**The Context and Cognition of Opportunity Recognition: a Perspective on Science Researchers**

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## ABSTRACT

We address the question of how context affects whether and how scientists recognize entrepreneurial opportunities. Our model analyzes how individuals' immediate institutional context and other contextual factors affect the necessary cognitive perceptions of positive situation, potential gain and controllability. Our theoretical model draws on entrepreneurial and managerial cognition research, and research on entrepreneurial context, including institutional and social networks perspectives. The model has implications for research in opportunity recognition, and for policies designed to increase entrepreneurial behavior.

## THE INFLUENCE OF CONTEXT ON OPPORTUNITY RECOGNITION

Why does one does person recognize an opportunity to create a valuable new venture while others do not? This question is becoming as central to research on entrepreneurship as the question of why one firm succeeds and another fails is to strategy. In some ways this is a nature or nurture question. Do individuals recognize opportunities because of the context in which they are living and working (nurture) or is it because of some unique cognitive process (nature)? Answering this question is central to advancing our understanding of the emergence of new ventures and one of the key challenges for researchers interested in entrepreneurship, strategy and innovation. Recently Shane & Venkataraman challenged entrepreneurship research to engage in "the scholarly examination of how, by whom and with what effects opportunities to create future goods and services are discovered, evaluated and exploited" (2000: 218). This paper accepts this challenge by deriving a model of the influence of individuals' context on their propensity to recognize an opportunity. We explore whether and how scientists recognize business opportunities by examining how the institutional and other contextual influences affect the perceptions that precede opportunity recognition. Similar to the recent research on the development of the brain, we believe that it is the intersection of the individual's context and cognitive processes that explain why a specific individual recognizes an entrepreneurial opportunity. We extend prior work on opportunity recognition by developing an integrative model of opportunity recognition that bridges research on cognitive schema (Dutton & Jackson, 1988) and institutional and network perspectives as explored in entrepreneurship research.

Opportunity recognition by scientists working in universities and research institutions has important implications for economic development. During the past thirty years, the number of scientists taking the steps towards creating their own business has increased substantially (Blumenthal, 1986; Kreminsky, et al., 1991). New industries have emerged that are increasingly dependent upon the basic scientific research for their core technologies and products and on scientific researchers for their founders (McMillan, Narin & Deeds, 2000; Deeds & Hill, 1999). At the same time demands for universities and research institutions to play a stronger role in regional economic development are increasing. Despite these demands the number of ventures emerging from the these institutions remains a relatively small number when compared to the total entrepreneurial activity in the United

States less than 450 ventures were created in 2002 (AUTM, 2003). With the mission and demands on the 'Republic of Science' changing in the Post-Cold War era, the need to understand the process of venture emergence from within these academic research institutions is increasingly important to the institutions themselves and also the broader societies, both of which are in search of ways to increase economic growth and return on investment in basic research. Note that successful science-based firms often make significant economic and quality of life contributions to society.

Opportunity recognition by scientists also has interesting features that lead to theoretical insights. In the context of the Bayh-Dole Act in the U.S., the process of moving science discovery in the university to the market place typically requires the scientist to disclose a discovery and make a case for establishing intellectual property rights through material transfer agreements or patents. In many universities, the process essentially requires the scientist to recognize an opportunity to apply the scientific discovery to a current or potential market need. Once the IP process is initiated, it is often unlikely and even undesirable for the scientist to actually found their ventures. Thus, policy makers want scientists to engage in the essential entrepreneurial act of opportunity recognition, and yet not 'be' entrepreneurs. The scientist is critical in moving scientific discovery from the cycle of knowledge creation to knowledge exploitation; the situation focuses our attention clearly on the opportunity recognition. In this paper, we take the perspective of the individual researcher. The focus of the model is the researcher's recognition of a business opportunity, as influenced by social context, especially the institutional norms, policies and venturing knowledge of the university or research institute.

## PERSPECTIVES ON OPPORTUNITY RECOGNITION AND CONTEXT

We modify Dutton and Jackson (1987, 1988) to model the cognitive schema of opportunity recognition. They identify three dimensions which are opportunity-consistent and distinguish opportunities from threats or other situations. "Specifically, the "opportunity" category implies a *positive* situation in which *gain* is likely and over which one has a fair amount of *control*" (Dutton & Jackson, 1987: 79). In the context of managers responding to information from the perspective of strategic issues, the presence of information cues fitting or matching these dimensions predict the identification of a strategic issue as an opportunity.

The perception of a positive situation refers to a generalized individual judgment about the situation. Individuals that do not see entrepreneurship or involvement in business as desirable for whatever reason are far less likely to recognize business opportunities. In fact, if the person's career is perceived as highly desirable and incompatible with entrepreneurship, opportunity recognition would be extremely unlikely. Thus scientists that are highly dedicated to their profession and believe they are making valuable contributions to society may not consider any type of entrepreneurship as positive, because of the conflicts between their professional norms and entrepreneurship. Under these circumstances they are unlikely to ever recognize an entrepreneurial opportunity. This dimension is consistent with current entrepreneurship research on entrepreneurial motivation. In this research, we find that individuals are more likely to recognize opportunities if they already wish to become entrepreneurs (Zeitsma, 1999). The desire to become an entrepreneur may have ambiguous roots, however, as entrepreneurship may appear positive if only because the apparent alternatives are not at all desirable (Amit, et al., 1995). For example, a scientist facing lack of research funding may turn to entrepreneurship as a more positive alternative.

Gain refers to beliefs that the opportunity will result in gains in profits or other valued results. In the context of an individual, positive gain may refer to benefiting people with the product or service, or gaining access to cash and other resources for future projects. Note that these estimations of future gain include both personal and business results. If the potential gain is significant and unambiguous, individuals are more likely to recognize business opportunities.

Controllability is defined as the perception that the individual believes they can successfully act to create those gains. Jackson and Dutton found that controllability included "perceived autonomy about how to respond (to a strategic issue), freedom to choose whether to respond, access to resources or means for resolving the issue, and feelings of personal competence" (1988: 384). In some contexts, the relative lack of career choices or

resources may trigger the search for other types of resources needed to pursue a livelihood or passion. In other cases, resource slack such as the availability of assets or a strong labor pool may trigger a more entrepreneurial orientation.

The entrepreneurship studies discussing context are numerous; the challenge is to identify a framework which provides insight into the scientists' perspective. This requires a model of opportunity recognition which explicitly models the cognition of scientists that are embedded in an immediate institutional context and also may have a range of network connections to distant contexts. In integrating previous cross-national research, Busenitz, Gomez and Spender (2000) propose a three-dimensional, entrepreneurship-specific model and survey instrument for measuring factors influencing the emergence of entrepreneurship in a nation. The dimensions include regulatory factors (i.e. institutions, regulations, policies, etc.), cognitive factors (i.e. knowledge of how to start ventures, obtain financing, etc.), and normative factors (i.e. value for entrepreneurship as a career). Changing the level of analysis and details from the original model of Busenitz and colleagues, we find these dimensions provide a useful conceptual framework for analyzing the institutional influences of the immediate context of individuals on their propensity to recognize an entrepreneurial opportunity.

Institutions vary in their orientation to the core values and practices of entrepreneurship, and in their institutional arrangements to encourage or discourage the propensity to entrepreneurship by individuals. This leads to variations in the rate of entrepreneurship across countries, companies and other institutional contexts. For example, Goldfarb and Henrekson (2002) show that the institutional context for entrepreneurship at universities varies due to differences in national policies. The Bayh-Dole Act, they argue, created incentives for American institutions to develop their own specifically local policies regarding technology transfer, and in the process created the incentives that individual researchers' react to while recognizing opportunities.

Placing opportunity recognition within the context of networks, we gain further insight into the situation facing individuals. Research on entrepreneurial networks has demonstrated that "social networks affect organizational emergence by structuring the context in which nascent entrepreneurs must act" (Aldrich, 1999: 88). On the one hand, to the extent that entrepreneurs are embedded in a social context, the ability of individuals to act in entrepreneurial ways or to access resources is constrained by the norms and restrictions of those networks, as well as by the information available through their networks. On the other hand, social capital theory has been used to show that advantages stemming from the resources embedded in networks may lead to improved performance or competitive advantage (cf. Florin, Lubatkin & Schulze, 2003; Yli-Renko, Autio & Sapienza, 2001; Blyler & Coff, 2003). Aldrich (1999) summarizes findings in research on network structures of entrepreneurs by concluding that diversity (differing professional competencies and experience) and tie strength (often frequency of contact) impact the entrepreneurial actors' access to valuable resources for creating a new venture, including information, support, financing, advice resources, legitimacy and other necessities. More recently, research on networks and knowledge transfer suggest that network cohesion (i.e. relationships that are surrounded by strong third-party ties) and personal relations may help in transferring knowledge across domains (Reagans & McEvily, 2003).

These observations have interesting implications for scientists and opportunity recognition. Because we can expect that proximity and certain forms of homophily would affect the structure of scientists' (and potential entrepreneurs') personal networks (Ruef, Aldrich & Carter, 2003), many individuals are likely to be embedded in personal networks that constrain entrepreneurship because of the conflict between the norms of their profession or community and the rather different demands of business opportunity recognition. Also, the complexity of many science based ventures requires reliance on others for everything from professional and entrepreneurial competence to finances. Thus, for example, the scientist whose work and network is largely bounded within a non-business career is constrained in many ways, and would not be expected to recognize entrepreneurial opportunities if only because of the perceived lack of controllability. If, in contrast, scientists' personal relations and network ties bridge outside their immediate research context to more distant and diverse contexts, greater entrepreneurial ambition may be observed (see for example, Nicolaou & Birley, 2003).

Outside the institutional context of scientists, the regional industrial context may provide precisely the

influential resources, expertise and norms needed to encourage or enable business opportunity recognition. Research on high-technology industrial clusters (e.g. Saxenian, 1991) and networks within biotech industries (e.g. Stuart & Sorenson, 2003) demonstrate that regional industrial networks have significant impact on the emergence and success of new firms. The empirical research suggests that access to these networks may be essential to business opportunity recognition, as evidenced by different patterns of venture emergence and innovation between regions (Reynolds, Storey & Westhead, 1994; Sorenson & Audia, 2003). The value of regional industrial networks to scientists varies from one region to another depending on the relevance of the resources and expertise available. From the perspective of individuals, the regional industrial networks may counter-balance or complement the influence of the non-entrepreneurial institutional structures of their immediate context – or the networks may even be irrelevant if individuals lack the social capital to access the regional networks.

Institutional regulatory factors describe the rules that operate in the individuals' immediate context. In the case of science researchers, the regulatory factors may include university policies and programs regarding leave of absence, royalty rates, patenting and the promotion and tenure guidelines, each of which may directly affect the scientists' probability of recognizing and pursuing a commercial opportunity. Our model is general, however, and refers to all relevant policies and programs with an institutional context. The regulatory factors describe the rules of the game, and may create incentives and/or barriers for entrepreneurship.

Institutions often have contradictory policies, leaving significant room for mixed influences on individuals' perceptions. For example, an institution may have made policy statements in support of entrepreneurship, and yet individuals may perceive little or no resource slack for providing support such as leaves of absence, patenting and the basis for promotion and tenure. While significant research has developed on technology transfer there has been relatively little examination of the impact of specific policies on the level of technology transfer. Our propositions deal with the issue of institutional policies in general, and allow for variation in the response of individuals to the regulatory factors.

One aspect of regulatory factors affects whether individuals view an opportunity is potential gain. In the university context, leave of absence policies influence researchers through by decreasing the opportunity costs of venturing. The one thing every researcher or entrepreneur needs more of is time. In the case of scientists thinking about a new venture, a leave of absence provides the time to pursue the venture without losing their career rank and status within their home institutions. The availability of leaves of absence and the length of the leaves will increase the perceived potential gain from the opportunity by lowering the potential costs of pursuing a venture for research scientists, by allowing the researchers to postpone the decision about continuing their academic career until after they have had time to pursue the opportunity recognition process and develop the venture. Therefore policies such as the availability of leaves of absence and longer leaves of absence are likely to increase the probability that an individual researcher will recognize an opportunity because they are more likely to view the situation as offering potential gain overall.

Regulatory factors should also affect individuals' perceptions of controllability. For example, for a researcher, a significant area of institutional policy relates to the protection and exploitation of intellectual property. The ability to get an idea patented is the first hurdle in the long road to creating a viable new technology-based venture. Patenting is also an expensive and time-consuming process with the costs of obtaining a patent frequently running in excess of $20,000. The willingness of an institution to provide support for patenting activity, both monetary and expertise, will be critical precursor to opportunity recognition by the researchers at that institution.

In summary, we propose that regulatory factors of the immediate context influence the cognitive dimensions of potential gain and controllability. The influence on the perception of potential gain may be due to institutional policies, for example, that affect how revenues or profits are shared between institutions, departments and individuals involved in an entrepreneurial venture. Conversely, the institutional regulations may lower the costs of pursuing a business opportunity, and thus increase the perception of potential gain. Controllability, including the domains of autonomy, freedom to act and access to resources, and the means to pursue an opportunity, is affected by a wide range of institutional regulations.

**Proposition #1: The individual's perception of the policies and procedures of their immediate context will impact the likelihood they perceive positive situation/potential gain and controllability in a business situation, and thus increase the likelihood they will recognize an entrepreneurial opportunity.**

**Institutional Knowledge of Entrepreneurial Processes**

The actual knowledge of how to set up a company, file a patent appropriate for exploitation, and attract major financing, will affect an individual's feeling of personal competence, and thus their perception of controllability. In the academic context, where researchers typically know little to nothing about how to start a new venture, individuals will be unlikely to recognize opportunities (unless their feeling of competence is directed towards working with strong institutional staff support or external network contacts). Aldrich (1999) suggests that knowledge about organizing is widely shared, although societies may differ in specific strategies. Busenitz, Gomez and Spencer (2000) in fact find that knowledge related to new venture start-ups differs significantly from one country to another, as measured by a common survey instrument. They also find that countries with less entrepreneurship knowledge may have fewer venture start-ups (Busenitz, et al., 2000); we posit that this also applies to the emergence of entrepreneurs from contexts with low venturing knowledge (such as many research institutions).

Institutional knowledge of the specifics of creating and nurturing a successful entrepreneurial venture is most likely to be gained directly from experience. Therefore the more new ventures an institution has been involved in creating, the more knowledge about the process is likely to be embedded within the institution. The detailed knowledge and experience gained through active involvement in new ventures (perhaps as an equity holder) will increase the institution's knowledge of the venture creation process and access to the capital networks that fund new ventures. Therefore, the knowledge gained by a scientist's home institution is likely to increase the entrepreneurial knowledge, perspective and contacts available to the researchers. To the extent that the specialized, research-related venturing knowledge affects an individual researcher's feelings of controllability, we expect the researchers' propensity to recognize an opportunity will increase. If the institution in which the scientist works lacks knowledge about these processes, then the researchers feelings of control will also be less and thus less likely to recognize an opportunity.

**Proposition #2: The venturing knowledge in the individuals' immediate context will increase the likelihood they perceive positive situation/potential gain and controllability in a business situation, and thus increase the likelihood they will recognize an entrepreneurial opportunity.**

**Institutional Norms**

Normative factors may affect the motivation for pursuing opportunities through increasing or decreasing the perception that a potential opportunity could be a positive situation. In an immediate context that supports entrepreneurship, for example, individuals may perceive that actors within their institution will value the experience they gain from starting a new venture, which would lead them to perceive a potential opportunity as offering a positive personal situation. Research on university technology transfer has found significant resistance among university faculty to proprietary work (Larsen & Wigand, 1987) and a belief that an emphasis on commercialization and economic development including closer ties with industry and new ventures is a "Faustian" bargain, trading income and research support for new values that threaten academic freedom and integrity (Lee, 1996; Bozeman, 2000). The fundamental tension for researchers, from the perspective of opportunity recognition, are norms which emphasize knowledge creation and priority of discovery established through publications and conferences, versus norms which emphasize application and private use of knowledge through patents and commercialization. Successfully integrating the paradox of the norms of science and business at the institutional level seems rare, however, and few institutions achieve successes as both a leading research institution and as a leader in technology transfer and entrepreneurial spinouts (such as MIT). As a member of the institution, the researcher will

be influenced by these norms and values, because of the influence on the individual's beliefs and because of institutional 'rewards' for conforming to these norms and penalties for acting contrary to these norms. The net result of these normative influences is that the researcher will judge whether a situation is positive or negative, affecting the likelihood or recognizing an opportunity.

**Proposition #3: Individuals whose immediate context has strong norms in favor of entrepreneurship are more likely to perceive positive situation/potential gain and controllability in a business situation, and thus increase the likelihood they will recognize an entrepreneurial opportunity.**

**Regional Industrial Networks**

The disconnection between an individual's immediate context and the business world can mean that many ideas never get beyond discussions with colleagues. Networks influence opportunity recognition to the extent they provide relevant resources, expertise and information, thus influencing feelings of control, perception of potential gain and fresh information flow. In the case of research scientists, these resources could include general business related knowledge, specific expertise and access to financial capital. Yet scientists typically interact with their immediate colleagues and other scientists specializing in the same topic. This personal network complements the existing knowledge base of the scientists, reinforcing the effect of past knowledge on future opportunity recognition and reducing the likelihood of fresh information flow. In fact, the measures of success, publications and citations promoted by the values of the academia reinforce the need for a personal network focused on other academics. For some researchers, their personal network may give them serendipitous ties into the business world, such as if family members or old friends are active in the business world and provide access to this type of knowledge. However, in most instances the individuals' personal network lacks access to specific knowledge about venture formation and financing, as well as access to risk-capital and the numerous other specialized resources needed by a scientist/entrepreneur. In these cases, access to regional industrial networks is critical to opportunity recognition, and in particular to create the feeling of control and evaluations of potential gain that drive opportunity recognition.

Access to financial and other resources, information and expertise are all critical to opportunity recognition. However, the regional industrial networks available to a specific university or discipline community may, in fact, be relatively impoverished in specific knowledge about the creation and funding of technological ventures. A region's network may be short on the risk capital required to seed and grow ventures, particularly costly technology-based businesses. Thus, even if the individual researcher is well-connected to the available regional networks, the resources and knowledge available within those networks may be insufficient to stimulate opportunity recognition. Therefore, the impact of access to regional networks is likely to interact with the quality of the knowledge and resources available in the regional network.

**Proposition 4: Scientists who have access to the resources of regional industry networks will impact the likelihood they perceive positive situation/potential gain and controllability in a business situation and greater information flow, and thus increase the likelihood they will recognize an entrepreneurial opportunity.**

**Proposition 4A: Scientists with access to regional industry networks rich in knowledge and resources oriented to entrepreneurship will have greater perceptions of controllability and positive situation/potential gain, and are more likely to recognize an entrepreneurial opportunity.**

**Personal Networks**

As discussed earlier, individuals typically interact with their immediate colleagues and other people specializing in the same area. In the case of academia, for example, the personal network complements the knowledge base of the scientists, reinforcing the effect of past knowledge on future opportunity discovery. Their science may gain prestige and quality, but awareness of commercial opportunities and/or knowledge of relevant

industries would probably be weaker. Conversely, the probability of individual researchers recognizing an opportunity is likely to increase as the diversity of the contacts and knowledge within their networks increases (cf. Nicolaou & Birley, 2003). In fact, we hypothesize that the likelihood of recognizing an opportunity is greatly diminished, to the extent that the individuals' networks are restricted primarily to like-minded others, due to decreased cognition of gain and controllability. Kaufmann and Toedtling argue "it is the exchange between actors belonging to different social systems which has a positive influence on firms' innovativeness" (2001: 791). To the extent that the nascent entrepreneurs have a diverse network, access to these resources is more likely, leading to greater likelihood of perceptions of controllability and recognition of a business opportunity.

**Proposition 5: Scientists who have higher diversity in their personal network will have greater perceptions of controllability and positive situation/potential gain, and thus are more likely to recognize opportunities.**

**Entrepreneurial Catalysts in the Immediate Context**

From the perspective of the individual, the barriers to discovering an entrepreneurial opportunity may be quite formidable, particularly if access to distant contexts through personal or regional networks is limited. A critical role in both inspiring and helping potential entrepreneurs overcome those barriers may be played by people who act as catalysts for entrepreneurship within their immediate contexts. Entrepreneurial catalysts may have specific experiences in starting new ventures or working with companies, and thus are both positively oriented to working across the boundaries of very different contexts and have relevant skills and knowledge that can be accessed by those around them. Within academia, for example, catalysts may be 'star scientists' (Zucker, Darby & Armstrong, 1998) whose research prowess has attracted attention and support from the corporate world.

Catalysts may serve several roles in the venturing process, and in fact may be involved in many venturing initiatives. They may influence and encourage their peers to create new ventures. One way in which they may do this is by recognizing the opportunity for a new venture based on other's prior knowledge (or current research) and by motivating others to move on the opportunity. In the university, their involvement may legitimize the process of commercialization, providing cover for less senior researchers to pursue opportunities. Catalysts may tap into sponsorship relationships and networks to identify potential resources. They also can act as liaison whose communication skills and abilities in both the research and business context allow them to act as a bridge of information, particularly to the degree they are willing to collect and disseminate information from and to internal and external sources (Allen, 1970; Goldhar, Bragaw & Schwarz, 1976; Tushman & Katz, 1980). In the case of science-based entrepreneurship, this communication role can be essential to 'translate' ideas and concepts between the two contexts. The presence of a catalyst in an individual's immediate context provides a unique resource for opportunity recognition. In summary, individuals who are uniquely placed to act as catalysts will change the rate of opportunity recognition by affecting others' perceptions that a business situation may be positive and controllable. In addition, they mediate the impact of regional networks on potential gain and controllability. This leads to our next proposition.

**Proposition 6A: The presence of entrepreneurial catalysts within an institutional context will increase the likelihood scientists will have greater perceptions of controllability and positive situation/potential gain, and are more likely to recognize an entrepreneurial opportunity.**

**Proposition 6B: The presence of entrepreneurial catalysts within an institutional context will positively mediate the impact of regional networks on other scientists' perceptions of controllability and positive situation/potential gain, and increase the likelihood they will recognize business opportunities.**

**DISCUSSION**

We began by asking why scientist recognizes an opportunity to move a discovery into the market place and

others do not. In order to answer this question we developed a model of opportunity recognition based on the premise that the context in which individuals operate will heavily influence their propensity to recognize an opportunity, by influencing their perceptions of a situation as *positive* in which *gain* is likely and over which one has a fair amount of *control*. Specifically we have proposed that the immediate institutional context in which individuals operate, their access to distant contexts such as regional industrial networks and the composition of their own personal networks will greatly influence their propensity to recognize opportunity in any given situation. The likelihood of any individual recognizing an opportunity increases with access to a diverse network of people and specifically more business-oriented contacts. Through their network ties to distant contexts, individuals access information, identify potential resources and expertise, and observe new role models and perspectives, all of which influence their perception of business situations as potentially positive, leading to potential gain and being controllable.

We also suggest that if a scientist knows a person acting as an entrepreneurial catalyst, that person may also influence the impact of both immediate and distant contexts on opportunity recognition. This influence may be due to moderating, mediating or interaction effects – current theory and empirical results do not provide sufficient guidance at this time, although we posit mediating effects for access to regional networks in this paper.

The cognitive dimension of controllability has particular interest in considering policy implications of the model of context and cognition for opportunity recognition, as this dimension has been established as the most robust and significant of the three dimensions in empirical research on strategic issues (Barr & Glynn, 2004). If this result holds for potential entrepreneurs as well as corporate managers, then organizational and government policies which directly address perceived controllability are most likely to result in higher opportunity recognition, and ultimately by implication venture creation. Theoretically, any configuration of institutional regulations, knowledge and norms could 'work', if the perception of these dimensions positively impacts individual perceptions of controllability. Conversely, policies and regulations that negatively impact perceptions of controllability will decrease the rate of new venture formation. Similarly, regional development may be best served by focusing on building multiple avenues between high potential entrepreneurs such as researcher and regional business leaders, and ensuring the individuals feel greater controllability. To achieve these outcomes, policy makers and network leaders would need to evaluate how their activities are perceived, whether connections are made that increase potential entrepreneurs' sense of control and not just how well attended their events are.

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