Shared Cognitive Structures and Entrepreneurial Opportunity Identification and Exploitation

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Abstract

This paper analyzes collective cognitive structures in entrepreneurial teams. Recently, there has been increased interest in entrepreneurial cognition and teams. This study contributes to explaining how entrepreneurial teams identify and exploit opportunities. The focus is on shared cognition and its evolution over a period of two years in the German-speaking software industry.

Keywords: collective cognitive structures, entrepreneurial teams, opportunity identification and exploitation.

Introduction

In the pursuit of opportunity identification and exploitation (Shane & Venkataraman, 2000), entrepreneurs develop cognitive structures. The cognitive structures oftentimes span across the entire entrepreneurial team (Ensley & Pearce, 2001; West, 2007). This research analyzes the differences in team members' cognitive structures and the shared cognition of the entrepreneurial team. Moreover, this study concerns the evolution of cognitive structures or, in other words, the learning of entrepreneurial team members over time. Finally, the relationship between the change in shared cognition in the entrepreneurial teams and the identification and exploitation of opportunities is examined. The research questions are:
(1) How do shared cognitive structures of entrepreneurial teams evolve over time?
(2) How do these shared cognitive structures relate to opportunity identification and exploitation?

Literature

Shared team cognition has been understood in many different ways. In this paper, shared cognition is conceptualized as overlapping causal maps (Laukkanen, 1994). More generally, shared mental models are "beliefs that shape inferences, predictions, and decisions about what actions to take" (Cannon-Bowers, Salas, & Converse, 1993).

In management, shared mental models were discussed as "dominant logic" (Prahalad & Bettis, 1986) and other frameworks of social cognition (e.g., Ginsberg, 1990). Levine, Resnick and Higgins (1993) pointed out that "outside the laboratory and the school, cognition is almost always collaborative" (p. 591). Walsh (1995) argues that "When a group of individuals is brought together, each with their own knowledge structure about a particular information environment, some kind of emergent collective knowledge structure is likely to exist." (p. 291). There is plenty of empirical evidence that entrepreneurial teams are omnipresent (e.g., Kamm et al., 2000). Moreover, Gartner et al. (1994) suggested that "entrepreneurship is more likely to be plural".

In order to better understand shared mental models of entrepreneurial teams, this study draws on insights from the group literature in management (e.g., Miller, Burke, & Glick, 1998). Particularly, Fiol (1994) discusses the tensions between unified thinking and multiple interpretations. In addition, there is evidence of cognitive variance of the team members (Ginsberg, 1990; Prahalad & Bettis, 1986). In the field of entrepreneurship, West (2007) proposes a model where Entrepreneurial Team Collective Cognition (ETCC) is a mediator between the individual-level factors and the decisions and actions of the new venture. West finds an inverted U-shaped relationship between the new venture performance and the degree of differentiation and integration of strategic constructs within the top management team of a venture. The current study builds on the insights gained from a limited number of studies on entrepreneurial teams (e.g., Ensley & Pearse, 2000; West, 2007) and from group research in management (e.g., Miller et al., 1998).

Yet, the objective of this paper goes beyond understanding shared mental models of entrepreneurial teams. This paper focuses on the evolution of shared mental models and their impact on opportunity identification. In essence, this paper tries to understand collective cognitions of entrepreneurial teams from a dynamic perspective. With the prominent exception of Barr, Stimpert and Huff (1992) very few studies analyze cognitive maps over time. Barr et al. investigated the cognitive maps of two railroad companies over time where only one had satisfactory performance and survived. Although both railroad companies recognized the decline in the rail industry, only the surviving firm changes their mental model of how organizational performance is affected by the changed environment. While Barr et al. (1992)'s paper is extremely important and highly relevant, by design it cannot analyze the divergence among the different members of the management team because it uses letters to shareholders as

data source rather than individual interviews as does the current study.

Methodology and Research Design

The research is designed as a comparative case study (Yin, 1994; Eisenhardt, 1989/2007) of nine ventures in the German-speaking software market. The Software Industry within the Information Technology Industry is interesting for several reasons: first, the burst of the internet bubble (European Information Technology Observatory, 2004) and the economic downturn 2001/02 (OECD report, 2002/03) hit very hard as the evaluation in this sector in the stock market and the projects done in this field were incomparably well paid. This, of course, led to major change and new opportunities in this industry. On the other hand, many potential opportunities through merging with other industries such as the telecommunication industry arose. Second, the software industry reaches maturity over the observation period: professionalization, standardization, and industrialization become very relevant in this industry. The above arguments together with the fact that this industry is characterized by little regulation by authorities, few standards and no patents makes it an interesting industry to study entrepreneurial opportunities.

The ventures investigated here are located in Munich (Germany) and Zurich/St. Gallen (Switzerland) and are comparable along a number of dimensions such as business, customers, size, structure and development of the company. At three equidistant time points between 2004 and 2006 semi-structured interviews of each 90 minutes were conducted with the three most influential individuals in each one of the nine ventures resulting in 81 interviews.

The method for data analysis is cognitive mapping technique (Eden, 1992; Eden & Spender, 1998; Fiol & Huff, 1992; Huff, 1990, Walsh, 1995). Precisely, causal mapping technique (Eden & Ackermann, 1998) was used. The causal maps are analyzed on the individual level and on the collective level. For the collective level, the causal maps are aggregated across participants with the focus on the diversity of explanations that the team members provided (Bougon, 1992; Cossette & Audet, 1992; Laukkanen, 1994). As opposed to congregate maps, aggregate maps include dominant causalities and concepts of individuals maps (Bougon, 1992). This is essential for this study as it preserves the diversity of concepts since concepts that are dominant in individual maps are retained. In sum, the cognitive maps will be analyzed on three levels: (1) individual cognitive structures; (2) collective cognitive structures; and (3) collective cognitive structures over time (=collective learning about opportunities). This stepwise analysis enables me to compare the collective or shared cognitive structures over time and its impact on entrepreneurial opportunity identification.

The dependent variable in this study is opportunity identification and exploitation. In line with Shane and Venkataraman (2000; 220) I define opportunities as "situations in which new goods, services, raw materials, markets and organizing methods can be introduced through the formation of new means, ends, or means-ends relationships". Regarding opportunity exploitation, an index was created from the actual opportunities that have been implemented by the company on a scale of 1 through 10. It is important that these measures are – as opposed to the shared cognitive maps described above - not subjective. These measures are objective and based on a multitude of internal and external documents of each one of the ventures (e.g, internal reports, marketing reports, websites, reports about the company, sales figures, etc.) that were triangulated. In this process of triangulation, only information was tested for consistency across sources and only used when consistent across at least two sources. In order to be comprehensive, a given venture's opportunity exploitation was examined along five dimensions: product innovation, service innovation, technology innovation, marketing innovation, and organizational innovation. The opportunity identification is constructed from additional information and interviews with people within the entrepreneurial team and outside of the entrepreneurial team in order to get a sense of the number of opportunities currently identified.

In the interviews, a set of questions was asked relative to opportunities identified by each company. These questions were asked in the same way in t1, t2, and t3. In order to be inclusive, the questions in each one of these interviews refer to a compilation of the different strategic areas of any business: business model, learning and challenges, strategy and core competencies, customer focus and management, strategic alliances, perception of industry and competition and vision. While the focus of these interviews is intentionally broad, it is systematic in its replication over time (i.e., the same set of questions is asked at the three different points in time, interviews span 2 years and are separated by eight months each). These maps are aggregated into a map representing the overlap and diversity of concepts and causalities. The aggregate maps were subject to an analysis of centrality, domain and cluster. These three measures together indicate the dominance of certain concepts from different angles and therefore guarantee validity. The coding process for two randomly selected interviews was replicated by two independent researchers that are active in other disciplines. The inter-rater reliability was 87%.

Data Analysis and Results

In the following, the insights from the analysis of the individual and the shared cognitive maps over time are presented.

1. Diversity of complexity of shared cognitive map (concepts and causalities)

Researchers have found that complex mental model structure increases both individual and organizational capacity to respond and perform successfully (Ginsberg, 1990). Ginsberg (1994) argues that groups with greater cognitive complexity are more likely to define their competitive environment comprehensively and creatively than homogenous groups. The importance of cognitive complexity on a variety of output variables having been shown in on the individual level (e.g., Bartunek, Gordon, & Weathersby, 1983) and on the organizational level (e.g., Goodwin & Ziegler, 1998), there is reason to believe that it leads to convergent results in the context of entrepreneurial opportunity identification and exploitation given uncertainty and the ambiguity of the entrepreneurial situation and the fact that processes and routines are usually not yet in place in this young firms to cope with these challenges. Therefore, the following is proposed:

Proposition 1a: Low complexity of the shared cognitive map is associated with identification and exploitation of few opportunities.

Proposition 1b: High complexity of the shared cognitive map is associated with identification and exploitation of many opportunities.

The data analyzed in this study clearly showed the above stated relationship. For instance, the company with the highest overall average of cognitive complexity of the shared cognitive maps over time, Epsilon-Tech showed a clear vision to expand their current business to reach a very large and different market. The company envisions a strategy where they can replicate their business model with exponential growth. Delta-Tech, by contrast, is the company in the entire sample that neither identified nor exploited any substantial business opportunities over the observation period.

Related to this is the question to what degree are the cognitive maps shared by the members of the entrepreneurial team which I will discuss in the following sections and which will result in propositions 2, 3a and b. Given that cognitive maps consist of concepts and causalities, four theoretical possibilities of overlap present themselves in this context. The first set of possibilities is that the concepts and causalities are shared or are not shared. The second set of possibilities is that only concepts or only causalities are shared.

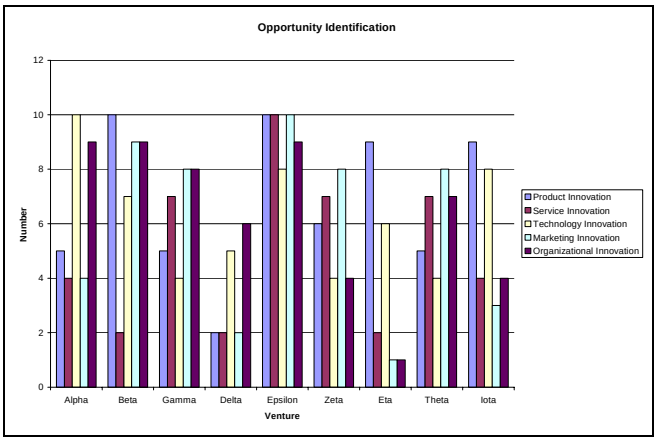

Figure 1: Opportunity Identification

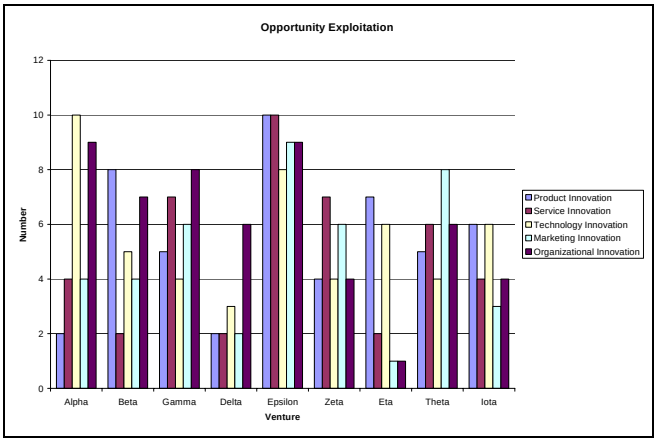

Figure 2: Opportunity Exploitation

2. Number of Shared Concepts and Causalities

Fiol (1994) investigated the new venture development process and found that organizational learning is really about the development of diverse interpretations. Fiol shows how the team members in the ventures that she analyzed developed unified ways of framing their arguments, while at the same time maintaining diversity through differences in the content of team members' interpretations. Similarly, Clarysee & Moray (2004) relate knowledge diversity to team learning, which, respectively is likely to lead to a greater number of opportunities. For the study of shared cognitive maps, this finding would translate into a high number of shared elements of the maps and a low number of shared elements of the maps. Given that the constituent elements of cognitive maps are concepts and causalities (i.e., links), the following is proposed:

Proposition 2: A ratio of shared concept to shared causalities of greater than 2 results in the identification of a great number of opportunities.

At Epsilon-Tech, for instance, at t1 adaptiveness was the most dominant concept for all three interviewees. Figure 3 illustrates the map across participants (=different colors) for Epsilon-Tech at t1. The different dominant decision makers recurred to different explanations how adaptiveness serves the company and how it may be reached. Yet, the different causal explanations all support the general concept of adaptiveness to the environment. The reasons provided by the team members are of different nature such as "freedom of the partners", "clarity of guiding principles", "performance of strategy process", or "compatibility of product roadmap".

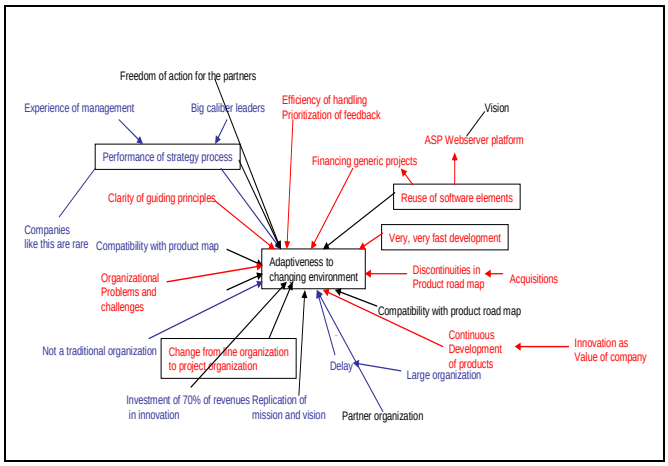

Figure 3: Map of Epsilon at t1.

By contrast, Beta-Tech (data available from the author) shows the highest number of shared concepts and causality in the sample. In other words, the maps of Beta-Tech are strikingly coherent and integrated; nearly every element in the maps is connected with every other element in the map. Beta-Tech identifies quite a number of opportunities such as developing a new product on a different technological platform and a completely new business model and organizational structure as well as strategic partners. Beta-Tech did have some interesting ideas, yet all the members of the team were so familiar with the company that they found a lot of reasons why the opportunities should not be exploited at this specific point in time. In this sense, the shared cognition inhibited the exploitation of opportunities. This raises another interesting issue, i.e. that shared cognition has a differential effect on opportunity identification and exploitation.

3. Shared concepts and cognitive complexity

Just like Beta-Tech above, Delta-Tech is a company that had also a substantial overlap of concepts and causalities. Yet, it identified only very few opportunities and these opportunities were highly related to their current business and their strategic moves were rather reactive. The remaining cases in the sample show a similar pattern. Therefore, a set of propositions is derived:

Proposition 3a: A high number of shared concepts and causalities results in the identification and exploitation of few opportunities when overall complexity of cognitive maps is low.

Proposition 3b: A high number of shared concepts and causalities results in the identification of a high number of opportunities but the exploitation of many opportunities when overall complexity of cognitive maps is high.

Theoretically, there are two more possibilities. The first possibility is that near to no concepts and causalities are shared. This was not the case for any of shared cognitive maps analyzed here. The last alternative would be that only the causalities are shared but not the concepts. Yet, this theoretical possibility is precluded from empirical occurrence since causalities without concept cannot exist in this approach.

4. Change of Shared Cognitive Maps over time

Only few studies in the field of management investigate the change of cognitive maps over time. Barr et al. (1992) did not look at the overall integration of the map in terms of centrality, domain and cluster. The analysis of integration of cognitive concepts and causalities of this study and the comparison with the opportunity identification and exploitation gave a different pattern. Based on the identification of continuity vs. discontinuity of concepts from tn to tn+1, I explored the following set of propositions:

Proposition 4a: The continuity of concepts in shared cognitive map (concepts and causalities) is associated with the identification (and hence exploitation) of fewer opportunities.

Proposition 4b: The discontinuity of concepts in shared cognitive map (concepts and causalities) is associated with the identification and exploitation of more opportunities.

The development of the shared cognitive maps of Alpha-Tech and Epsilon-Tech are illustrated in Figures 4 and 5 respectively.

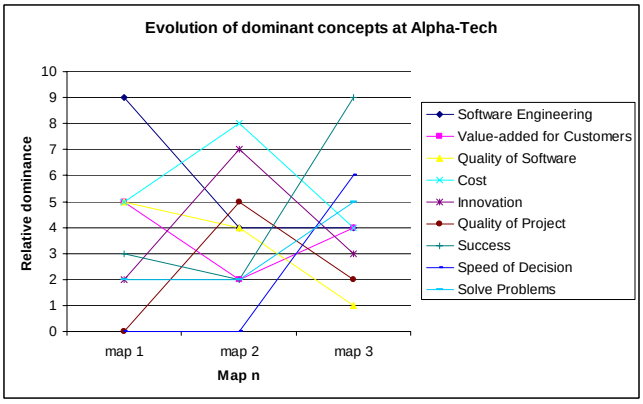

Figure 4: Evolution of dominant concepts at Alpha-Tech

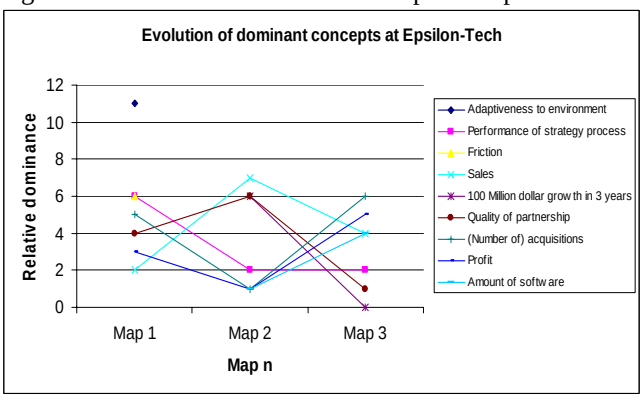

Figure 5: Evolution of dominant concepts at Epsilon-Tech

At each time point the concepts that were the most prominent in the collective maps are illustrated. While evolution of the shared cognitive maps at Alpha-Tech is characterized by the highest continuity, the cognitive map at Epsilon-Tech is associated with discontinuity. The continuity of all central concepts at Alpha-Tech is evidenced by the continued line in the above graph. This continuity of the concepts is striking when compared to the remaining firms in the sample. Alpha-Tech's cognitive maps show extremely consistent argumentation over time.

The most dominant concepts at Epsilon-Tech clearly change (indicated by the single data points in Figure 5). At t2 the most relevant shared concept at Epsilon-Tech is a financial goal, i.e. "100 million dollar growth in three years" and at t3 the most dominant shared concept is "profit" with acquisitions and more precisely an acquisition capability being the main driver for profits. Yet, the pattern in the shared cognitive maps supporting the changing most dominant constructs remains, i.e. high number of shared constructs with high diversity in causalities.

Summary and Contribution

The objective of this study consisted in analyzing the emergence of team mental models or cognitive structures and their impact on opportunity identification and exploitation. The findings are summarized in the model in Figure 6.

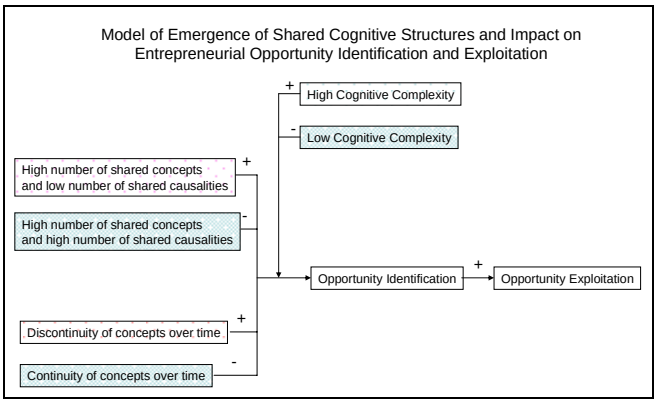

Figure 6: Model of Emergence of Shared Cognitive Structures

Figure 6 illustrates that the total overlap between concepts and causalities is negatively related to opportunity identification and exploitation. The partial overlap of concepts only but not causalities, by contrast, is positively related to opportunity identification and exploitation. Discontinuity of concepts contained in the shared cognitive map over time is also positively related to opportunity identification and exploitation. Furthermore, overall cognitive complexity of the collective map was identified as a moderator in this relationship by this study.

There may be trade-offs between these variables that have not yet been fully explored in this study. It would be interesting to understand, for instance, whether a discontinuity of concepts (that could be generated through external consultants and/or industry outsiders) could mitigate the negative effect of limited cognitive complexity or exceeding overlap at a map at one point in time. Conceivably, an intervention in some companies that share too much of their knowledge in order to generate creative "follow-up opportunities" could be valid basis for generating new ideas, yet the complexity of the maps need to be increased through outsider input resulting in a discontinuity. In sum, the model invites researchers to a rigorous large sample test of the variables in this model and (entrepreneurial) teams to reflect on their current practices and mental models and how they fit this model.

While being limited to one cultural context and a selection of ventures, this project provides insights into the development of shared collective cognition and its impact on business outcomes.

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References

Barr, P.S., Stimpert J.L., & Huff A.S. (1992). Cognitive Change, Strategic Action, and Organizational Renewal. *Strategic Management Journal, 13,* 15-36.

Bartunek, J.M., Gordon J.R., & Weathersby R.P. (1983). Developing "complicated understanding" in administrators". *Academy of Management Review, 8,* 273-284.

Bougon, M.G. (1992). Congregate cognitive maps: A unified dynamic theory of organization and strategy. *Journal of Management Studies, 29(3),* 369-389.

Cannon-Bowers, J.A., Salas E., & Converse S. (1993). Shared mental models in expert team decision making. In Individual and Group Decision Making, Castellan NJ (Ed). Lawrence Erlbaum: Hillsdale, NJ, 241-246.

Cannon, M.D., & Edmondson, A.C. (2001). Confronting failure: antecedents and consequences of shared beliefs about failure in organizational work groups. *Journal of Organizational Behavior, 22,* 161-177.

Clarysee, B., & Moray, N. (2004). A process study of entrepreneurial team formation: The case of a research-based spin-off. *Journal of Business Venturing, 19(1),* 55-76.

Cossette, P., & Audet, M. (1992). Mapping on idiosyncratic schema. *Journal of Management Studies, 29(3),* 325-347.

Dutta, D.K., & Thornhill, S. (2008). The evolution of growth intentions: Toward a cognition-based model. *Journal of Business Venturing, 23,* 307-332.

Eden, C. (1992). On the Nature of Cognitive Maps. *Journal of Management Studies, 29,* 261-265.

Eden, C., & Spender J.-C. (1998). *Managerial and Organizational Cognition. Theory, Methods and Research.* London: SAGE Publications Ltd.

Eden C., & Ackerman F. (1998). *Making Strategy: The Journey of Strategic Management.* London: Sage.

Eisenhardt, K.M. (1989). Building theories from case study research. *Academy of Management Review, 14(4),* 532-550.

Eisenhardt, K.M. (2007). Theory building from cases: opportunities and challenges. *Academy of Management Journal, 50(1),* 25-32.

Ensley, M.D., & Pearce, C.L. (2001). Shared Cognition in Top Management Teams: Implications for New Venture Performance. *Journal of Organizational Behavior, 22(2),* 145-160.

Fiol, C.M. (1994). Consensus, diversity, and learning in organizations. *Organization Science, 5(3),* 403-420.

Fiol, C.M., & Huff, A.S. (1992). Maps for Managers: Where are we? Where do we go from here? *Journal of Management Studies, 29(3),* 267-285.

Gartner, W.B., Shaver, K.G., Gatewood, E, & Katz, J.A. (1994). Finding the entrepreneur in entrepreneurship. *Entrepreneurship: Theory and Practice, 18(3),* 5-9.

Ginsberg, A. (1990). Connecting diversification to performance: A socio-cognitive approach. *Academy of Management Review, 15,* 514-535.

Ginsberg, A. (1994). Minding the competition: From mapping to mastery. *Strategic Management Journal, 15,* 153-174.

Goodwin, V.L., & Ziegler, L. (1998). A test of relationships in a model of organization cognitive complexity. *Journal of Organizational Behavior, 19(4),* 371-390.

Hodgkinson, G.P., Maule A.J., & Bown, N.J. (2004). Causal Cognitive Mapping in the Organizational Strategy Field: A Comparison of Alternative Elicitation Procedures. *Organizational Research Methods, 7(1),* 3-26.

Huff, A.S. (1990). *Mapping Strategic Thought.* Chichester: Wiley.

Jenkins, M., & Johnson, G. (1997). Entrepreneurial intentions and outcomes: A comparative causal mapping study. *Journal of Management Studies, 34,* 895-920.

Kamm J.B., Shuman J.C., Seeger J.A., & Nurick A.J. (1990). Entrepreneurial Teams in New Venture Creation: A Research Agenda. *Entrepreneurship: Theory and Practice, 14(4),* 7-11.

Langfield-Smith, K. (1992). Exploring the Need for a Shared Cognitive Map. *Journal of Management Studies, 29,* 349-368.

Laukkanen, M. (1994). Comparative Cause Mapping of Organizational Cognitions. *Organization Science, 5(3),* 322-343.

Levine, J.M., Resnick L.B., & Higgins, E.T. (1993). Social Foundations of Cognition. *Annual Review of Psychology, 44,* 585-612.

Mathieu J.E., Heffner T.S., Goodwin G.F., Salas E., & Cannon-Bowers, J.A. (2000). The Influence of Shared Mental Models on Team Process and Performance. *Journal of Applied Psychology, 85(2),* 273-283.

Miles, J.R., & Kivlighan, D.M. (2008). Team Cognition in Group Interventions: The Relation Between Coleaders' Shared Mental Models and Group Climate. *Group Dynamics: Theory, Research, and Practice, 12(3),* 191-209.

Miller, C.C., Burke, L.M., & Glick, W.H. (1998). Cognitive diversity among upper-echelon executives: Implications for strategic decision processes. *Strategic Management Journal, 19(1),* 39-59.

Prahalad, C.K., & Bettis, R.A. (1986). The Dominant Logic: A New Linkage Between Diversity and Performance. *Strategic Management Journal, 7(6),* 485-501.

Reger, R.K., & Palmer, T.B. (1996). Managerial Categorization of Competitors: Using Old Maps to Navigate New Environments. *Organization Science, 7(1),* 22-39.

Shane, S., & Venkataraman, S. (2000). The Promise of Entrepreneurship as a Field of Research. *Academy of Management Review, 25(1),* 217-226.

Walsh, K.P. (1995). Managerial and organization cognition: notes from a trip down memory lane. *Organization Science, 6(3),* 280-321.

West, P.G. (2007). Collective Cognition: When Entrepreneurial Team, Not Individuals, Make Decisions. *Entrepreneurship: Theory and Practice, 31(1),* 77-102.