaurants are now emerging—for instance, restaurants that cater to the needs and preferences of senior citizens or those of growing ethnic minorities. In the

absence of careful attention to relevant changes and trends, these opportunities might not be readily discernible.

Second, a pattern recognition perspective also suggests that opportunity recognition can be enhanced by providing potential entrepreneurs with a very broad range of experience. The broader this experience (e.g., the wider the range of positions held, the greater the number of different industries) the richer will be the prototypes and store of exemplars at their disposal, and hence, the more likely the entrepreneurs will be to perceive connections between seemingly unrelated events or trends—especially connections that are not immediately apparent to any casual observer. Research findings offer support for this possibility: entrepreneurs with greater experience and knowledge have been found to be more effective at identifying opportunities than those with less experience and knowledge.<sup>46</sup>

Finally, if exemplars play a role in opportunity recognition, exposing individuals to a wide range of business opportunities that vary greatly in quality might well prove beneficial. The richer and more complete the store of exemplars individuals have in memory, the more effective they may be in comparing newly encountered events or stimuli with these exemplars and hence, in identifying emergent opportunities.

Overall, then, a “connect the dots” perspective on opportunity recognition is quite optimistic: it suggests that entrepreneurs can learn, through appropriate training, to be more adept at this task. Further it suggests that helping current or prospective entrepreneurs to be better at recognizing opportunities is something that can be provided in business education. Courses in entrepreneurship can be designed to include information and training focused on where entrepreneurs should direct their attention (e.g., to important changes, trends, and events in technology, demographics, markets, government policies, etc.) and on the task of searching for patterns in these events and changes. Such training would provide students—and future entrepreneurs—with important advantages in the search for opportunities.

A pattern recognition perspective also suggests the potential value of exposing business students

to a wide range of exemplars—examples of good opportunities that served as the foundation for successful new ventures, and poor ones that seemed promising but for various reasons did not yield positive results. The richer the store of exemplars they acquire (e.g., through exposure to a wide range of cases), the better equipped they will be, cognitively, to recognize patterns suggestive of new opportunities.

In short, the perspective offered here suggests specific ways in which entrepreneurship education (and perhaps business education generally) can contribute to current and future entrepreneurs’ ability to recognize emerging business opportunities. To the extent such training is effective, entrepreneurs and many other persons, too, may benefit.

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*“If I were to wish for anything, I should not wish for wealth and power, but for the passionate sense of the potential, for the eye which, ever young. . . sees the possible. . . what wine is so sparkling, what so fragrant, what so intoxicating as possibility?”*

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To conclude: writing more than 150 years ago, the Danish philosopher Soren Kierkegaard<sup>47</sup> offered these words: “If I were to wish for anything, I should not wish for wealth and power, but for the passionate sense of the potential, for the eye which, ever young. . . sees the possible. . . what wine is so sparkling, what so fragrant, what so intoxicating as possibility?” It is a basic premise of this paper that this sense of “the possible” underlies the activities of many entrepreneurs who seek to convert their ideas and visions into reality—profitable companies supplying products and services that enhance the lives of many persons. Since recognition of new opportunities is often the starting point of this journey, it seems crucial that we gain full understanding of this process and how it can be enhanced. Doing so may provide important insights not merely into what entrepreneurs do, but also how they do it; and in this case, understanding the “how” may help us to achieve one of the key goals of entrepreneurship education—assisting entrepreneurs to reach their goals.

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