Essays on Knowledge Intensive Groups

by

Xiumei Zhu

Department of Business Administration
Duke University

Date: 06/03/2009
Approved:

_____
Jonathon N. Cummings, Supervisor

_____
Richard P. Larrick

_____
Richard M. Burton

_____
Nan Lin

Dissertation submitted in partial fulfillment of
the requirements for the degree of
Doctor of Philosophy in the Department of
Business Administration in the Graduate School
of Duke University

2009

ABSTRACT

Essays on Knowledge Intensive Groups

by

Xiumei Zhu

Department of Management and Organizations
Duke University

Date: 06/03/2009
Approved:

_____
Jonathon N. Cummings, Supervisor

_____
Richard P. Larrick

_____
Richard M. Burton

_____
Nan Lin

An abstract of a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Business Administration in the Graduate School of Duke University

2009

Copyright by
Xiumei Zhu
2009

Abstract

Expertise is regarded as the most important asset for groups working on knowledge-intensive tasks. This dissertation advances a multi-dimensional conception of group expertise that includes depth, breadth and variety as three distinct dimensions, and develops a model of the joint effect of the three dimensions on knowledge sharing and group performance. Two empirical studies test different components of the model. Using data on 174 groups from a Fortune 500 telecommunications company, one study supports the hypothesis that depth of group expertise will have a less positive effect on group performance as breadth of group expertise increases, particularly when groups engage in a low level of external task process. Using data on knowledge sharing networks among 44 employees of a supply chain service organization, the second study probes into dyadic interactions underlying group process, and tests how individual variety of experience, functional department experience (proxy for depth of expertise at the individual level), and dyadic functional difference (proxy for breadth of expertise at the dyadic level) affect dyadic knowledge sharing. Results show that individual variety of experience improves ease of knowledge sharing, and that the negative effect of functional department experience on ease of knowledge sharing is mitigated by individual variety of experience. Theoretical and practical implications of the findings are considered, and directions for future studies are discussed.

Dedication

This dissertation is dedicated to my family. The first is my father. He would have been happy if he had been able to live to see the completion of my dissertation. The second is my mom. She has given me unconditional love and support through out these difficult years. The third is my son. He is the best gift that I have received in my life. His smile is the spring of joy, and the foremost source of strength. He seems to be growing into a wonderful little human being, in spite of the fact that his mom was less available than she would have wanted. The last but not the least is the father of my son, my dearest friend and husband. He has shared equally with me the financial and emotional burdens involved in pursuing my graduate study. He has given me all the understanding, support and care that I could have hoped for.

Contents

Abstract iv

List of Tables xi

List of Figures xii

Acknowledgements xiv

1. Introduction 1

2. Unpacking the three dimensions of group expertise 8

2.1 Three dimensions of group expertise composition 8

2.1.1 Depth 9

2.1.2 Breadth 12

2.1.3 Variety 15

2.2 Group expertise, knowledge sharing, and group performance 18

2.2.1 The unique impact of depth, breadth and variety on group performance 22

2.2.2 The interrelationship between depth, breadth and variety in influencing group performance 23

2.2.2.1 Depth, breadth, knowledge sharing, and group performance 25

2.2.2.2 Depth, variety, knowledge sharing, and group performance 27

2.2.2.3 Breadth, variety, knowledge sharing, group performance 28

2.3 Testing the interactive effects between depth, breadth and variety 30

3. Leveraging depth and breadth of group expertise: The moderating role of task process 36

3.1 Background 36

3.2 Theory and hypotheses 42
3.2.1 Absorptive capacity: The role of pre-existing knowledge 42
3.2.2 Depth of expertise, breadth of expertise, and group performance 45
3.2.3 Group expertise and group performance: The moderating role of task process 51
3.3 Methods 57
3.3.1 Sample and data collection 57
3.3.2 Measures 59
3.3.2.1 Depth of expertise 59
3.3.2.2 Breadth of expertise 61
3.3.2.3 Internal task process 62
3.3.2.4 External task process 63
3.3.2.5 Group performance 64
3.3.2.5 Control variables 65
3.4 Analysis and results 66
3.4 Discussion 78
3.4.1 Relationship between expertise, task process, and group performance 78
3.4.2 Implications for absorptive capacity theory 82
3.4.3 Limitations 83
3.4.4 Directions for future studies 86
3.4.5 Conclusion 87
4. A conceptual model of variety of experience: Implications for individuals and groups 89

4.1 Brief review of research on experience 91
4.2 Conceptualizing variety of prior experience 95
4.2.1 Direct involvement and vicarious experience 98
4.2.2 Between-job and within-job variety of experience 101
4.2.3 Antecedents of variety of prior experience 102
4.3 Implications for individuals 105
4.3.1 Variety of prior experience and knowledge 105
4.3.1.1 Variety of prior experience and domain specific knowledge 106
4.3.1.2 Variety of prior experience and integrated understanding 108
4.3.2 Variety of prior experience and boundary-crossing capability 109
4.3.2.1 Variety of prior experience and knowledge sharing 110
4.3.2.2 Variety of prior experience and knowledge integration 112
4.3.3 Variety of prior experience and person perception 115
4.3.4 Implications for individual job performance 117
4.4 Implications for groups 121
4.4.1 Variety of prior experience, group processes and group performance 124
4.4.1.1 Variety of prior experience and intra-group knowledge sharing 124
4.4.1.2 Variety of prior experience and knowledge integration 127
4.4.1.3 Variety of prior experience and task conflict 129
4.4.2 Variety of prior experience, group expertise, and group performance 131
4.5 Summary and conclusion 134
5. An empirical study of variety of experience and dyadic ease of knowledge sharing 139

5.1 Background 139

5.2 Literature review 141

5.2.1 Research on interpersonal knowledge sharing 141

5.2.2 Research on individual experience 144

5.3 Theory and hypotheses 146

5.3.1 Variety of individual experience and ease of knowledge sharing 147

5.3.2 Variety of individual experience, individual functional department experience, dyadic functional difference and ease of knowledge sharing 150

5.3.2.1 Variety of individual experience and functional department experience 152

5.3.2.2 Variety of individual experience and dyadic functional difference 154

5.3.3 Variety of individual experience, strength of ties and ease of knowledge sharing 156

5.4 Methods 161

5.4.1 Network data 163

5.4.2 Variables 164

5.4.2.1 Dependent variable 164

5.4.2.2 Independent variables 166

5.4.2.3 Control variables 169

5.4.3 Analysis 170

5.5 Results 172

5.5.1 Variety of experience, dyadic common experience, and ease of knowledge sharing 172

5.5.2 Variety of experience, functional department experience, functional difference, and ease of knowledge sharing 181

5.5.3 Variety of experience, dyadic tie strength, and ease of knowledge sharing ... 185

5.6 Discussion 190

References 198

Biography 212

List of Tables

Table 1: Three dimensions of group expertise composition 9

Table 2: Descriptive statistics of main variables. 66

Table 3: Correlations among main variables. 67

Table 4: Predicting externally rated group performance. 69

Table 5 (Continued): Predicting externally rated group performance. 70

Table 6: Expertise, task process, and absorptive capacity. 81

Table 7: Summary of different conception of experience 97

Table 8: Items for ease of knowledge sharing and knowledge codifiability. 165

Table 9: Correlations between main variables 174

Table 10: Predicting ease of knowledge sharing from variety of individual experience and dyadic common experience 176

Table 11: Predicting dyadic common experience from variety of experience. 180

Table 12: Interaction between variety of experience and functional department experience, and between variety of experience and functional difference. 182

Table 13: Predicting ease of knowledge from variety of experience and tie strength. 187

List of Figures

Figure 1: Model of group expertise and group performance in the current literature on group expertise. 20

Figure 2: Interactions between dimensions of group expertise in shaping group performance. 24

Figure 3: Interactions between dimensions of group expertise in shaping group performance, with intervening variable. 25

Figure 4: Micro-decomposition of relationships between group expertise and group knowledge sharing. 35

Figure 5: Model of depth and breadth of group expertise, internal and external task process, and group performance. 55

Figure 6: Interaction between depth and breadth in predicting group performance. 73

Figure 7: Interaction between depth and internal task process in predicting group performance. 74

Figure 8: Interaction between breadth and internal task process in predicting group performance. 74

Figure 9: Interaction between depth and external task process in predicting group performance. 75

Figure 10: Interaction between breadth and external task process in predicting group performance. 75

Figure 11: Interaction between depth and breadth across low and high level of external task process in predicting group performance. 77

Figure 12: Conceptual model of variety of prior experience, knowledge process, and group performance. 121

Figure 13: Model of individual variety of experience and ease of knowledge sharing. . 161

Figure 14: Predicting ease of knowledge sharing from variety of experience and functional department experience. 184

Figure 15: Predicting ease of knowledge sharing from variety of experience and dyadic functional difference. 184

Figure 16: Predicting ease of knowledge sharing from variety of experience and tie duration. 188

Figure 17: Predicting ease of knowledge sharing from variety of experience and closeness. 188

Figure 18: Predicting ease of knowledge sharing from variety of experience and frequency of communication. 189

Acknowledgements

My graduate study has been a long journey. A great many of people have contributed to its completion. I am deeply indebted to all who have made this dissertation possible and made my graduate study an experience that I will cherish forever.

My deepest gratitude is to my advisor, Prof. Jonathon Cummings, and my committee members, Prof. Richard Larrick, Prof. Richard Burton, and Prof. Nan Lin. I have been very fortunate to have Prof. Jonathon Cummings as my advisor. Jonathon gave me the freedom to explore on my own, and at the same time provided valuable practical guidance in conducting survey research and developing research papers. Jonathon has always been readily available and patient. His support and encouragement helped me overcome frustrations and crisis situations during the course of my research. He has carefully read and insightfully commented on countless revisions of the dissertation essays. He has always responded to my questions or requests more quickly than I could have hoped.

I have been very fortunate to have the opportunity to work with Prof. Richard Larrick very early on. Rick has always been generous in spending time with students. I am grateful for the many thought-provoking long discussions with Rick, which helped me develop ideas, and sort through practical issues and technical details. Rick has been

there to listen and provide advice since the very beginning of my dissertation research. His insights and comments at different stages of my research were always perceptive, and greatly helped strengthen and enrich my research.

I am indebted to Prof. Richard Burton for his support and advice. Rich has always been so kind and warm that sitting in his class or speaking with him always helped me lighten up. At the same time, he asked questions that pushed me to be clear and precise. He also brought up issues that pushed me to think from a different perspective.

I am very grateful to Prof. Nan Lin. I benefited a great deal from his class and workshop on social capital, not only because I learned about a substantively interesting stream of research, but also because the class was exemplary in showing the development of an interesting construct and a rigorous program of research. I hope that one day I would be able to do the same. He has pushed me to theoretically integrate the different components of my dissertation research, and provided advice that that would remain helpful in my future research.

Many people on the faculty of Duke Graduate School outside of my committee assisted and encouraged me in various ways during my graduate study. I am especially indebted to Prof. Jack Soll. I have learned a great deal on both research and teaching from working with Jack. Jack has always been encouraging, willing to talk and give advice. He has always been there for my presentations and provided insightful

comments. Working with Jack also provided me with the opportunity to get in touch with executive students, which was pivotal in securing a research site for my dissertation. I am also thankful to Prof. Xueguang Zhou for his encouragement and advice. Finally, I am grateful to Prof. Thomas DiPrete, Prof. Jeffrey Edwards, Prof. Miller McPherson, and Prof. John Payne for all that they have taught me.

I am thankful to Fuqua staff for various forms of support during my graduate study, including Ms. Beverly James, the Ford library staff, the TSC staff, and the BMO staff. I want to thank Ms. Bobbie Clinkscales in particular. Bobbie has been amazingly helpful in all administrative matters related to my graduate study. She has always been patient and warm, and kept me out of trouble by carefully making sure that I had all the paperwork ready and followed all due procedures.

My graduate study would not have been the same without the social support, and academic challenges and diversion provided by my student-colleagues in the management area. Some of my best friends were made during my graduate study. My research would have been much less efficient without their help. The journey would have been much lonelier without their care and company. I forever cherish their friendship.

Of course, despite the assistance of my dissertation committee and other people, I alone remain responsible for any errors or omissions which may unwittingly remain.

1. Introduction

The knowledge-based view of organizations holds that specialized knowledge accumulated by employees is the most important asset for organizations, particularly those engaged in knowledge-intensive tasks (Grant, 1996; Kogut & Zander, 1992, 1996). Better utilization of employee knowledge is likely to enhance organizational survival by making organizations more innovative, efficient and effective (Argote, 1999). As a result of increasing complexity, organizations have dramatically expanded the use of groups to complete a variety of tasks such as delivering services, recommending improvements, and making strategic decisions (Cohen & Bailey, 1997). Groups, by bringing together individuals with diverse expertise from different parts of the organization, can divide and conquer complex tasks that are beyond the capacity of any single individuals. Thus, groups constitute a prevalent form of organizing where the actual utilization of knowledge takes place, as members share and combine their knowledge and ideas to generate group decisions and task solutions (Huber, 1991; Nonaka, 1994). However, putting knowledge to use so that it can improve group performance is far from easy. In fact, groups often do not manage to live up to their potential due to the failure to translate available resources, such as member expertise, into high quality group decisions or task solutions (Steiner, 1972). Although a few streams of research have vigorously scrutinized when and how group expertise can have a greater beneficial effect on group performance, there are still many fundamental questions in need of an

answer. My dissertation focuses on one of those questions, namely, the lack of a multi-dimensional conception of group expertise composition, and the limited understanding of the relationship between different dimensions of group expertise in shaping group processes and performance.

Groups possess expertise via group members. It is commonly assumed that a group possesses a piece of information or knowledge as long as one of its members possesses it and is aware that it may be potentially useful for group tasks (Huber, 1991). At the individual level, expertise is defined as specialized knowledge and skills in a particular area (Faraj & Sproull, 2000). Group expertise is composed of the sum total of expertise possessed by individual group members. Three distinct dimensions of group expertise have surfaced in the existing literature, namely, depth, breadth and variety. Depth of group expertise concerns the level or amount of knowledge and skills that group members have in their respective functional domain (e.g. beginner, intermediate, expert). Groups are considered to have greater depth when more of the members possess a higher level of expertise in their respective domain. Breadth concerns the different domains of expertise across members (e.g. marketing, operation, information technology). Groups are considered to have greater breadth when group members come from a greater number of unique areas of expertise. Finally, variety concerns the extent to which individual group members have experience or expertise in multiple areas of

functional expertise. Groups composed of more members with higher individual variety will have higher levels of group variety.

However, while depth and breadth of group expertise have been subjected to rigorous examination, variety has largely been neglected. Additionally, breadth and depth are studied in separate literatures. Applied psychological research has exclusively focused on depth (e.g. Tziner & Eden, 1985; Barrick, Stewart, Neubert & Mount, 1998; Neumann & Wright, 1999; Devine & Philips, 2001), while the literature on group functional composition has largely focused on breadth (e.g. Ancona & Caldwell, 1992b; Pelled, Eisenhardt, & Xin, 1999; Keller, 2001). With rare exception (Bunderson & Sutcliffe, 2002), neither literature has paid much attention to the third dimension, variety. Only recently have researchers started to consider the implication of the variety dimension on group process and performance (Boh, Slaughter, & Espinosa, 2007; Cannella, Park, & Lee, 2008).

In short, although three distinct dimensions of group expertise have been identified, existing studies have tended to focus on a single dimension. Although this single-dimensional approach has greatly advanced our knowledge on the impact of each dimension on processes and outcomes important to group and organizational effectiveness, such an approach can only provide a partial picture of expertise composition in groups. In addition, focusing on a single dimension renders it impossible to discuss the relationship between the three dimensions in shaping group process and

performance. Do the three dimensions have a similar or different impact on groups? Are their effects additive or multiplicative? Prior work does not provide an explicit theoretical discussion of a multi-dimensional conception of group expertise or empirical study of the possible interplay between the three dimensions in shaping group effectiveness. My dissertation research aims to extend existing scholarship on group expertise by (1) advancing a multi-dimensional conception of group expertise, and (2) empirically testing the interrelationship between the three dimensions in shaping group processes and outcomes. In doing so, my research also underscores the importance of bringing in the variety dimension of group expertise composition, and the importance of initial group expertise in shaping the utilization of expertise to improve group performance.

The remaining four chapters of my dissertation are organized as follows: Chapter 2 reviews existing literature on group expertise, advances a three-dimensional conception of group expertise, and develops a theoretical model specifying the relationship between different dimensions of group expertise, knowledge sharing and group performance. Chapters 3 to 5 present empirical studies and theoretical discussion addressing different parts of the overarching framework developed in Chapter 2. Chapter 3 tests the interaction between depth and breadth of group expertise, and tests the role of both internal and external task process in shaping the relationship between group expertise and group performance. Chapter 4 presents a thorough conceptual

discussion of the implication of variety of experience for individuals and groups, including its relationship with depth and breadth of group expertise.

Chapter 5 reports an empirical study testing the relationship between individual variety of experience and dyadic knowledge sharing. The study also tests if variety of individual experience moderates the associations between individual functional department experience and dyadic knowledge sharing, and between dyadic functional difference and dyadic knowledge sharing. Individual functional department experience refers to the extent to which an individual's fulltime working experience is confined within the current functional department. Assuming that experience and expertise are correlated, functional department experience is considered a proxy for depth of expertise at the individual level. Dyadic functional difference refers to difference in the current functional department between the two individuals within a dyad. It acquires the value of one if the two are currently working in different functional departments, and zero if they are in the same functional department. As a larger value indicates greater breadth in functional expertise within the dyad, functional difference is equivalent to breadth of group expertise when the group consists of two members. Depth and variety of group expertise are essentially aggregations of individual level constructs, and group processes such as knowledge sharing basically hinge upon dyadic interactions. Thus, the empirical study in Chapter 5 sheds light on the interrelationship

between variety, depth and breadth of group expertise in shaping intra-group knowledge sharing.

A few constructs are in need of clarification before moving onto Chapter 2. The theoretical discussion and empirical studies in my dissertation pertain to temporary organizational groups working on knowledge-intensive tasks. In my research, groups are defined as a set of individuals who are interdependent in their tasks, collectively accountable for task outcomes, and who consider themselves and are perceived by others as social entity embedded in one or more larger social systems (Cohen & Bailey, 1997; Gibson & Gibbs, 2006; Guzzo & Dickson, 1996; Hackman, 1987).

The literature on organizational groups has differentiated temporary and on-going groups. Ongoing groups are long-term organizational units engaged in multiple or recurring tasks to accomplish the many or recurring goals that are established at their inception or evolve over time (Saunders & Ahuja, 2006). For example, the accounting unit of an organization can be considered an ongoing group. The unit is not established to complete a single task, but recurring tasks within the same functional area. Members of the unit may come and go. The unit, however, would remain functional, probably for the lifetime of the organization.

Temporary groups are often formed around a common task with a finite life span, and are typically dissolved once the goal is achieved (Meyerson, Weick & Kramer, 1996). Members in temporary groups have a limited (or no) history of working together,

and little prospect of working together again in the future (Jarvenpaa, 1998). Project groups and task forces are usually temporary groups. Project groups dedicated to a single task constitute a more flexible and efficient form of organizing, and often serve to replace the complexity associated with coordination across organizational units with the nimbleness of intra-group coordination among a small number of personnel dedicated to the group task.

By knowledge intensive task, I refer to tasks that are often non-routine, uncertain and complex (Faraj & Sproull, 2000; Tushman, 1979). For example, designing a handheld scanning device for a super market is a knowledge-intensive task, while working as a cashier in a super market is not. Knowledge-intensive tasks often require specialized expertise from a number of different areas. For example, designing a handheld scanning device may involve expertise from engineering, manufacturing, quality, marketing, and customer service (Cummings, 2004).

2. Unpacking the three dimensions of group expertise

Groups possess expertise via group members. My discussion of group expertise operates under the common assumption that a group possesses a piece of information or knowledge as long as one of its members possesses it and is aware that it may be potentially useful for the group task (Huber, 1991). At the individual level, expertise is defined as specialized knowledge and skills in a particular area (e.g. human resources, accounting, etc.) (Faraj & Sproull, 2000). Group expertise is the sum total of expertise possessed by group members. Expertise that members bring to the group, often through prior education, professional training, and work experience, is one of the most critical resources for groups to effectively make decisions, solve problems, and complete tasks (Hackman & Morris, 1975). It is therefore only natural that group expertise has received rigorous scrutiny and that a few streams of research have studied different aspects of group expertise. Building upon existing literature, this chapter advances a three-dimensional conception of expertise composition in groups, and specifies the inter-relationships among the three dimensions in affecting group knowledge sharing and group performance.

2.1 Three dimensions of group expertise composition

A number of different literatures have studied group expertise. While each stream of study tends to focus on a single aspect of group expertise, together, they suggest that group expertise is multi-dimensional, including at least three distinct

dimensions, namely, depth, breadth, and variety (See Table 1 for a summary of the three dimensions).

Table 1: Three dimensions of group expertise composition

Three Dimensions of Group Expertise Composition	
Depth	• First defined at the individual level: Specialized knowledge and skills an individual possesses in a particular area. • For groups, greater depth of group expertise results from more members with greater depth of expertise.
Breadth	• Defined directly at the group level • Range of unique area of expertise that group members bring to the group.
Variety	• First defined at the individual level: The extent that individuals have experience in multiple areas of expertise. • A higher level of variety at the group level results from having more members with greater variety of expertise.

2.1.1 Depth

Depth of group expertise is aggregated from the depth of its members. At the individual level, depth refers to the level or amount of knowledge and skills a person possess in a particular domain (e.g. novice, inter-mediate, expert). Groups are considered to have greater depth of expertise when more of the members possess a higher level of expertise.

It usually takes years of educational and professional experience to accumulate advanced expertise (Ericsson & Lehmann, 1996). For individuals, greater depth of expertise in a particular domain usually implies a larger body of knowledge and superior problem solving skills in that domain, because advanced knowledge and

extended experience enable individuals to tell relevant knowledge from irrelevant knowledge, and to apply their knowledge to solving problems with greater proficiency (Ettenson, Shanteau, & Krogstad, 1987; Franz & Larson, 2002; Larkin, McDermott, Simon, & Simon, 1980). When more of its members have greater depth of expertise in their respective area of expertise, a group as a whole has the capability to solve problems and complete tasks faster and better.

Applied psychological research has studied depth of group expertise. This literature examined the effect of group member knowledge and skills, and general cognitive ability on group performance, and has generally documented a positive association between the level of task-specific knowledge and skill, and/or the level of general cogitative ability, and group performance (Day, Arthur, Miyashiro, Edwards, Tubre, & Tubre, 2004; Barrick, Stewart, Neubert & Mount, 1998; Devine & Philips, 2001; Neumann & Wright, 1999; Obrien & Owens, 1969; Tziner & Eden, 1983).

Steiner (1972) differentiates potential performance, performance that is expected given the available group resources such as the level of knowledge and skills member bring to the task, and actual performance, and posits that groups often fail to live up to its potential. A moderation model is implied whereby the association between depth of group expertise and group performance is contingent upon other factors. One important factor is the degree of collaboration required, and the extent that groups actively engage in collaborative planning. A study by Obrien & Owens (1969) reported that the level of

group ability is not significantly related to group productivity when group tasks require intra-group collaboration. Recently, Woolley, Gerbasi, Chabris, Kosslyn, and Hackman (2007) found that bringing in members with expert level of task-appropriate expertise has a positive impact on group performance only when groups engage in collaborative planning. Recent studies on expertise recognition suggest that accurate recognition of group member expertise and allowing members with more task experience or more expertise to exert greater influence on group decisions increases the likelihood of achieving better group performance (e.g. Baumann & Bonner, 2003; Bunderson, 2003; Littlepage & Robison, 1997). However, these studies did not test the implied moderation model whereby accurate expertise recognition may allow expertise to have a more positive impact on group performance.

A critical difference between working individually and working in a group is that working in groups requires members to share and integrate their knowledge. Therefore, intra-group knowledge sharing and factors that may influence the quantity and quality of intra-group knowledge sharing may affect the extent that depth of expertise is beneficial to group performance. However, the moderating role of knowledge sharing is often implied, but not explicitly tested.

In short, the literature on depth of group expertise suggests that the potential benefits of depth may be translated into group performance to varying degree, yet we only have very limited knowledge about factors that may moderate the association

between depth of group expertise and group performance. Given that expertise is often a scarce resource for organizations, and that organizational groups, particularly those in knowledge intensive settings often engage in tasks that are interdependent and require coordination and collaboration, it is important to move beyond demonstrating that depth matters to understand when the potential benefits associated with depth of expertise can be fully exploited to improve group performance.

2.1.2 Breadth

While depth of group expertise captures the *volume* of knowledge and skills members bring to the group, breadth of group expertise concerns the existence of different *type* of expertise available to the group (e.g. marketing, operation, information technology, etc.). A group will have greater breadth when members specialize in different area of expertise. While the depth dimension is first defined at the individual level, breath, as is defined here, is inherently at the group level.

Studies on functional diversity are of great relevance to understanding breadth of group expertise. Functional diversity is one type of group diversity. In research on group diversity, functional area is considered as one of many social attributes (others include gender, race, tenure, education, etc.) that can divide group members into sub-groups and undermine group cohesion and coordination (Mannix and Neale 2005; William & O'Reilly, 1998). Group diversity focuses on the pattern of sub-grouping of members according to their demographic and task-related attributes within the

boundary of a work group. Accordingly, the focus of functional diversity is on the distribution of members into different functional areas (Williams & O'Reilly, 1998).

Breadth also concerns the functional composition of groups. However, it emphasizes group member functional composition as an important dimension of the repertoire of professional knowledge and skills in the group, as opposed to the pattern of sub-grouping. The focus of breadth is on the presence of different types of expertise in the group, regardless of member distribution. Additionally, functional diversity emphasizes functional areas as an organizational unit, whereas breadth emphasizes functional areas as a proxy for different domains of expertise. Although organizational units and domains of expertise often have a one-to-one correspondence, it is not always the case. To a certain extent, breadth and functional diversity overlaps conceptually and are expected to be correlated empirically. However, they are still distinct, and breadth is examined here in the context of group expertise.

Theoretical discussion of the benefits and costs of functional diversity is usually couched in terms of the availability of non-redundant information, and emphasizes differences in expertise and perspectives across functional areas (e.g. Ancona & Caldwell, 1992; Pelled, Eisenhardth, & Xin, 1999; Simons, Pelled & Smith, 1999). This knowledge-based argument is especially relevant to my discussion of breadth of group expertise.

It is generally agreed that breadth of expertise is double-edged (William & O'Reilly, 1998). Greater breadth implies that group members each possess unique knowledge, skills and perspectives to the task, and can bring in a wide range of knowledge and information from outside of the group via their network ties (Ancona & Caldwell, 1992a). The availability of different knowledge and perspectives is potentially beneficial to group performance, because it can potentially lead to a more thorough examination of task issues, more innovative ideas, and more appropriate task solutions (Jehn, Northcraft, & Neale, 1999; Dahlin, Weingart, & Hinds, 2005). On the other hand, different functional domains often have diverging goals and interests, and develop different specialized knowledge and conceptual frameworks, idiosyncratic norms and values, and local languages and vocabularies (Dougherty, 1992; Lawrence & Lorsch, 1967; March & Simon, 1958; Van Maanen and Katz, 1979). Differences in multiple aspects can make communication across functional domains difficult, increase conflict, delay decision making, and prevent effective sharing and integration of knowledge. Consequently, breadth of expertise may have a negative impact on group performance.

The multifaceted nature of breadth of expertise is reflected in mixed empirical findings regarding its relationship with group performance, as researchers have reported results that suggests a positive (e.g. Ancona & Caldwell, 1992a), negative (e.g. Bunderson & Sutcliffe, 2002) or insignificant association (e.g. Pelled, Eisenhardt, & Xin, 1999) between breadth and group performance. Recent research has consequently

shifted to explore when breadth of expertise promotes group effectiveness (Simons, Pelled & Smith, 1999; Van Der Vegt & Bunderson, 2005). While this shift of focus has generated important insights on the role of factors such as the nature of group task, group identification, and group debate in moderating the relationship between breadth and group performance, our understanding of the conditions under which groups can better leverage the potential benefits of breadth of expertise is far from complete.

2.1.3 Variety

Similar to depth of group expertise, the variety dimension is also first defined at the individual level and then aggregated to the group level. At the individual level, it refers to the extent to which an individual has experience in multiple areas of functional expertise. A group will have greater variety when more of its members have a higher level of variety. While breadth of group expertise is defined on the basis of the current or dominant functional experience of group members, variety of expertise attempts to cover the whole history of a group member's work experience. In addition, while breadth of group expertise exists across group members, variety at the group level is an aggregation of a within-person characteristic.

Understudied in comparison to the depth and breadth dimension, the variety dimension has recently received increasing attention from organizational researchers. Research on career development and human resources has pointed out the inadequacy of the prevailing focus on length of experience, such as tenure in company or number of

years worked, in the literature on individual work experience, because the same amount of fulltime working experience or the same tenure in a company may involve quite different challenges and opportunities. Scholars have been calling for more attention to the qualitative side of experience such as the variety of tasks and expertise (Quinones, Ford & Teachout, 1995; Tesluck & Jacobs, 1998). Organizational learning researchers have also questioned the assumption that learning is maximized through specialization, an assumption underlying the dominant conception of experience as repeated performance of the same task in the learning curve literature (Boh, Slaughter, Espinosa, 2007; Schilling, Vidal, Ployhart & Marangoni, 2003). Finally, the implicit assumption in research on cross-functional groups that individuals are narrow specialists with experience in a single area has been recently questioned, as researchers start to take account of the possibility that individuals can be broad generalists with experience in several areas (Bunderson & Sutcliffe 2002; Cannella, Park, & Lee, 2008).

Experience in multiple areas allows individuals to acquire domain-specific technical knowledge and to understand the goals and interests, perspectives on organizational issues, and normal ways of doing things (Boh, Slaughter & Espinosa, 2007). It also allows individuals to obtain a broader perspective through which they can make sense of their work in relation to the work of people from different organizational units, a better understanding of the linkages between different parts of the organization and overall operation of the organizational system (Campion, Cheraskin & Stevens,

1994; Parker & Axtel, 2001). This learning reduces ego-centric bias as to whether there is one right approach to organizational issues and increases openness to different perspectives. This learning also increases the absorptive capacity to recognize the relevance of and assimilate new knowledge (Bunderson & Sutcliffe, 2002; Cohen & Levinthal, 1990). Additionally, the opportunity to work with people from different areas also helps individuals develop the ability to communicate effectively with people of different backgrounds (Reagans & McEvily, 2003). Consequently, individuals with experience in multiple areas are better able to effectively share knowledge with others and are more motivated to share knowledge. Such individuals are also better at integrating diverse perspectives and new information when examining an issue, as they have the motivation and the ability to reconcile and combine different opinions.

At the group level, knowledge sharing and integration in groups will become more effective when more group members have experience in multiple areas. Consequently, groups with greater variety are expected to perform better. While initial studies found empirical results consistent with the positive association (Boh, Slaughter and Espinosa, 2007; Bunderson & Sutcliffe, 2002; Schilling, Vidal, Ployhart & Marangoni, 2003), the process through which variety of experience affects group performance needs further study.

Boh et al (2007) and Schilling et al (2003) did not examine the underlying processes. Although Bunderson and Sutcliffe (2002) reported that intra-group

knowledge sharing partially mediates the association between variety of experience and group performance, their measure of knowledge sharing seems to capture the motivation and the extent that information and knowledge is made known to all members. Yet theories on the benefits of variety heavily stress variety making knowledge sharing easier and more effective due to enhanced ability of individuals to communicate to and understand others. It is therefore important to test the connection between variety of experience and this qualitative aspect of knowledge sharing. More importantly, as knowledge sharing and integration may determine the extent that groups can pool and combine the knowledge and perspectives of group members to make decisions and devise task solutions, variety of experience may allow groups to translate group expertise into performance gains to a greater extent. In other words, variety of experience may allow depth and breadth of group expertise to have a more positive impact on group performance. None of the existing studies, however, have made this theoretical argument or empirically studied this possibility.

2.2 Group expertise, knowledge sharing, and group performance

The discussion in the previous section suggests that depth, breadth and variety delineate distinct dimensions of a critical group resource, and that each dimension is associated with unique potential benefits for group performance. While research on depth has tended to focus on the direct effect of depth on group performance with little to offer regarding the intervening process, the literature on both breadth and variety has

emphasized a mediation model whereby task-related processes such as knowledge sharing mediate the relationship between breadth or variety and group performance, and between variety and group performance. Additionally, research on depth and breadth has both emphasized the need to understand when groups can translate the potential benefits of depth and breadth into actual effective group performance, in other words, the need to identify factors that may moderate the association between depth and group expertise so that they are more positive. Groups need to effectively share knowledge before the expertise members bring can be combined to generate group decisions and task solutions (Crossan, Lane & White, 1999), and that without effective knowledge sharing, the potential benefits of group expertise would remain untapped and have no influence on group performance. However, the potential moderating role of intra-group knowledge sharing is often implied but rarely tested in the existing literature on depth and breadth (Simons, Pelled & Smith (1999) is an exception). Figure 1 constructs a model of group expertise and group performance that has been empirically tested in existing literature.

It must be noted that while each of the linkages from depth, breadth and variety to group performance has been tested individually, no has considered all three dimensions simultaneously, let alone the interrelationship between different dimensions in shaping group performance. It is the major objective of my dissertation research to address the combined effect of the three dimensions. Building upon the separate

literatures on the three dimensions of group expertise, I posit (1) that depth, breadth, and variety of group expertise will each make a unique contribution to group performance, and (2) that the effect of the three dimensions of group expertise on group performance is multiplicative.

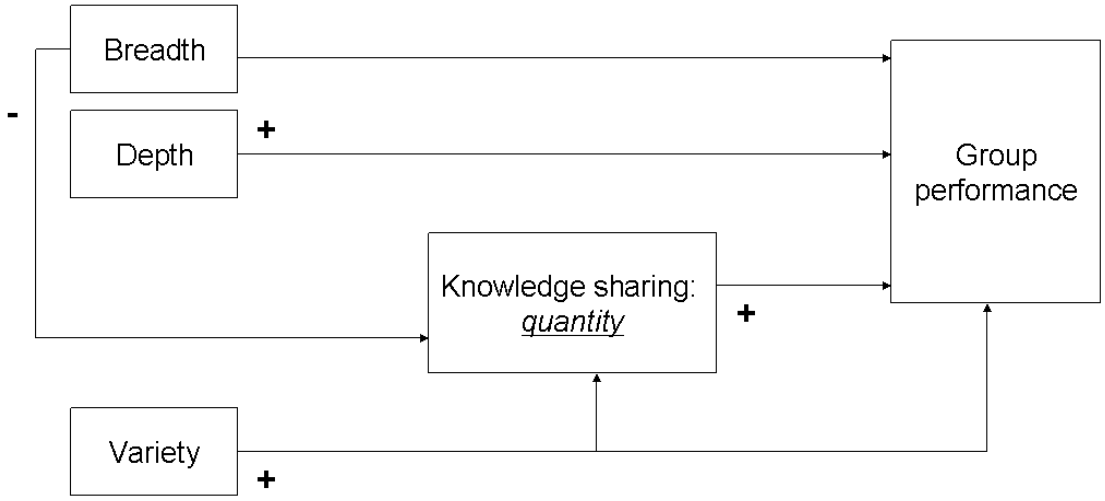


Figure 1: Model of group expertise and group performance in the current literature on group expertise.

In addition, existing studies have focused more on the quantitative aspect of knowledge sharing or task communication, such as the frequency or amount of task-related communication (Ancona & Caldwell, 1992a; Keller, 2001), frequency of knowledge sharing (Cummings, 2004), and extent to which members engage in learning behaviors (Bunderson & Sutcliffe, 2002; Wong, 2004). While acknowledging the importance of the quantitative aspect of knowledge sharing, I believe it is also important

to consider the qualitative aspect of knowledge sharing. In my dissertation research, I specifically focus on ease of knowledge sharing.

The decision to focus on a qualitative aspect of knowledge sharing, namely, ease of knowledge sharing, is theoretically derived. Existing theoretical discussion on the impact of breadth and variety of group expertise on group knowledge sharing emphasizes the qualitative aspect of knowledge sharing as much as the quantity. It is commonly argued that breadth may negatively influence group performance because greater breadth is associated with greater cognitive barriers to communication, as individuals with different areas of expertise not only have different knowledge, but also different perceptual frameworks, goals and interests, and vocabulary and language. Existing research also suggest that individuals with greater variety of experience may be able to communicate across functional boundaries because variety of experience increases the likelihood of shared knowledge, which makes it easier to achieve mutual understanding. Although discussion of the impact of breadth and variety on knowledge sharing has both considered motivation as an important mechanism that leads to more knowledge sharing, ease of knowledge sharing may precede motivation.

Ease of knowledge sharing is also practically very relevant. As knowledge sharing follows the path of least-effort (Reagans & McEvily, 2003), and that anticipated difficulty in knowledge sharing can reduce the motivation to engage in knowledge

sharing (Bunderson & Sutcliffe, 2002), perception of ease of knowledge sharing may determine the location and frequency of knowledge sharing.

However, while frequency or amount has been commonly considered as an important mediating variable, the qualitative aspect of knowledge sharing such as ease of knowledge sharing has rarely been studied. My dissertation study, particularly the conceptual discussion in Chapter 4 and empirical study in Chapter 5 will focus on ease of knowledge.

2.2.1 The unique impact of depth, breadth and variety on group performance

The literature reviewed earlier suggests that different dimensions of group expertise are linked to group performance for very different reasons. Breadth can potentially enhance group performance because groups with greater breadth can draw upon different expertise that members possess, and seek information and knowledge from a broader set of non-redundant external source. Additionally, it can be harmful to group performance because it increases difficulty in knowledge sharing. Depth can potentially promote group performance because groups with greater depth have more advanced knowledge and superior problem solving skills in the different functional domains present in the group. Finally, variety can have a beneficial effect on group performance because it facilitates knowledge sharing in groups. Therefore, it is expected that the effects of depth, breadth and variety on group performance when each is studied alone would remain significant when all are considered together.

2.2.2 The interrelationship between depth, breadth and variety in influencing group performance

Furthermore, the effect of depth, breadth and variety on group performance should be multiplicative. One key difference between working individually and working in a group is the need for sharing knowledge across group members before the expertise members bring can be combined to generate group decisions and task solutions (Crossan et al. 1999). While group expertise constitutes a critical resource that can potentially promote group performance, without effective knowledge sharing, the resource would remain untapped and have no actual influence on group performance. As both breadth and variety of group expertise influence knowledge sharing, they are expected to influence the extent to which the potential benefit of other dimensions of group expertise is translated into actual performance. Figure 2 presents a model of the interrelationship between different dimensions of group expertise in shaping group performance. Figure 3 presents a more elaborate model that incorporates knowledge sharing as the intervening variable, and allows an easier comparison with the model reflecting the current literature on group expertise in Figure 1. In both figures, relationships that have not been studied in the current literature are represented by dash-dot arrows.

As Figure 2 shows, I have three key propositions on the interaction between different dimensions of group expertise in shaping group performance: (1) the relationship between depth of group expertise and group performance will be

moderated by breadth, (2) the relationship between depth and group performance will be moderated by variety of group expertise, and (3) the relationship between breadth and group expertise will be moderated by variety of group expertise.

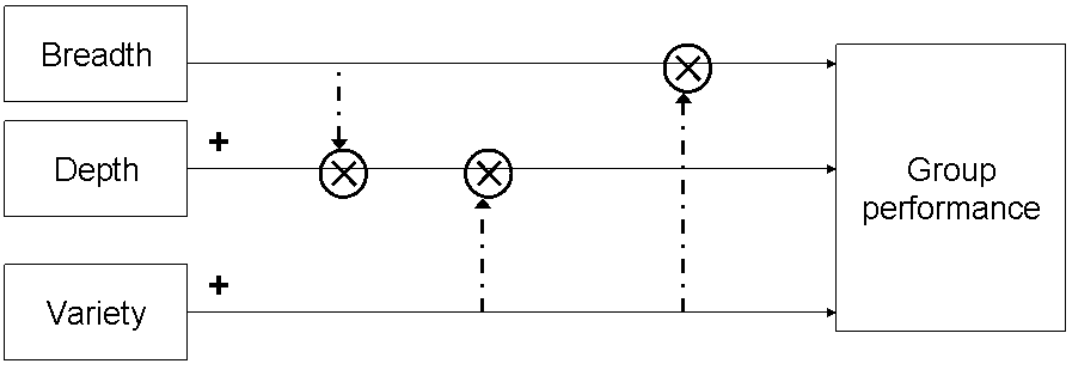


Figure 2: Interactions between dimensions of group expertise in shaping group performance.

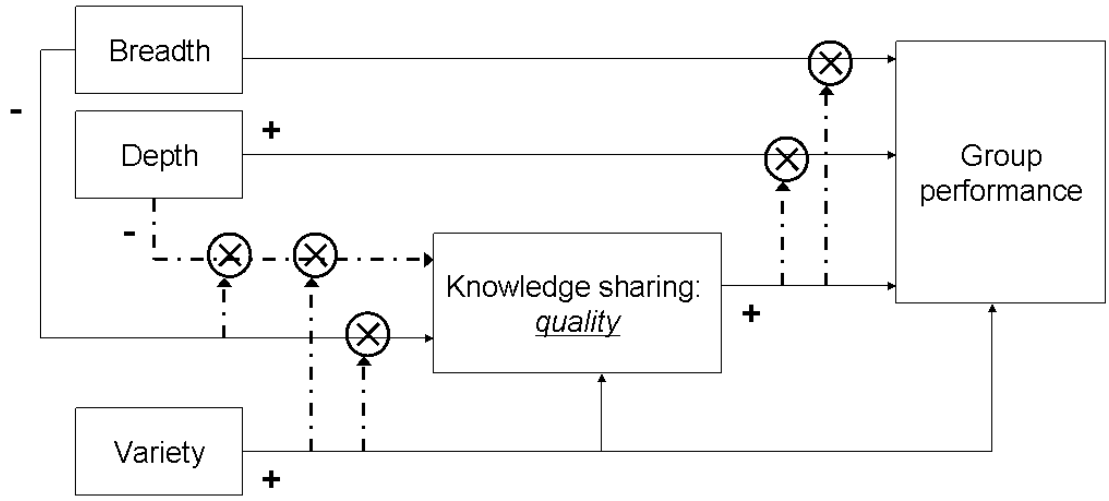


Figure 3: Interactions between dimensions of group expertise in shaping group performance, with intervening variable.

2.2.2.1 Depth, breadth, knowledge sharing, and group performance

Breadth of group expertise may moderate the association between depth of group expertise and group performance. As pointed out earlier, the literature on depth of group expertise implies that effective task process such as knowledge sharing is critical for groups to pool and apply member expertise to group tasks. Thus, breadth can moderate the association between depth and group performance via its negative influence on knowledge sharing. The presence of members from multiple functional areas poses multiple cognitive and motivational barriers to knowledge sharing. Therefore, as breadth of expertise increases, it will become increasingly difficult for groups to translate the advanced knowledge and superior problem solving skills of

group members into actual performance. In other words, the positive effect of depth on group performance will become weaker with an increase in breadth of group expertise.

Breadth may also moderate the association between depth and group performance by moderating the association between depth and knowledge sharing. The literature on depth of group expertise has little to offer regarding the relationship between depth and knowledge sharing. Research on individual expertise, however, suggests that when breadth of expertise is high, greater depth of expertise may introduce additional obstacles to communication, and further compound the difficulty of knowledge sharing. People with advanced expertise in a domain follow a more abstract conceptual model in approaching problems (Gitome, 1988). They articulate their thoughts in a more abstract way, for example, by skipping steps, using short cuts in describing how to solve a problem, using language with connotations specific to their area, or using more abstract statements in communication (Blessing & Anderson, 1996; Hinds, Patterson, & Pfeffer, 2001). This is usually not a problem when experts are communicating with people from the same area, as shared experience provides a rich context for people to figure out the skipped steps, to appropriately interpret jargon, and to make sense of abstract expressions, but may create a comprehension problem for people from a different area who lack the background knowledge. Therefore, when breadth is high, depth may be associated with increased difficulty in knowledge sharing, and consequently have a less positive impact on group performance.

2.2.2.2 Depth, variety, knowledge sharing, and group performance

Variety may also moderate the association between depth of group expertise and group performance such that depth will have a more positive impact on group performance when variety is high. As argued earlier, when individuals have had experience in multiple functional areas, they acquire the knowledge and skills to be more effective in knowledge sharing across functional boundaries, and become more motivated to share knowledge with people of different functional background. With a higher level of variety, a group will be more effective in knowledge sharing, and consequently will be in a better position to translate the potential benefits associated with depth of group expertise into actual group performance.

Variety may also moderate the association between depth and group performance because variety can mitigate the negative association between depth and knowledge sharing. As pointed out earlier, as individuals gain experience and expertise in an area of expertise, they tend to develop more abstract conceptual model, and articulate their thoughts in a more abstract way by skipping steps and using more abstract statements in communication (Blessing & Anderson, 1996; Hinds, Patterson, & Pfeffer, 2001). In addition, effective communication requires that communicators make accurate assumptions about the audience's knowledge of the topic and adjust their presentation to a level appropriate to those with less knowledge and experience in the domain. However, individuals with advanced expertise face greater cognitive barriers in

imagining the experience of others with little knowledge in their domain of expertise, and are less flexible in adjusting to the audience (Hinds, 1999).

To the extent that individuals with greater depth of expertise in their primary area manage to obtain experience in multiple functional areas, they are less likely to fall victim to their own expertise. As mentioned earlier, greater variety of experience may be associated with the opportunity and need to interact with people of different background, which require individuals to adjust their communication to audience and to try to communicate in a concrete and clear manner. Consequently, depth of expertise is less likely to reduce effectiveness of communication and knowledge sharing when there is a high level of variety.

2.2.2.3 Breadth, variety, knowledge sharing, group performance

Variety of group expertise may moderate the association between breadth and group performance by facilitating intra-group knowledge sharing. As pointed out earlier, greater breadth is potentially beneficial to groups because the availability of a wide range of knowledge and perspectives may trigger more thorough examination of issues and generate more creative ideas. When groups are composed of members with experience in multiple areas, intra-group knowledge sharing is easier, and knowledge and perspective from multiple functional areas can be fully pooled and integrated into group decisions and task solutions. Consequently, the potential benefits associated with

breadth can be realized to a greater extent, resulting in a more positive influence on group performance.

Variety of group expertise may also allow breadth to have a less negative association with group performance by mitigating the negative association between breadth and knowledge sharing. Charged with different tasks and responsibilities, different functional areas tend to develop different specialized knowledge and conceptual framework in defining and interpreting organizational issues, as well as norms and values specific to their respective task and social context (Lawrence & Lorsch, 1967; Van Maanen & Katz, 1979). They also tend to have diverging goals and interests, and idiosyncratic language and vocabularies that are unfamiliar to outsiders (March & Simon, 1993; Tushman & Scanlan, 1981). Due to these differences, knowledge sharing across functional boundaries is difficult, which has been cited as an important reason why greater breadth of group expertise may reduce group effectiveness (Bunderson & Sutcliffe, 2002).

Individuals with experience in multiple functional areas may be able to overcome the multiple barriers involved in knowledge sharing across functional boundaries. As argued earlier, when communicating with someone from a different area, the chance is greater that individuals with prior experience in multiple areas are familiar with the knowledge, conceptual framework, norms, values, and languages of the other person. Additionally, individual with prior experience in multiple areas may

also develop the capability to convey ideas and thoughts originated from his/her area in a way that is easy to understand by outsiders. Consequently, individuals with greater variety of experience are better positioned to understand others as well as making themselves understood. When more of its members have experience in multiple areas, a group can break down the barriers to knowledge sharing associated with greater breadth of group expertise, and more effectively pool and combine different knowledge and information. Therefore, variety of group expertise may help mitigate the negative effect that breadth exerts on group performance by weakening the negative association between breadth and knowledge sharing.

2.3 Testing the interactive effects between depth, breadth and variety

The primary objective of my dissertation study is to advance a multi-dimensional conception of group expertise so that the inter-relationship between different dimensions can be considered, and the much understudied variety dimension can be thoroughly examined. Chapters 3 to 5 are steps I have taken toward this goal.

Chapter 3 reports an empirical study testing the interaction between depth and breadth of group expertise in predicting group performance. Chapter 4 and Chapter 5 present attempts on both theoretical and empirical fronts to bring variety of experience into an integrated conceptual framework of group expertise composition. Chapter 4 offers a comprehensive conceptual discussion of the implications of variety of experience for both individual learning and group performance. Chapter 5 reports an

empirical study testing the relationship between individual variety of experience and ease of knowledge sharing at the dyadic level. Chapter 5 also tests if variety of experience moderates the relationships between individual functional experience (a proxy for depth of individual functional expertise) and ease of knowledge sharing, and between dyadic functional difference (equivalent to breadth of expertise at the dyadic level) and ease of knowledge sharing.

Dyads are the simplest form of social interaction, and are by far the most common in naturalistic social interaction (Bakeman & Beck 1974, James 1953). Group processes often involve dyadic interactions. For example, helping behaviors in project groups essentially occurs between pairs of group members (Van der Vegt, Bunderson & Oosterhof, 2006). It follows that knowledge sharing is likely to take place among pairs of individuals as well. Ease of knowledge sharing also involves dyads as individuals need to have a specific communication target in mind when rating how easy or difficulty it is to share knowledge. While research on groups has tended to focus on group level measures of processes such as communication and knowledge sharing, researchers often feel the need to go down a level of analysis and exactly specify the individual behaviors or dyadic dynamics underlying group processes. The study in Chapter 5 is precisely an effort to probe into the micro-underpinning of the relationship between group expertise and intra-group knowledge sharing.

As pointed out earlier, the depth and variety dimensions of group expertise are first defined at the individual level. Breadth requires at least two individuals and is equivalent to functional difference (whether the two individuals are from different functional areas) at the dyadic level. The smallest unit that knowledge sharing can be defined is also dyads. Figure 4 illustrates the relationships between different dimensions of group expertise and knowledge sharing decomposed into relationships across the individual and dyadic levels of analysis. The relationships depicted in this figure, when aggregated to the group level, correspond to relationships enclosed in the dashed square in Figure 3.

While studying individual variety of experience and dyadic knowledge sharing can help us understand the impact of variety of experience on group knowledge sharing, I am fully aware that relationships valid at the individual or dyadic level of analysis do not necessarily hold at the group level, and vice versa, as is the case with atomic fallacy and ecological fallacy. In the case of variety of experience and ease of knowledge sharing, however, I expect the same relationship to hold across levels of analysis. Individuals with greater variety of experience are expected to have the knowledge and capability to communicate effectively across boundaries. Dyadic knowledge sharing will be easier when individuals in the dyad have greater variety of experience. Groups as a whole will experience greater ease in knowledge sharing if more members have greater variety of experience.

However, the impact of variety of experience could vary across levels of analysis. For example, variety of experience may influence performance differently across the individual and group levels of analysis. As I discuss in Chapter 3, to the extent that variety in multiple areas is achieved at the expenses of depth in a focal domain, greater variety of experience does not necessarily improve individual productivity in the focal domain. However, given the importance of knowledge sharing to group functioning, groups composed of more individuals with greater variety of experience will be able to share knowledge more effectively and consequently be more productive. Postel (2002) also noted the possible tradeoff one has to make between acquiring depth of experience and expertise in a specific domain that promotes individual productivity in that domain, and variety of experience in multiple domains that may promotes knowledge sharing and group performance. In a study on the productivity of software engineers, Boh and her colleagues (Boh, Slaughter, & Espinosa, 2007) reported that individual prior experience in the same software system has a stronger positive influence on individual productivity than experience in related or different software systems. In contrast, experience in related and unrelated system (not the same system) has greater impact on group productivity. While the study did not directly test the impact of variety of experience on individual performance vs. group performance, it provides suggestive evidence consistent with my speculation. While acknowledging possible variation in the impact of variety of experience across different levels of analysis, it is beyond the

capacity of my dissertation research to fully elaborate on the issue and empirically tests the proposition.

Additionally, dyadic interactions in groups can be observed, responded to, and interfered by other people in the group. Knowledge sharing during group meetings may also involve processes that are more complicated than dyadic exchange. Therefore, an aggregation of dyadic interaction may not perfectly capture group processes. Nevertheless, dyadic interactions are probably the most essential to group knowledge sharing. The aggregation of dyadic interaction to group level may also require attention to issues similar to those encountered in individual-to-group aggregation, such as issue of inter-rater agreement or aggregation strategy (e.g. mean or variation). It is beyond the capacity of my dissertation research to elaborate on the above issues, but will be addressed in future studies. Although the empirical study to be reported in Chapter 5 focuses on the dyadic level of analysis, I will continue to fully test the overarching model developed in Chapter 2 in the future, which would involve multi-level modeling of the impact of variety of experience on knowledge sharing at the dyadic and group levels of analysis.

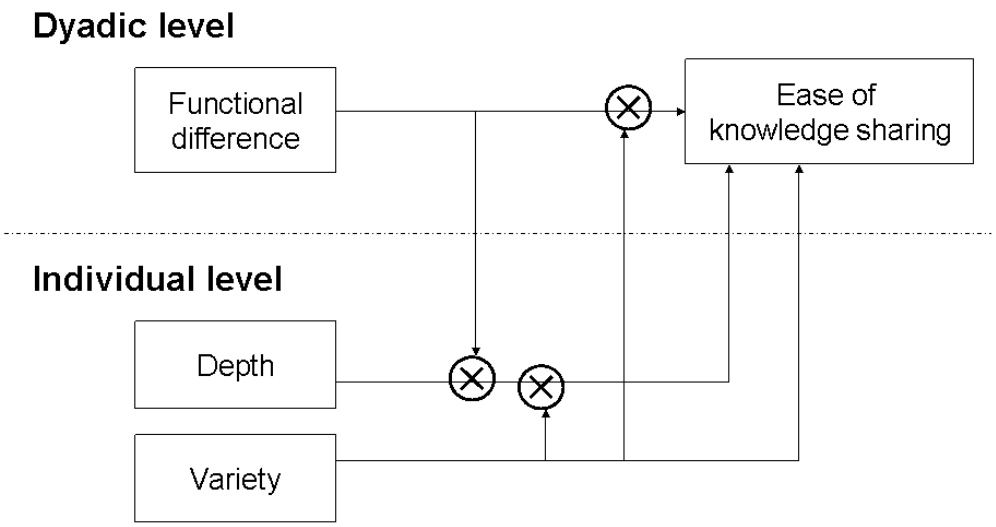


Figure 4: Micro-decomposition of relationships between group expertise and group knowledge sharing.

3. Leveraging depth and breadth of group expertise: The moderating role of task process

The empirical study presented in this chapter has two major objectives. First, it empirically tests a component of the theoretical model developed in Chapter 2, namely, the interaction between depth and breadth of group expertise in shaping group performance. Second, it extends the absorptive capacity theory to the group level and tests the role of both internal and external task process in moderating the association between group expertise and group performance.

3.1 Background

In knowledge-based organizations, tasks are often inherently complex and beyond the capacity of any single individual, thus they require the expertise and joint effort of people from multiple functional domains. For example, developing a new product often requires the involvement of group members from engineering, marketing, and manufacturing. As a result of increasing complexity, organizations have dramatically expanded the use of groups to complete a variety of tasks such as delivering services, recommending improvements, and making strategic decisions (Cohen & Bailey, 1997). Expertise that members bring to the group, often through prior education, training, and experience, is one of the most critical resources for groups to effectively solve problems, make decisions, and complete tasks (Hackman & Morris, 1975). To perform effectively, groups not only need to utilize expertise possessed by

group members, but also need to acquire additional expertise from external sources (Ancona & Caldwell, 1992a). Management research has seen a rise in scholarship on how groups leverage expertise to achieve better performance, and the processes surrounding the acquisition and integration of expertise in group tasks (e.g. Hansen, 1999; Faraj & Sproull, 2000; Bunderson, 2003; Haas, 2006).

Two different streams of research have investigated expertise in work groups. One stream of research has focused primarily on the *depth of group expertise*. Usually measured as the level or amount of knowledge and skills related to a task (sometimes as the general cognitive ability of group members), depth of expertise has had a positive relationship with group performance (Tziner & Eden, 1985; Barrick, Stewart, Neubert & Mount, 1998; Neumann & Wright, 1999; Devine & Philips, 2001). This stream of research also includes studies of how factors such as prior group experience, variation in member's level of expertise, and member status cues affect the recognition and utilization of expertise in groups (e.g. Littlepage & Robison, 1997; Austin, 2003; Baumann & Bonner, 2003; Bunderson, 2003). These studies suggest that accurate recognition of expertise and allowing members with more task experience or expertise to exert greater influence on group decisions increases the likelihood of achieving better group performance. Combining insights from research on depth of expertise, as well as research investigating expertise recognition and utilization, it is reasonable to suggest that the positive association for depth of group expertise should be reduced or enhanced

depending on how effectively groups can utilize member expertise. However, this implicit moderation model has not been tested.

Another stream of research has focused primarily on the *breadth of group expertise*, that is, the extent to which groups are composed of members with expertise in different functional domains. The literature on group diversity (e.g. Ancona & Caldwell, 1992b; Pelled, Eisenhardt, & Xin, 1999) suggests that the linkage between breadth of group expertise and group performance is not as clear cut as the linkage between depth of group expertise and group performance. While breadth of expertise brings a broad range of knowledge and perspectives to bear and can generate more thorough examination of issues and potentially more creative ideas, differences across functional "thought worlds" increases difficulty in sharing and integrating knowledge, and can reduce group performance (Dougherty, 1992; Williams & O'Reilly, 1998). The multifaceted nature of breadth of expertise is reflected in the mixed research results regarding its relationship with group performance. While some studies have reported a positive association between breadth of expertise and performance (e.g. group innovation, efficiency, company profit, market share) (Ancona & Caldwell, 1992a, Hambrick, Cho & Chen, 1996), other studies have failed to document any significant association between breadth and performance (Pelled, Eisenhardt, & Xin, 1999; Smith, Smith, Olian, Sims, O'Bannon, & Scully, 1994) or have even reported a negative association (Bunderson & Sutcliffe, 2002). Recent research has consequently shifted to

explore when and how breadth of expertise promotes group effectiveness (Simons, Pelled & Smith, 1999; Van Der Vegt & Bunderson, 2005). While this shift of focus has generated important insights on the role of factors such as the nature of group task, group identification, and group debate, our understanding of the conditions under which groups can better leverage the potential benefits of breadth of expertise is far from complete.

To perform effectively, groups not only need task-related interactions among members so that their expertise can be shared and integrated to make decisions and solve problems, but also need to interact with external parties to acquire project-related knowledge (Ancona & Caldwell, 1992b). In research on both depth and breadth of expertise, internal task process has garnered much more attention than external task process. For example, research on depth of expertise has established the importance of internal processes such as expertise recognition and coordination to group performance (e.g. Littlepage, Robison, & Reddington, 1997; Faraj & Sproull, 2000; Bunderson, 2003), while research on breadth of expertise has investigated how internal processes such as internal communication and task conflict impact group performance (Pelled, Eisenhardt, & Xin, 1999; Bunderson & Sutcliffe, 2002). While external activities of groups in general have received more attention in recent scholarship (e.g. Ancona & Caldwell, 1992b; Cummings, 2004; Haas, 2006), they have not studied the role of both internal and

external task process in shaping the association between depth and breadth of expertise and group performance.

In summary, while existing studies have greatly advanced our understanding of expertise in groups, two important issues are in need of further study. First, the above studies tend to focus on either depth *or* breadth of expertise. We are not clear how depth and breadth of expertise combine to influence group performance. Do depth and breadth, as distinct dimensions of group expertise, each make a unique contribution to group performance? Do they relate to group performance in similar or different ways? Are they additive or multiplicative in their impact on group performance? Second, studies on depth and those on breadth seem to converge on one important point, that is, the impact of member expertise on group performance can vary, and it is necessary to understand when expertise is more or less beneficial to group performance. While recent research on group diversity, in which breadth of expertise constitutes an important dimension of group diversity, has started to investigate moderation models (e.g. Jehn, Northcraft, & Neale, 1999; Van Der Vegt & Bunderson, 2005), relatively little has been done with regard to moderators of depth of expertise. Studies of group diversity have identified factors such as team commitment, value diversity, and task type (e.g., routinization, variety) that moderate the association between breadth of expertise and group performance. Relatively less attention has been paid to the possibility that both

internal and external task process can moderate the relationship between expertise and group performance.

This chapter reports a study that attempts to address the two sets of issues described above. Building on absorptive capacity theory (Cohen & Levinthal, 1990), we develop an integrative theoretical model for the linkage between depth and breadth of group expertise and group performance, and how internal and external task process shapes this linkage. Theory on absorptive capacity holds that pre-existing knowledge is not just a resource to draw upon for identifying task solutions or making decisions, but constitutes an important basis for acquiring new knowledge. Thus, while existing research has largely focused on expertise as the source of solutions or decisions, absorptive capacity theory suggests two ways of leveraging the potential benefits of expertise: One focuses on enhancing inward-looking absorptive capacity, that is, internal task processes that facilitate the utilization of expertise possessed by members; the other emphasizes taking advantage of outward-looking absorptive capacity, that is, external task processes that tap into the ease of learning associated with depth and breadth of expertise.

Combining insight from absorptive capacity theory with existing research on depth and breadth of expertise, we first argue that depth and breadth each makes a unique contribution to group performance, but that their impact on group performance may not be entirely independent. We next argue that the linkage between group

expertise and group performance may be moderated by both internal and external task process. This chapter contributes to the burgeoning literature on leveraging expertise in groups. By extending and adapting absorptive capacity theory to the group level of analysis, this chapter also has implications for the further development of absorptive capacity theory. As we discuss later, while theory on absorptive capacity provides insights for investigating the different ways that expertise matters to group performance, groups provide a setting in which key constructs of absorptive capacity theory can be more precisely measured and major hypotheses can be directly assessed. We test our hypotheses using data from 174 groups in a Fortune 500 telecommunications company. Groups in our sample worked on knowledge-intensive tasks such as product development, process management, and service improvement, and on average completed their projects in 15 months.

3.2 Theory and hypotheses

3.2.1 Absorptive capacity: The role of pre-existing knowledge

Absorptive capacity refers to the ability of organizations to recognize and assimilate new knowledge, and to exploit knowledge for commercial use (Cohen & Levinthal, 1990). It involves an outward-looking component (i.e., the ability to acquire external knowledge) and an inward-looking component (i.e., the ability to utilize internal knowledge). Drawing from cognitive research on the associative nature of learning, absorptive capacity theory emphasizes pre-existing knowledge as an important

determinant of an organization's ability to acquire and integrate knowledge. Research on associative learning suggests that learning new knowledge in the same or similar domain is easier than learning in a different domain.

Absorptive capacity theory elaborates that both the depth and breadth of prior related knowledge enhances a firm's outward-looking absorptive capacity. Greater breadth of knowledge among organizational members provides the organization with access to a broader set of unique sources of knowledge and increases the chance that external knowledge is related to some part of a firm's pre-existing knowledge. Depth of knowledge expedites the comprehension and encoding of new knowledge (Bower & Hilgard, 1981; Lindsay & Norman, 1977). However, with regards to inward-looking absorptive capacity, breadth may play a negative role. Putting knowledge to use depends on effective internal sharing and integration of knowledge across organizational units. Given the variety of knowledge, language, and orientations associated with different functional specializations (Lawrence & Lorsch, 1967; Dougherty, 1992), breadth of knowledge can increase the difficulty of communication and could turn out to be an obstacle to the integration of knowledge across organizational units. Although Cohen and Levinthal (1990) did not discuss whether depth of expertise benefits or harms internal knowledge integration, we will later suggest that under some conditions in cross-functional group settings, high levels of expertise may not necessarily be beneficial.

Organizational absorptive capacity depends on the absorptive capacity of individual members. As Huber (1991) has pointed out, organizations acquire knowledge through learning by individual members. To the extent that individual members have a higher level of expertise and different types of expertise, an organization as a whole will be better positioned to detect and learn relevant new knowledge from the external environment. To the extent that individual members engage in external task interactions, the collective will be better able to take advantage of the learning benefits associated with greater depth and breadth of expertise. However, an organization's absorptive capacity is not simply the sum of individual absorptive capacity. The inward-looking component depends on task-related interactions that organizational members engage in from day to day so that knowledge from different parts of the organization can be shared and integrated, and the barriers to effective communication and comprehension can be overcome. Thus, internal task process is critical for allowing an organization to put its pre-existing knowledge to use, and to derive benefits from member expertise.

Two insights from absorptive capacity theory are particularly relevant to our discussion of expertise in groups: (1) Knowledge is not only a resource to be utilized, but also constitutes the basis for further learning, and (2) The extent to which expertise can benefit group performance may depend on both an internal task process through which group members share and integrate their knowledge to generate high quality solutions, and an external task process through which knowledge from the external environment is

acquired. In the context of groups, we consider expertise possessed by group members as the pre-existing knowledge in groups. Depth of group expertise is reflected in the overall level of knowledge and skills (e.g. novice, intermediate, or expert) that the collection of group members possess in their respective functional domains. Breadth of group expertise captures the range of functional expertise across group members, and is therefore conceptualized as the number of different functional domains represented in a group (e.g. engineering, manufacturing, and marketing). Groups have greater depth of expertise when a greater proportion of members possess higher levels of expertise, while groups have greater breadth of expertise when members come from a greater number of unique functional domains.

3.2.2 Depth of expertise, breadth of expertise, and group performance

As mentioned earlier, different literatures have covered depth and breadth of group expertise. Individuals with greater depth of expertise in a particular domain possess a larger body of knowledge in that domain, and have superior problem solving ability as they are better able to tell relevant knowledge from irrelevant knowledge, and are more proficient in applying their knowledge to solving problems (Larkin, McDermott, Simon, & Simon, 1980; Ettenson, Shanteau, & Krogstad, 1987; Franz & Larson, 2002). A group as a whole will have greater problem solving capability when more of its members have greater depth of expertise in their respective area of expertise. Existing research on depth of expertise has generally reported a positive association

between depth of expertise and group performance (e.g., Tziner & Eden, 1985; Barrick, Stewart, Neubert & Mount, 1998; Neumann & Wright, 1999).

In contrast to depth of group expertise, the linkage between breadth of group expertise and group performance is not as clear cut. On the one hand, breadth of expertise may improve group performance because members bring different perspectives and skills to bear, and can access a broader range of knowledge from outside the group, which should lead to more thorough examination of a problem, more innovative ideas, and more appropriate task solutions (Ancona & Caldwell, 1992b; Jehn, Northcraft, & Neale, 1999; Dahlin, Weingart, & Hinds, 2005). On the other hand, breadth of expertise may negatively affect group performance because differences in knowledge and perspectives across functional boundaries can increase difficulty in task communication and knowledge sharing (Dougherty, 1992; Bunderson & Sutcliffe, 2002).

Empirical studies have reported mixed findings regarding the association between breadth of group expertise and group performance. Some studies have reported a positive association between breadth of expertise and performance (e.g. group innovation, efficiency, company profit, market share) (Ancona & Caldwell, 1992b, Hambrick, Cho & Chen, 1996), whereas other studies have failed to document any significant association between breadth and performance (Pelled, Eisenhardt, & Xin, 1999; Smith, Smith, Olian, Sims, O'Bannon, & Scully, 1994) or have even reported a negative association (Bunderson & Sutcliffe, 2002).

The above discussion suggests that as distinct dimensions of group expertise, depth and breadth are related to group performance via different mechanisms: Depth of expertise has the potential to improve group performance because of more advanced knowledge and superior problem solving skills within domains, while breadth of expertise may promote group performance because of the variety of knowledge that can be brought to bear on the task, but at the same time can hurt group operation because of greater difficulty in communication and coordination. As such, we expect that depth of group expertise each will have a significant association with group performance controlling for breadth. While we expect breadth of expertise to have unique association with group performance after controlling for depth, the association could empirically be positive, negative, or even insignificant, depending on the extent to which groups can realize the benefits and mitigate the problems associated with breadth. Thus, we will not hypothesize about the main effect of breadth of expertise on group performance.

Hypothesis 1a (H1a). *Depth of group expertise will have a significant positive association with group performance controlling for breadth of group expertise.*

We further posit a negative interaction between depth and breadth of group expertise in predicting group performance. As pointed out earlier, the potential positive association between expertise and group performance may be enhanced or weakened depending on how effectively groups can share and integrate knowledge to make high quality decisions and devise appropriate task solutions. Many groups cannot reach their

full potential due to ineffectiveness in utilizing expertise. For groups working on pooled tasks (Thompson, 1967), putting expertise to use should simply require individual members to apply their knowledge and skills to complete the tasks. However, we focus on group tasks that are complicated and interdependent which require members to share and integrate different views and ideas before their expertise can have an impact on group performance. Integrating member expertise involves task-related interactions through which different ideas are retrieved, communicated, and combined into a group decision or problem solution (Dahlin, Weingart, & Hinds, 2005; Huber, 1991). The more effective groups are in this task process, the more likely that greater depth and breadth of expertise can lead to better decisions and task solutions, and can result in a stronger positive influence on group performance.

Prior research has documented a positive main effect of depth of expertise on group performance. We suggest here that breadth of expertise may weaken this positive relationship, because breadth of group expertise often impedes knowledge sharing and integration across functional domains. Different functional domains in organizations vary in their task responsibilities and specialized knowledge. As a result, differences in norms, values, time frames, and coding schemes across domains often increase difficulty in communication, and reduce the effectiveness of knowledge sharing and integration across functional domains (Lawrence & Lorsch, 1967; Dougherty, 1992; Pelled, Eisenhardt, & Xin, 1999; Bunderson & Sutcliffe, 2002). Consequently, groups with

members coming from many different functional areas may not be able to fully consider and combine the ideas and insights of members. Existing research has highlighted the difficulty in knowledge integration as one of the major reasons why the presence of members with expertise from different functional domains could itself reduce group performance (Williams & O'Reilly, 1998). We suggest that difficulty in knowledge integration associated with breadth of expertise also makes it harder for depth of expertise to have a positive impact on group performance. Without effective knowledge integration, members' superior knowledge and problem solving skills cannot be fully utilized in group decisions and task solutions. As a result, depth of expertise may have a less positive effect on group performance in groups when breadth of expertise is high.

In addition, when breadth of expertise is high, greater depth of expertise may also introduce obstacles to communication across functional boundaries, and further compound the difficulty of knowledge sharing and integration. People with advanced expertise in a domain follow a more abstract conceptual model in approaching problems (Gitome, 1988). They articulate their thoughts in a more abstract way, for example, by skipping steps, using short cuts in describing how to solve a problem, using language with connotations specific to their area, or using more abstract statements in communication (Blessing & Anderson, 1996; Hinds, Patterson, & Pfeffer, 2001). This is usually not a problem when experts are communicating with people from the same area, as shared experience provides a rich context for people to figure out the skipped steps,

to appropriately interpret jargon, and to make sense of abstract expressions, but may create a comprehension problem for people from a different area who lack the background knowledge.

In addition, effective communication requires that communicators make accurate assumptions about the audience's knowledge of the topic and adjust their presentation to a level appropriate to those with less knowledge and experience in the domain. However, because people tend to rely heavily on their own recent experience, people with advanced expertise would face greater cognitive barriers in imagining the experience of others with little knowledge in their domain of expertise – sometimes referred to as the "curse of expertise" (Hinds, 1999). Finally, people with advanced expertise are likely to be more confident about their knowledge and perspectives in their own area and strongly believe in the value of their expertise. They may be less likely to consider and accept different opinions, or be influenced and persuaded by others, posing additional challenges to knowledge integration across boundaries (Crano & Prislin, 2006). Given the above discussion, we expect that the association between depth of expertise and group performance will be less positive when breadth of expertise is high rather than low.

Hypothesis 1b (H1b). *Breadth of expertise will moderate the association between depth of expertise and group performance such that depth of expertise will have a less positive association with group performance when there is greater breadth of expertise.*

3.2.3 Group expertise and group performance: The moderating role of task process

As noted, depth of expertise is generally beneficial in group settings due to specialized knowledge that members can draw on, but the potential benefits may not always be fully realized, while breadth of expertise can increase the diversity of ideas and perspectives available to the group, but at the same time can lead to difficulties in knowledge sharing and integration. It is therefore important to explore factors that could help groups to fully realize the benefit of both dimensions of expertise. We argue that internal and external task process should determine the extent to which groups can derive benefits from depth and breadth of expertise.

The moderation model we theorize about views group process as a factor that affects the sign or magnitude of the relationship between group expertise and group performance. Many types of processes occur in group settings. Research on group interactions has identified social integration and communication as two key predictors of group performance (McGrath, 1984; Shaw, 1981). Other process variables that have been used in group research, such as consensus (Knight et al., 1999) and conflict (Jehn, Northcraft, & Neale, 1999), represent overlapping conceptualizations of social integration and communication. Recently, there has been a rise in studies focusing on knowledge sharing and learning processes in groups (Edmondson, 1999; Cummings, 2004; Wong, 2004; Haas, 2006). Group process can be broadly classified as social process and task process. While social process has to do with group members' feelings and

emotions toward one another, task process has to do with interactions related to task issues (Pelled, Eisenhardt, & Xin, 1999). Social integration and emotional conflict are examples of social process; learning behaviors and knowledge sharing are examples of task process.

In this chapter, we focus on one essential task process, i.e., the communication and discussion of domain-related expertise with group members and with outside parties. Internal task process exploits the expertise of members by putting available knowledge and skills to use. It is the process through which members share and integrate their different expertise. Members not only need to contribute ideas and insights from their own area, but also need to actively participate when others are sharing knowledge from their area of expertise. Therefore, internal task process involves communication and discussion across all areas of expertise that group members possess.

In contrast, external task process is critical for groups to obtain new and up-to-date knowledge, thus expanding the knowledge available to groups. While it is likely that members talk with outside people on a variety of issues, it is more common that they spend time discussing issues related to their own domain of expertise, given that they have more connections and greater access to their own functional unit or professional community. Furthermore, knowledge from their own domain, rather than from domains in which other group members know more, is what is expected and valued by the group. Ancona and Caldwell (1992b) found that communication with a

functional area went up dramatically when someone from that area joined the new product team. In addition, this within-domain external task interaction is also likely to generate the greatest value for the group, given the associative nature of pre-existing knowledge. With each member focusing on communication and discussion related to their own area of expertise, the group as a whole is tapping into unique sources of knowledge.

As absorptive capacity theory suggests, expertise that members bring to the group is not only a resource to draw upon for making decisions and solving problems, but also the basis for further learning (Cohen & Levinthal, 1990). We argue that the association between both depth and breadth of expertise and group performance may be moderated by internal task process and external task process, as internal task process should facilitate the sharing and integration of expertise, and external task process should allow members to capitalize on the learning advantage associated with depth and breadth of expertise.

The basic argument for the moderating role of internal task process, such as discussion of functional expertise within the group, is that without internally sharing and integrating member expertise, the potential advantage associated with depth and breadth of expertise would remain untapped and would have a limited effect on group performance. A higher level of internal task process should enable members with advanced expertise to more fully contribute their rich knowledge and superior skills to

solve problems faster and better. A higher level of internal task process should also allow groups to more thoroughly share and integrate diverse knowledge and perspectives to improve the quality of group decisions and task solutions. Therefore, internal task process should be an important condition for expertise to benefit group performance.

Hypothesis 2a (H2a). *Depth of expertise will be more positively related to group performance when there is a higher level of internal task process*.

Hypothesis 2b (H2b). *Breadth of expertise will be more positively (or less negatively) related to group performance when there is a higher level of internal task process*.

Groups also need to acquire information and knowledge from the external environment. As absorptive capacity theory suggests, groups with greater depth and breadth of expertise possess greater outward-looking absorptive capacity (i.e., are better able to learn from the external environment). Greater depth of pre-existing knowledge expedites the comprehension and encoding of new knowledge (Bower & Hilgard, 1981; Lindsay & Norman, 1977). Greater breadth of pre-existing knowledge among organizational members provides the organization with access to a broader set of unique sources of knowledge and increases the chance that the external knowledge is related to some part of a firm's pre-existing knowledge (Cohen & Levinthal, 1990). To tap into the learning advantage associated with expertise, group members need to engage in external task process to seek out or expose themselves to knowledge relevant to group

tasks (Ancona & Caldwell, 1992a). If group members do not reach out, the group's outward-looking absorptive capacity is not utilized and will have a limited impact on group performance. Therefore, external task process constitutes another important condition for groups to realize the potential benefits of expertise. See Figure 5 for a graphic presentation of the theoretical model.

Hypothesis 3a (H3a). *Depth of expertise will be more positively related to group performance when there is a higher level of external task process.*

Hypothesis 3b (H3b). *Breadth of expertise will be more positively (or less negatively) related to group performance when there is a higher level of external task process.*

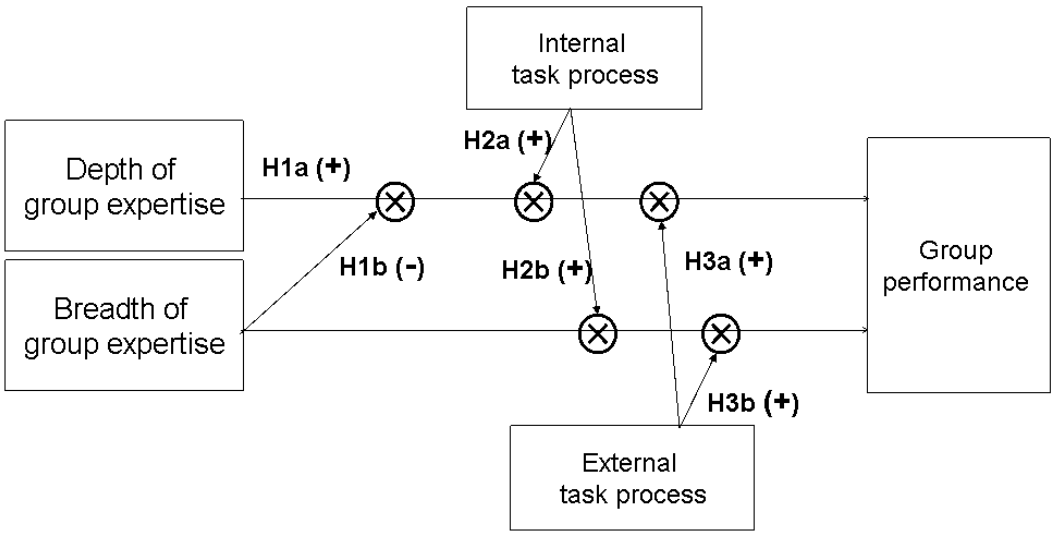


Figure 5: Model of depth and breadth of group expertise, internal and external task process, and group performance.

The above discussion highlights the critical role that internal and external task process play in helping groups to realize the potential benefits of depth and breadth of

group expertise. If the above argument holds, we would also expect that the interaction between depth and breadth of expertise varies across different levels of internal task process and external task process. We hypothesized that depth of expertise will be less positively related to group performance when breadth of expertise is higher, because breadth of expertise increases the difficulty in knowledge sharing and integration, and depth of expertise itself may also introduce communication problems in groups with greater breadth of expertise. Thus, groups may not be able to make use of the superior knowledge and skills associated with depth of expertise, and depth of expertise will only have a limited impact on group performance.

However, when groups engage in a higher level of external task process, they take advantage of the learning benefits associated with greater depth of expertise, which should allow depth of expertise to exert a stronger positive influence on group performance, and consequently offset the dampening effect that breadth of expertise could have on the relationship between depth of expertise and group performance. Similarly, when groups engage in a higher level of internal task process, groups will be able to share and integrate member expertise to a greater extent. Although greater quantity does not necessarily imply that the process is more effective or smooth, more communication and discussion of expertise is necessary to improve the chances of solving problems in comprehension associated with breadth of group expertise so that the potential benefits of depth of group expertise may still be realized. In this chapter,

we will explore the possibility that internal and external task process may offset the negative influence that breadth of group expertise is expected to have on the association between depth of expertise and group performance (i.e., a three-way interaction between depth, breadth, and task process).

3.3 Methods

3.3.1 Sample and data collection

We used survey data from a field study of groups in a telecommunications firm to test the above hypotheses. At the time of the study, the firm employed more than 100,000 individuals all over the world. Group members in this chapter came from the United States-Canada (63%), Latin-South America (3%), Europe (15%), Middle East-Africa (5%), India-China (5%), and Japan-Korea-Malaysia (9%). Groups in the sample worked mainly on four types of tasks: product development (such as designing a hand-held scanning device, 25%), service improvement (such as changing the client platform for car phones from analog to digital, 25%), process management (such as executing the separation and sale of a business unit, 25%), and manufacturing operations (such as modify existing factories to support new pager production, 25%).

We took advantage of a corporate-wide reward and recognition program established to publicly acknowledge high-performing groups in the company. A total of 280 groups were first nominated by General Managers from more than 20 regional sites around the world. In the regional events, each group made a 20-30 minute presentation

and was rated by a panel of 5 to12 senior executives on multiple dimensions of effectiveness. 122 of the 280 groups were judged the highest and advanced to five separate division-level events with a different panel of judges. 21 of the 122 groups were judged the highest and moved on to a final corporate-level event, where they made presentations to the company CEO and senior vice-presidents.

Division managers provided archival data on the groups, including project documentation, presentation slides, and other available written materials. Background information was missing for 98 of the 280 groups, so this sample includes 84/137 (61%) of groups in the regional-level events, 77/122 (63%) of groups in the division-level events, and 21/21 (100%) of groups in the corporate-level event. Exploratory interviews were conducted with all members of 20 groups to learn about the nature of the projects and to develop surveys used later. Group leaders verified project descriptions, member names, domains of expertise, and other background information. Survey questions about domain expertise and task process were pre-tested on employees in the corporate office before being emailed to each group member with a valid e-mail address (1315/1474 or 89%). The survey included a cover letter to describe the purpose of the and to assure participants of confidentiality, and it took about 20-30 minutes to complete. The invitation email was sent an average of six months after groups completed their projects, and was followed by two reminders. The overall response rate for those who were emailed a survey was 73% (957/1315). After dropping groups with fewer than 2

members who responded to questions about domain expertise and task process, we were left with 174 (out of 182) groups for analysis.

3.3.2 Measures

3.3.2.1 Depth of expertise

Because the company did not have standard metrics for assessing depth of expertise across a wide range of functional areas, we first created an individual-level measure of depth of expertise. Given the difficulty in objectively assessing depth of expertise, prior research has tended to adopt self-reported measures (e.g. Obstfeld, 2005). We asked individual group members to rate the level of technical expertise in their own functional domain on a 5-point scale (1-novice, 2-beginner, 3-intermediate, 4-advanced, and 5-expert). Previous research suggests several approaches to constructing group-level measures: group variability, group mean, the highest or lowest individual score in the group, and a compositional approach (Barrick, Stewart, Neubert, & Mount, 1998; Devine & Philips, 2001; Rulke & Galaskiewicz, 2001).

We are not interested in variability of expertise, thus we did not consider the variability approach. The highest or lowest individual score is often used when a single individual can have an inordinate impact on group outcomes (Bonner, 2004), which is unlikely in cross-functional work groups with complex and knowledge-intensive tasks. Computing a group mean assumes that individual characteristics can combine additively to form a collective measure. This assumption would suggest that an expert

(rating of 5) together with a novice (rating of 1) in software engineering is equal to two intermediate (rating of 3) members in software engineering. However, our theoretical discussion earlier suggests that these two combinations are probably not the same in terms of the amount of knowledge that the group possesses. The first combination possesses superior knowledge and skills than the second combination, as we consider groups to possess knowledge or skills in a domain as long as one of its members has it (Huber, 1990). A few studies have adopted a compositional approach to avoid simply averaging expertise across individuals to form a group-level measure (e.g., Rulke & Galaskiewicz, 2001). For example, members with self-rated expertise above the sample grand mean or one standard deviation above the grand mean are considered to have a higher level of expertise, and the proportion of such members in a group is used as the group-level measure. Thus, groups collectively will have greater depth when a greater proportion of the members posses a higher level of depth of expertise. We believe that depth of expertise at the group level is more precisely captured by the compositional approach than by the group mean approach.

Consistent with the compositional approach, we consider individuals with a self-rating above the sample grand mean as having high expertise. In the case of the reported in this chapter, participants self-rated as advanced or expert (>=4) were placed in the high expertise category. We then calculated the proportion of members in each group

with a level of expertise above the sample grand mean to measure depth of expertise at the group level (Depth: Mean=0.66; SD=0.26).

3.3.2.2 Breadth of expertise

Group leaders provided information on the primary functional background of each group member. In a few cases where group member functional domains were missing, corporate database records were used. Fourteen domains of expertise were identified (overall percentage of group members in parentheses): engineering (29%), manufacturing (20%), technical operations (14%), quality (7%), marketing/strategy (5%), customer service (4%), project management (4%), information technology (4%), administrative support (3%), sales (3%), human resources (2%), finance (2%), business administration (2%), and purchasing (1%). Breadth of expertise at the individual level has been measured as the number of areas of expertise known to an individual (Reagans & McEvily, 2004). At the group level, research on group diversity has focused on functional diversity, which captures the distribution of members across different functional domains. While breadth of expertise should be positively correlated with functional diversity, they are conceptually distinct constructs, as breadth of expertise concerns the range of functional domains represented in the group regardless of the distribution of members into different domains. Thus, consistent with breadth of individual expertise, we counted the total number of unique functional domains in the group to measure breadth of group expertise (Mean=3.25; SD=1.65).

3.3.2.3 Internal task process

We focus on communication and discussion of domain-related expertise (e.g., marketing, finance, engineering) within the group. As we pointed out earlier, internal task process often involves the sharing and integration of different expertise that members bring to the group. Participants were therefore asked to rate on a five point scale (1-never; 2-rarely; 3-sometimes; 4-regularly; 5-a lot) how much they discussed with fellow members task issues in each of the different domains of expertise represented in the group during the project. For example, if a group has members from three different functional domains, members of that group would rate their discussion with group members on task issues in each of the three domains. Responses were first averaged across all domains for each member, and then averaged across all members to form a group level measure (Internal task process: Mean=3.90, SD=0.46). Intra-class correlations were used to assess whether there is sufficient between-group variation for a group-level analyses (Klein & Kozlowski, 2000). The ICC values were significant for internal task process (ICC_1=0.25, ICC_2=0.65, $p<0.01$)[1], suggesting adequate between-group differentiation that justifies a group-level analysis.

[1] Internal and external task process was both measured by having individuals rate their own interactions with people inside and outside of the group, respectively. They are therefore configurational properties rather than shared group properties (Klein and Kozlowski, 2000). An example of a shared group property would be group efficacy, usually measured as group members' belief in the efficacy of the group as a whole with the referent being the group rather than individual members themselves. While a shared group property requires researchers to demonstrate sufficient within-group agreement as well as between-group variation, a configurational property requires only sufficient between-group variation (Klein and

3.3.2.4 External task process

We know from existing research that group members engage in a variety of external task activities to obtain knowledge and information (Ancona & Caldwell, 1992a). Prior research has focused on different aspects of external task process. One approach focuses on the frequency of general task-related communication with external organizational units (Tushman, 1977). Another approach attempts to capture the different types of knowledge exchanged with external stakeholders (Cummings, 2004). A third approach focuses on a set of concrete learning behaviors directed toward external parties (Wong, 2004). A fourth approach assesses how much external knowledge group members have acquired (Haas, 2006). Absorptive capacity theory suggests that pre-existing expertise should matter most when external task interaction is related to a member's domains of expertise. Therefore, we focus on external task-related interactions related to the functional expertise of the individual group member.

Participants were asked to rate on a five-point scale (1-never; 2-rarely; 3-sometimes; 4-regularly; 5-a lot) how much they discussed topics related to their own domain of expertise during the project with employees outside of the group in the same business unit, employees in other units, and customers. Examples of external task process included getting feedback on a problem, verifying whether certain issues were

---

Kozlowski, 2000). ICC_1 for internal and external task process justifies a group-level analysis. We provide ICC_2 for reference.

also experienced by other units, and learning about how a customer used a particular product. Responses regarding external task process with the three target audiences were first averaged for each person, and then averaged across members to form a group-level measure (External task process: Mean=2.50; SD=0.61). The ICC values were significant for external task process (ICC_1=0.23, ICC_2=0.61, $p<0.01$), suggesting adequate between-group differentiation that justifies a group-level analysis.

3.3.2.5 Group performance

Senior executives rated groups on seven dimensions: quality of teamwork, clarity of problem definition, appropriateness of method, innovativeness of method, quality of impact from results, institutionalization of solution, and clarity of presentation. An analysis of a single event (N=12 judges and N=33 groups) revealed that judges were able to reliably rate overall performance (α= 0.80 across the seven dimensions). However, due to privacy concerns, we were unable to obtain the actual rating based on the seven dimensions for the entire sample. We should note that reliability is built into the measure because the groups were evaluated by different sets of senior executives, thus there was agreement across panels of judges for higher forming groups. Therefore, the performance measure used here is based on the highest level a group reached in the competition. The 174 groups received a ranking of 1 (regional level, N=76), 2 (division level, N=77), or 3 (corporate level, N=21) (Performance: Mean=1.68; SD=0.68).

3.3.2.5 Control variables

We control for group size, project length, task type, company experience, and proportion of group members with prior experience in similar project groups, which previous research suggests may influence group processes and performance. Group leaders indicated the number of members in the group (Group size: Mean=8.19; SD=1.90). Project length (Project length: Mean=15.16; SD=10.65) was measured by the group leader report of the number of months from the start of the project to the end. Because project length was not normally distributed, we used logged number of months in our analysis. Group members reported the number of years they have worked in the company. In keeping with the earlier approach to expertise, which is conceptually related to experience, we calculated the proportion of group members with months of company tenure greater than the sample grand mean (greater than 5 years) to measure company tenure at the group level (Company experience: Mean= 0.63; SD=0.30). Group leaders provided data on the type of task. The groups in the sample worked on four types of tasks, namely process management, product development, service improvement, and manufacturing operations. We dummy-coded project tasks and entered three of the four dummy variables into the regression model (process management was excluded). Group members indicated if they have had prior experience in similar project groups. The proportion of members in each group who

answered yes was computed to form a group level indicator (Prior experience in similar project: Mean=0.33; SD=0.28).

3.4 Analysis and results

Before testing the hypotheses, preliminary analyses were conducted on the main study variables. Table 2 and Table 3 present descriptive statistics of the variables. Table 3 shows correlations among the variables. It should be noted that three of the main variables, depth of expertise, breadth of expertise, and external task process, are significantly and positively correlated with group performance (Depth of expertise: $r=0.17$, $p<0.05$; Breadth of expertise: $r=0.29$, $p<0.01$; External task process: $r=0.38$, $p<0.01$). Internal task process, however, is not significantly correlated with group performance

Table 2: Descriptive statistics of main variables.

Variable	Obs	Mean	Std. Dev.	Min	Max
Externally rated performance	174	1.68	0.68	1	3
Group size	174	8.19	1.9	4	12
Manufacturing task	174	0.25	0.44	0	1
Service task	174	0.25	0.43	0	1
Product task	174	0.25	0.43	0	1
Project length, logged	174	2.51	0.64	1.1	4.17
Company experience	174	0.63	0.3	0	1
Experience in similar project	174	0.33	0.28	0	1
Breadth of expertise	174	3.25	1.65	1	7
Depth of expertise	174	0.66	0.26	0	1
Internal task process	174	3.9	0.46	2.2	5
External task process	174	1.84	0.45	0.94	3.07

Table 3: Correlations among main variables.

		1	2	3	4	5	6	7	8	9	10	11	12
1	Externally rated performance	1											
2	Group size	0.16	1										
3	Manufacturing task	0.04	0.14	1									
4	Service task	-0.05	-0.05	-0.33	1								
5	Product task	0.07	-0.1	-0.33	-0.33	1							
6	Project length, logged	-0.06	-0.08	-0.09	-0.03	0.11	1						
7	Company experience	-0.08	-0.01	-0.1	0.01	0.05	0.16	1					
8	Experience in similar project	0.09	0.06	0.15	0.05	-0.14	0.08	0.19	1				
9	Breadth of expertise	0.29	0.3	-0.02	0.07	-0.06	0.13	0.11	0.05	1			
10	Depth of expertise	0.17	0.06	-0.15	-0.01	0.06	0.05	0.11	-0.03	0.05	1		
11	Internal task process	0.11	-0.1	0.01	-0.09	0.09	-0.08	-0.13	0.13	-0.44	0.27	1	
12	External task process	0.38	-0.03	-0.05	0.1	-0.01	0	-0.06	0.11	0.23	-0.03	0.17	1

Note: $|r| >= 0.13$, $p<0.1$; $|r|>0.15$, $p<0.05$; $|r|>=0.29$, $p<0.01$

Since group performance in this chapter is an ordinal measure with three levels, ordered logistic regression was used to test the hypotheses. Table 4 presents the results. The coefficient estimates indicate the chance of a work group reaching the regional level, division level, or corporate level of the competition. Positive coefficients indicate that the likelihood of a group being observed in a higher level increases as the value of the independent variable increases, and negative coefficients indicate that the likelihood of a group being observed in a higher level decreases as the value of the independent variable increases. The Log Likelihood Ratio (LR) test compares nested models. The LR chi-squared for Model 1, the baseline model in our analysis that includes control variables only, compares Model 1 against a model in which all coefficients are set to zero. The LR chi-squared for later models indicates if the current model fit the data significantly better than a preceding model.

Table 4 (To be continued): Predicting externally rated group performance.

	Dependent variable: Externally rated performance									
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Group size	0.13	0.12	0.05	0.04	0.09	0.10	0.13	0.11	0.12	0.10
	(0.08)	(0.08)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Manufacturing task	-0.22	-0.04	-0.16	0.04	0.18	0.07	-0.06	0.13	-0.14	0.06
	(0.44)	(0.46)	(0.45)	(0.46)	(0.47)	(0.48)	(0.49)	(0.49)	(0.50)	(0.50)
Service task	-0.42	-0.34	-0.49	-0.38	-0.36	-0.50	-0.74	-0.43	-0.74	-0.45
	(0.45)	(0.46)	(0.46)	(0.47)	(0.48)	(0.48)	(0.50)	(0.49)	(0.50)	(0.50)
Production task	0.19	0.22	0.30	0.34	0.44	0.35	0.16	0.47	0.14	0.51
	(0.44)	(0.45)	(0.45)	(0.46)	(0.46)	(0.47)	(0.48)	(0.47)	(0.48)	(0.48)
Project length, logged	-0.19	-0.20	-0.31	-0.32	-0.31	-0.28	-0.32	-0.36	-0.34	-0.37
	(0.24)	(0.25)	(0.25)	(0.25)	(0.26)	(0.26)	(0.27)	(0.26)	(0.27)	(0.27)
Company tenure	-0.40	-0.59	-0.59	-0.77	-0.66	-0.71	-0.65	-0.63	-0.68	-0.87
	(0.52)	(0.54)	(0.53)	(0.54)	(0.56)	(0.57)	(0.57)	(0.57)	(0.57)	(0.59)
Experience in similar project	0.85	0.77	0.91	0.83	0.61	0.62	0.98	0.80	0.92	0.88
	(0.61)	(0.62)	(0.61)	(0.62)	(0.64)	(0.64)	(0.66)	(0.65)	(0.67)	(0.66)
Dept of expertise		1.72***		1.74***	1.73**	1.64**	1.70**	1.60**	2.00**	1.29*
		(0.61)		(0.62)	(0.69)	(0.70)	(0.73)	(0.71)	(0.79)	(0.72)
Breadth of expertise			0.34***	0.34***	0.32**	0.32**	0.30**	0.27**	0.27**	0.28**
			(0.10)	(0.10)	(0.12)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)
Internal task process					0.32	0.41	0.33	0.33	0.35	0.45
					(0.46)	(0.46)	(0.48)	(0.47)	(0.48)	(0.48)
External task process					1.31***	1.36***	1.49***	1.55***	1.54***	1.68***
					(0.42)	(0.43)	(0.44)	(0.44)	(0.44)	(0.45)

Table 5 (Continued): Predicting externally rated group performance.

	Dependent variable: Externally rated performance									
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Depth*breadth						-0.67*	-0.43	-0.81*	-0.41	-0.94**
						(0.40)	(0.47)	(0.42)	(0.47)	(0.43)
Depth*internal							4.22***		4.15***	
							(1.54)		(1.57)	
Breadth*internal							0.45*		0.57**	
							(0.23)		(0.26)	
Depth*breadth*internal									1.01	
									(0.99)	
Depth*external								3.10**		3.94**
								(1.49)		(1.56)
Breadth*external								0.44*		0.60**
								(0.25)		(0.28)
Depth*breadth*external										1.92**
										(0.96)
LR test of nested models				2--4 3--4	4--5	5--6	6--7	6--8	7--9	8--10
LR chi(2)		1—2 9.53***	1—3 4.82**	4.24** 8.96***	11.01***	3.06*	10.33***	6.56**	1.07	4.02**
Observations	174	174	174	174	174	174	174	174	174	174

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Model 1 is the baseline model that includes all control variables. Models 2 to 4 focus on the main effects of depth and breadth of group expertise. Model 2 has depth of expertise only, Model 3 has breadth of expertise only, and Model 4 has both. Either alone or together, depth ($b=1.74$, $p<0.01$) and breadth ($b=0.34$, $p<0.01$) of expertise both have significant positive associations with group performance. The results for depth are consistent with existing research that has documented a positive relationship between depth of group expertise and group performance. As pointed out earlier, the main effect of breadth could be positive, negative or insignificant, contingent upon the extent to which groups can realize its benefits and mitigate its problems (Williams & O'Reilly, 1998). In our data, groups with a greater number of functional domains performed better than those with fewer functional domains. Taken together, these results lend strong support to our expectation that depth and breadth each has unique impact on group performance. Model 6 assesses the interaction between depth and breadth of expertise. Consistent with H1b, the coefficient for the interaction term is negative and significant at 0.1 level ($b=-0.67$, $p<0.1$). As we will see later, Model 10 provides evidence that the negative interaction between depth and breadth may be moderated by the level of external task process.

Model 7 assesses whether the relationships between depth and group performance, and between breadth and group performance, are moderated by internal task process. As predicted by H2a, depth of group expertise interacts positively with

internal task process (b=4.22, p<0.001). Figure 7 plots the relationship between depth of expertise and group performance across high and low levels of internal task process. When internal task process is high, increases in depth of expertise are accompanied by rapid increases in group performance. In contrast, when internal task process is low, increases in depth of expertise are accompanied by little change in group performance. As predicted by H2b, breadth of group expertise also interacts positively with internal task process (p=0.45, p<0.1). Figure 8 plots the interactions between breadth and internal process. The upward slop for breadth of expertise is clearly steeper when internal task process is high rather than low. Overall, the results are consistent with our argument that a higher level of internal task process helps groups to derive more benefit from both depth and breadth of expertise.

Model 8 assesses how external task process affects the relationship between depth of expertise and group performance, and between breadth of expertise and group performance. Consistent with H3a, the interaction between depth of expertise and external task process is significant and positive (b=3.10, p<0.05). Figure 9 shows that depth of expertise has a steeper upward slope when external task process is higher rather than lower. Providing moderate support to H3b, the interaction between breadth of expertise and external task process is positive and significant at 0.1 level (b=0.44, p<0.1). Figure 10 shows that breadth of group expertise has a much steeper upward slope when external task process is higher rather than lower. Overall, there is strong

evidence that a higher level of external task process can help groups realize the benefits associated with depth and breadth of expertise.

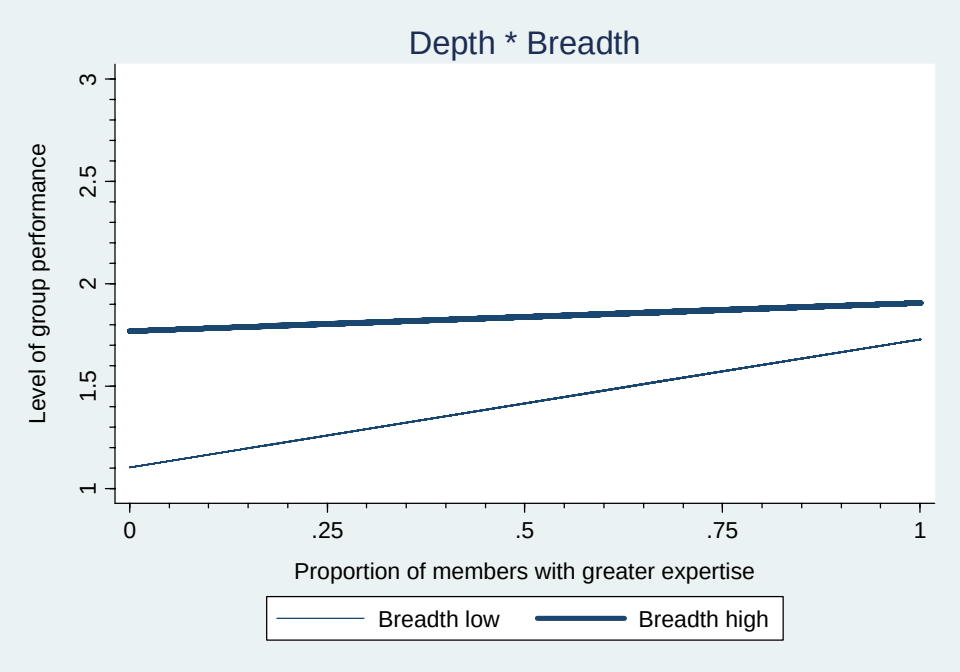


Figure 6: Interaction between depth and breadth in predicting group performance.

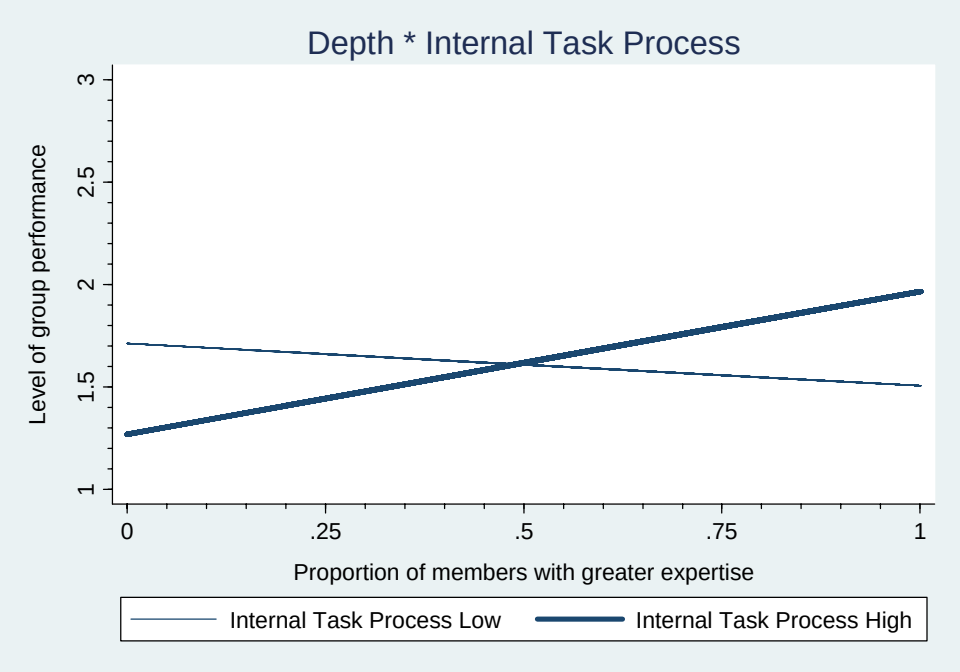


Figure 7: Interaction between depth and internal task process in predicting group performance.

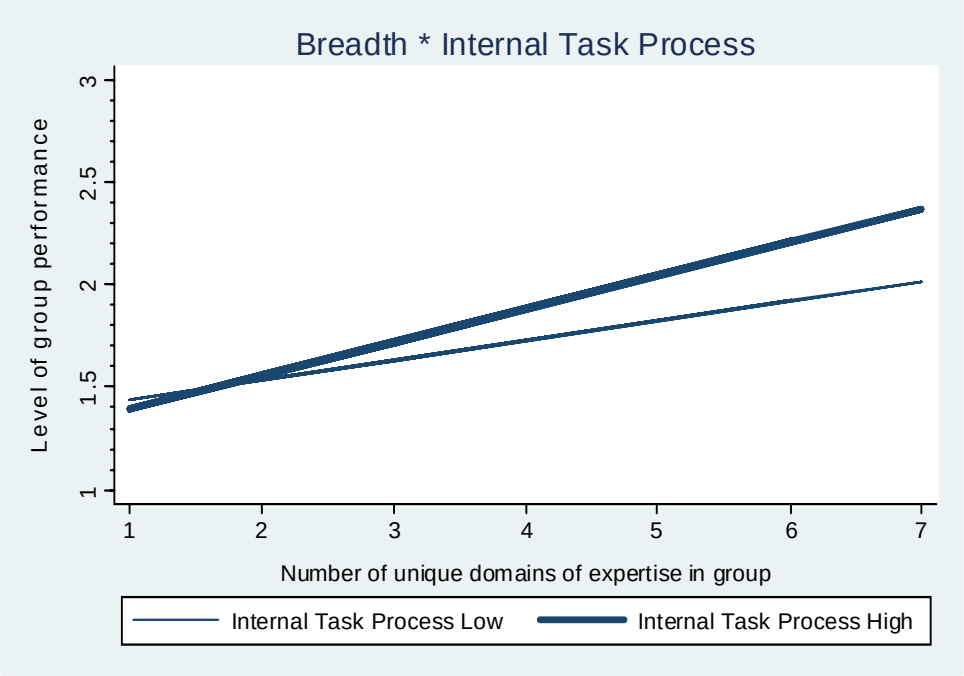


Figure 8: Interaction between breadth and internal task process in predicting group performance.

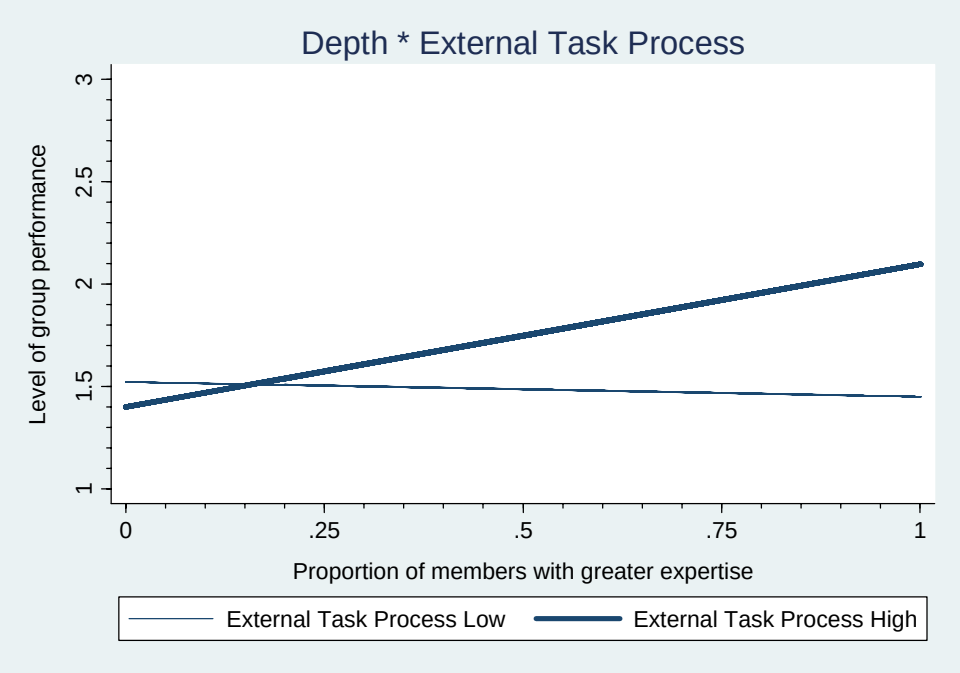


Figure 9: Interaction between depth and external task process in predicting group performance.

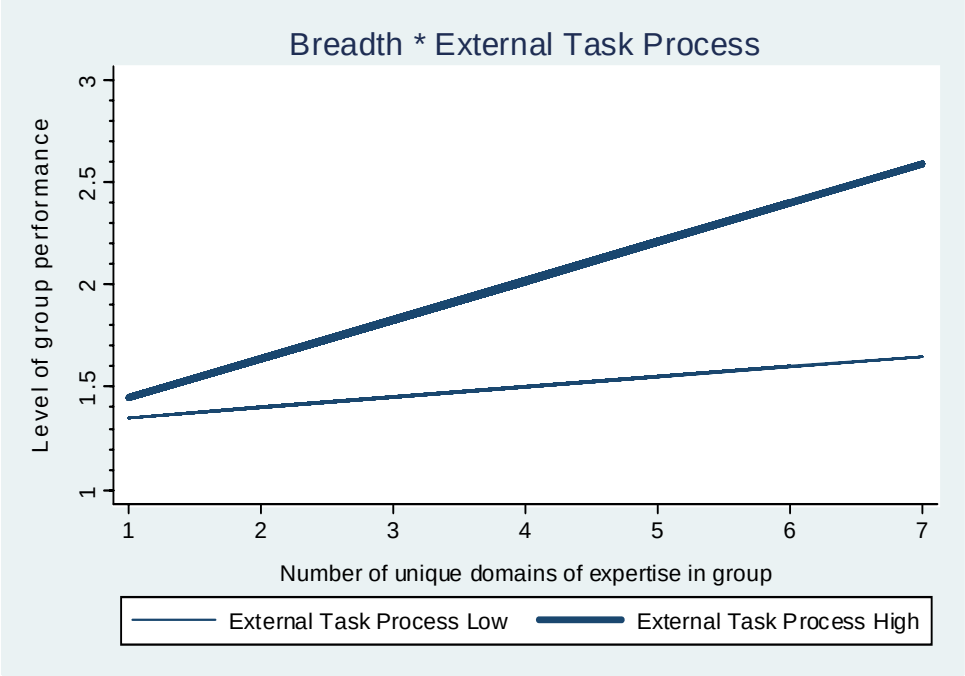
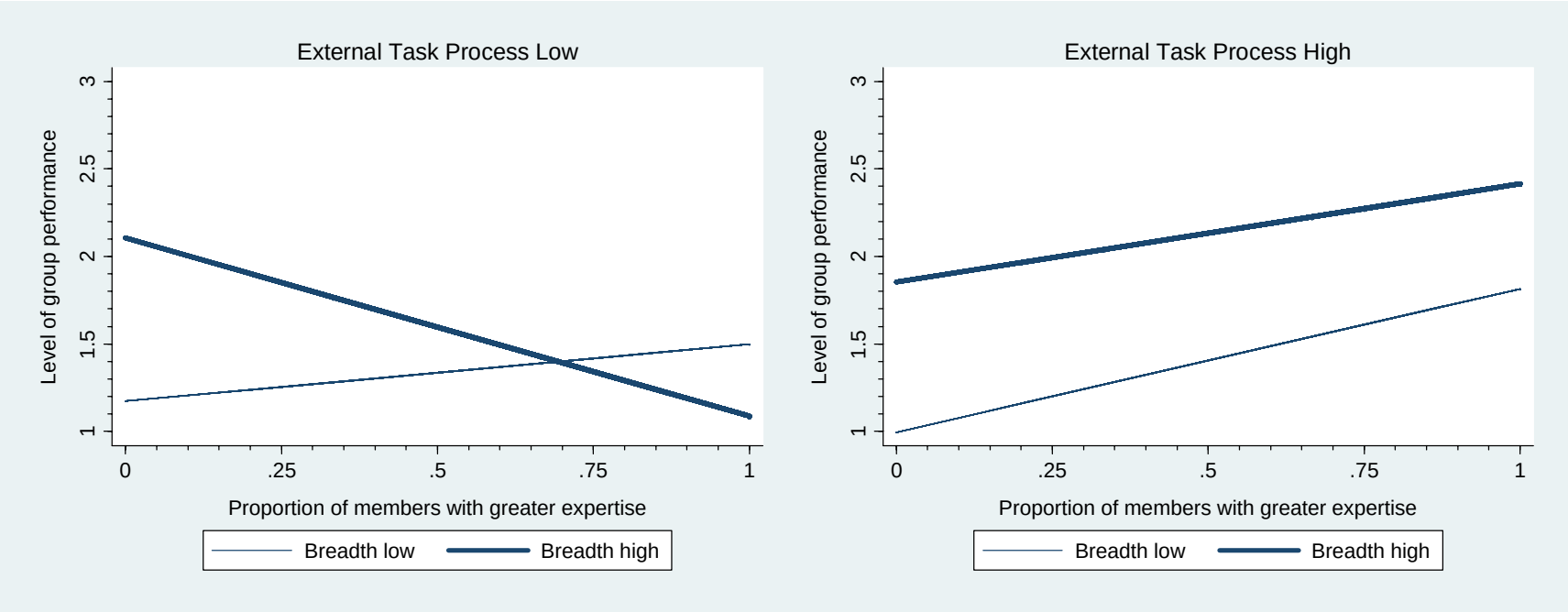


Figure 10: Interaction between breadth and external task process in predicting group performance.

Finally, Model 9 and Model 10 explore the three-way interactions between the two dimensions of group expertise and internal and external task process. The coefficient for the three-way interaction between depth, breadth, and internal task process in Model 9 is not significant. However, the three-way interaction between depth, breadth and external task process in Model 10 is marginally significant ($b=1.92$, $p<0.05$). We plot the interaction between depth and breadth across high and low levels of external task process in Figure 11 to facilitate interpretation. The right-hand side panel of Figure 11 shows that the slope of depth of group expertise in predicting group performance is about the same across high and low levels of breadth when there is a high level of external task process. In other words, depth and breadth of expertise do not seem to interact in impacting group performance when there is a high level of external task process. However, in the left-hand side panel in Figure 11, when external task process is low, there is a negative interaction between depth and breadth. Specifically, when breadth of expertise is low, the slope of depth of expertise is upward, suggesting a positive association with group performance; in contrast, when breadth of expertise is high, the slope goes downward, suggesting a negative association with group performance. Thus, there is initial evidence that external task process moderates the interaction between depth and breadth of group expertise such that the negative interaction becomes weaker in groups with a high level of external task process.



Note: To ease interpretation of the direction and magnitude of effects, the plots were all constructed using OLS regression. High depth, breadth, internal task process, and external task process were set at one standard deviation above the mean while low depth, breadth, internal task process, and external task process were set at one standard deviation below the mean, and all other variables were held constant at their means.

Figure 11: Interaction between depth and breadth across low and high level of external task process in predicting group performance.

3.4 Discussion

Contemporary organizations frequently resort to groups that bring together people with diverse backgrounds and expertise to complete complex knowledge-intensive tasks. A challenge such groups confront is how to translate member expertise into group decisions and task solutions to achieve optimal performance. Understanding factors that can promote a group's ability to derive benefits from member expertise has been a prevalent research focus in the literature on groups. This chapter extends absorptive capacity theory to the group level of analysis in order to understand the different ways that group expertise can be leveraged to promote group performance. Given that the preponderance of group research has focused on either depth or breadth of expertise, the study in this chapter is noteworthy in bringing together both depth and breadth of group expertise under one integrative framework. Empirically, our results point to the interrelation between the different dimensions of expertise and the different aspects of group process in shaping group performance. Theoretically, our findings have implications for absorptive capacity theory as it is among the first to our knowledge to test hypotheses derived directly from absorptive capacity theory at the group level of analysis.

3.4.1 Relationship between expertise, task process, and group performance

The results reveal several important relationships among expertise, task process, and group performance. We consider group expertise as having two dimensions: depth and breadth. A few lines of research have investigated the composition of expertise in groups. However, they have tended to focus on either depth or breadth. Due to the increasing prevalence of cross-functional groups in organizations, both depth and breadth have become important features of work groups. Results in this chapter suggest that depth and breadth of expertise each makes a unique contribution to group performance. In addition, our work contributes to current scholarship aimed at understanding when and how expertise matters to groups (e.g. Simmons, Pelled & Smith, 1999; Van Der Vegt & Bunderson, 2005). We found that both depth and breadth of expertise positively interact with both internal and external task process. The findings are consistent with our argument that expertise serves as a critical resource to draw upon for making decisions and solving problems, as well as an important basis for acquiring task-relevant knowledge. Internal and external task process allow groups to leverage both aspects of expertise: Internal task process facilitates the translation of expertise into better performance, while external task process taps into the learning advantage associated with greater depth and breadth of expertise.

Beyond the main effects of expertise, and the two-way interaction between expertise and task process, the marginally significant three-way interaction between depth, breadth, and external task process provides suggestive evidence for a negative

interaction between depth and breadth of expertise when groups have a low level of external task process. Most intriguing is that, when external task process is low, the sign of the association between depth and group performance switches from positive to negative when breadth of expertise moves from low to high. There are likely two things going on when external task process is low and breadth of expertise is high. First, groups are unable to leverage either the learning advantage or the superior knowledge associated with depth of expertise. Second, on top of the difficulty in knowledge sharing associated with breadth of expertise, depth may introduce additional obstacles to communication across functional boundaries. Failure to realize the benefit of depth of expertise alone cannot explain the negative association between depth of expertise and group performance. In short, while existing studies on depth of expertise have tended to focus on the benefits, our study provides suggestive evidence that there may be situations when depth can hamper group performance (see Table 5 for a summary of how expertise, task process, and absorptive capacity relate to one another).

Table 6: Expertise, task process, and absorptive capacity.

	Inward-looking absorptive capacity	Outward-looking absorptive capacity
Pre-existing knowledge	**Depth of expertise (when breadth is high)** Increases obstacles for knowledge sharing and integration across different functional domains as a result of the "curse of expertise"; experts may have stronger opinions and higher confidence, making integration across different domains more difficult **Breadth of expertise** Increases differences in knowledge, language, and orientations, making knowledge sharing and integration more difficult	**Depth of expertise** Expedites the comprehension and encoding of new expertise or more advanced knowledge in a specific domain **Breadth of expertise** Allows access to more non-redundant sources of information and knowledge; increases the chance that new knowledge is related to pre-existing expertise, negligible
Task process	**Internal task process** Helps realize the potential influence of expertise on group performance by translating depth and breadth of expertise to high quality decisions or problem solutions	**External task process** Helps realize the potential benefits of expertise for group performance by tapping into the learning advantage of depth and breadth of expertise

The result that depth and breadth do not interact when groups engage in a high level of external task process suggests that the difficulty a group encounters in utilizing internal expertise when breadth is high might have been counter-balanced when other factors exist that can help realize the potential benefits of depth of expertise. In our study, a high level of external task process appears to be critical in leveraging the learning benefits associated with depth of expertise to offset the performance loss due to difficulty in utilizing superior knowledge and problem solving skills associated with

depth of expertise. This finding should be particularly valuable to leaders who design and manage groups, as they can prepare for situations in which depth of expertise might create problems for groups.

Although we find it theoretically reasonable to expect that internal task process may also moderate the interaction between breadth and depth of expertise, because a higher level of internal task process may help groups resolve problems in knowledge sharing and integration, the three-way interaction between internal task process and depth and breadth was not significant. Internal task process has more restricted variation than external task process, and given that interaction effects are already difficult to detect in field settings, restricted variation may have resulted in an underestimation of its effect. It could also be that our measure of internal task process focuses on the amount rather than the quality of interaction. While a certain amount of internal task process may be a necessary condition for groups to address problems in utilizing expertise when depth and breadth are high, it is not guaranteed. A measure that taps the quality of internal task process may help refine these results.

3.4.2 Implications for absorptive capacity theory

The results in this chapter also have implications for absorptive capacity theory. Our results lend support to the hypotheses regarding the interplay between expertise and task processes derived from absorptive capacity theory. In addition, the offers some refinement to the theory by providing a more nuanced understanding of absorptive

capacity. One refinement is theorizing about the role that different dimensions of expertise play in shaping outward-looking absorptive capacity. While existing research has largely focused on the role of breadth, this chapter provides evidence that depth of expertise also matters for external knowledge acquisition. Another refinement is suggested by the finding that external task process moderates the interaction between depth and breadth. This finding raises the possibility that benefits associated with expertise acquisition may offset performance losses due to ineffective knowledge sharing and integration. Thus, outward-looking and inward-looking absorptive capacity may interactively affect group performance.

While this chapter provides some initial evidence that outward-looking absorptive capacity may make up for inadequacy in inward-looking absorptive capacity to a certain extent, the results were marginally significant. Future research can further probe into the possible interplay between outward-looking and inward-looking absorptive capacity, and explore the external conditions and organizational contexts that may shape this dynamic. Finally, because processes such as communication not only affect learning within groups, but also constitutes the micro-dynamics of learning within the broader organization, our analyses at the group level provide a small-scale analog to dynamics surrounding organizational absorptive capacity (Argote, 1999).

3.4.3 Limitations

Empirically, the results in this chapter are noteworthy in its relatively large sample of 174 groups in a field setting that improves external validity, and in its use of independent variables and a dependent variable that come from different sources. But the data are not without their limitations, and our findings should be interpreted and generalized with caution. In particular, the data are cross-sectional, thus they render causal interpretation difficult. Additionally, the groups under investigation worked on complex and knowledge-intensive tasks such as improving a business process and developing a new product. The performance gains from external task process by groups with high depth and breadth of expertise may be particularly large when groups are confronted with these kinds of tasks. As complex tasks are usually not well-understood, have few set procedures, and involve a high degree of ambiguity, groups need to bring multiple perspectives to bear and to collect information from diverse sources to accurately assess the situation, define the problem, and devise task strategies (Jehn, Northcraft, & Neale, 1999). As a result, the findings here may not necessarily apply to groups working on simple routine tasks.

The sample in this chapter is also biased in favor of relatively more successful groups, because we were only able to obtain data on groups that at least reached the regional level of competition. We do not have data on the unselected groups at the regional sites, and have no way to assess if the unselected groups were systematically different from the groups in the sample. The findings in this chapter would be

conservative if the unselected groups were not systematically different, because the current sample limits the range of the data. However, if the unselected low performing groups are distinctly different from those in the sample, the findings of this may not be generalizable to low-performing groups.

Another important limitation is that the data in this were collected an average of six months after project completion and by that time group members knew whether or not they had advanced in the competition. Even though group members were *not* told why they did not advance, awareness of advancing or not may have affected group members' recall of their expertise and task processes. For example, attribution theory has demonstrated that individuals tend to attribute the causes of favorable outcomes to internal factors and unfavorable ones to external events (Bradley, 1977). Individuals in groups that reached a higher level of competition may therefore assign credit mainly to factors such as the internal task process while considering the external task process to be less important. However, self-serving biases are unlikely to be a factor in this study. First, high-performing groups in the study reported higher levels of external task process than low-performing groups, which is the opposite of what attribution theory would have predicted. In addition, we asked behavior-based questions about how often participants discussed their own area of expertise with external parties rather than how important people thought such discussions were to group performance. Reports of behaviors are less prone to bias than reports of perception. It is unlikely that the findings

reflect lay theories of group performance rather than what was actually happening, because our hypotheses and findings concern complex interactions that involve three or four variables, rather than simple relationships between two variables.

3.4.4 Directions for future studies

The results in this chapter suggest a number of directions for future research. Because we investigated how task process moderates the association between expertise and group performance, one next step is to investigate if social processes, such as interpersonal conflict, trust, and social integration affect the extent to which groups can derive benefits from expertise. Theoretically, one would expect that troubled social processes may interfere with the utilization of member expertise, as interpersonal frictions may consume valuable time and cognitive resources that could have been used on task issues. Future research can investigate the potential interaction between expertise and social processes in predicting group performance.

It would also be useful to further investigate the interplay between different dimensions of expertise in groups. An implicit assumption of our discussion is that experts in a particular domain tend to have limited knowledge of other functional domains. This assumption is reasonable in many situations, given that people have limited time and attention. However, we are aware that some people can be very good at what they are doing, and at the same time can have broad experience and knowledge across a number of functional domains. Thus, there seems to be at least one more

dimension of expertise in groups: within-person breadth of expertise, or the breadth of experience and expertise within individual members. Groups composed of individuals with greater within-person breadth of expertise may have a higher level of shared knowledge, and this overlap in knowledge could facilitate communication among members from different functional domains (Bunderson & Sutcliffe, 2002). Future research can investigate if and how within-person breadth of expertise may influence a group's ability to utilize expertise.

3.4.5 Conclusion

Existing research on both depth and breadth of expertise in groups has suggested that the extent to which expertise can have a positive impact on groups depends on factors that affect a group's ability to leverage the potential benefits of expertise. Building on this notion, the study reported in this chapter adapted absorptive capacity theory to examine how internal and external task process interacts with depth and breadth of group expertise. The findings suggest that depth and breadth of expertise each make a unique contribution to group performance, and that both depth and breadth of expertise have more positive associations with group performance when groups experience higher levels of internal and external task process. These results lend strong support to our theoretical framework. The value of expertise to groups is two-fold: Expertise is not only a critical resource to draw upon for solving problems and making decisions, but is also the basis for effective acquisition of new knowledge. Thus,

both internal and external task process enhance a groups' ability to derive benefits from expertise, as internal task process facilitates the translation of expertise into high quality decisions and task solutions, and external task process leverages the learning benefits associated with depth and breadth of expertise. Our exploratory analysis of the three-way interaction suggests that there are situations when depth can negatively influence group performance, and that leveraging learning advantages associated with expertise may make up for performance loss due to the inability to utilize expertise.

4. A conceptual model of variety of experience: Implications for individuals and groups

Experience, as an important source of knowledge and skills, has attracted substantial attention among organizational researchers (Argote, 1999; Huber, 1991; Tesluk & Jacobs, 1998). The knowledge and capability developed from experience can be an important competitive advantage for individuals as well as collectives. Research at individual (Ellis, 1965; Mazur & Hastie, 1978), group (Argote, 1993; Argote, Insko, Yovetich & Romero, 1995) and organizational levels (Darr, Argote & Epple, 1995; Hatch & Mowery, 1998) has consistently shown a positive association between prior experience in a task, product, or job assignment, and subsequent performance. In much of the existing research on experience, researchers have focused on the amount of experience such as years of fulltime working experience, tenure in a job or company, or number of times completing a task.

Recently, however, researchers have begun to take note of the limitations of this focus. Noting the common conception of work experience in quantitative terms, Tesluk and Jacobs (1998) lament the inadequacy of such conceptualization in capturing the richer qualitative aspect of experience such as variety of experience. Indeed, with the same amount of fulltime working experience or tenure in a particular company, people can experience qualitatively different social interactions, task challenges, and learning opportunities that are not reflected by years of experience. Schilling and colleagues

(2003) also observed that the current conceptualization of experience as repetition of the same task, particularly in the learning curve literature, prematurely rules out the possibility that variation of task experience may have substantial implications for organizational learning and task performance. The limited study of variety of experience prevents researchers from fully understanding learning from experience. This limitation seems all the more noteworthy considering that today's workers change jobs and employers frequently, and that horizontal movement across different jobs has become increasingly important for career development (Beyer & Hannah, 2002; Authur & Rousseau, 1996).

This chapter adopts the view that experience should be conceptualized in complex multidimensional terms (Tesluk & Jacobs, 1998), and aims to contribute to research on experience by focusing on the understudied dimension of variety of experience. Toward this goal, we define the construct *variety of experience* as the extent to which individuals have had experience in different domains of knowledge. Our conceptualization of variety of experience considers experience obtained through direct involvement and via association with others, and differentiates between-job variety and within-job variety. Building on existing research on experience, we discuss the implications of variety of experience for individual learning, and how variety of experience, when aggregated to the group level, may enable groups to derive greater benefits from member expertise. We offer propositions that can be further investigated

and tested, and conclude by briefly discussing the theoretical and practical implication of research on variety of prior experience.

It is important to be clear that the unit of analysis in our discussion includes both the individual and the group level of analysis. The focal construct, variety of experience, is first defined at the individual level, as the extent to which an individual has experience in different functional areas either through direct involvement or via network association with people who are from diverse functional areas. Variety of experience for groups is defined as the extent to which groups are composed to individuals with a high level of variety of experience. For example, individual A with experience in three different functional areas will have greater variety of experience than individual B with experience in only a single functional area. If we categorize individual A as having high variety of experience while individual B as having low variety of experience, then, a group of two As and two Bs will have greater variety of experience than a group of one A and three Bs. Therefore, variety of experience for groups refer to experience accrued by individual members but aggregated to the group level, rather than experience accrued by the group as a whole.

4.1 Brief review of research on experience

Research from a number of different disciplines has suggested that what we have experienced has a lasting impact on our knowledge, perspectives and attitudes. Organizational research has highlighted experience as an important source of individual

and organizational learning (Argote, 1999; Huber, 1991; Levinthal & March, 1993). Literature on learning curves has documented that the time individuals, groups or organizations need to perform a task or create a product, and the number of errors they made decreased at a decreasing rate as experience was gained with the task (e.g. individual: Ellis, 1965; Mazur, 1978; group: Leavitt,1951; Guetzkow & Somin, 1955; and organization: Epple, Argote & Devadas, 1991). Experience improves performance because it is critical in acquiring task knowledge and skills. Researchers of career development and human resources have been interested in employee work experience such as tenure in the company or in the job. Work experience is thought to be critical to the development of work-based knowledge, skills, values and attitudes, and consequently affect subsequent work performance (Tesluck & Jacobs, 1998; Quinones, Ford, Teachout, 1995). For example, Schmidt, Hunter, and Outerbridge (1986) reported that job experience directly impacts on job knowledge which partially mediates its effect on job performance. Borman, Hanson, Oppler, Pulakos and White (1993) reported that prior supervisory experience affects skills in dealing with common supervisory situations. A common feature of these studies is that they all focus on the quantitative aspect of experience. The learning curve literature has defined experience as the number of times a task has been performed or a product has been created (Ellis, 1965; Epple, Argote & Devadas, 1991). Research on career development has defined experience as

years of fulltime working experience or tenure in a job or a company (Tesluck & Jacobs, 1998).

The one-dimensional conceptualization of experience has recently been called into question. Research on career development and human resources has illustrated that time-based conception such as tenure in company or number of years worked, and amount-based measures, such as the number of times a task is performed, fail to account for the qualitative aspect of experience, such as the variety of knowledge and skills exposed and the opportunities and challenges experienced (Quinones, Ford & Teachout, 1995; Tesluck & Jacobs, 1998). Research on learning curves has also questioned the assumption that learning is maximized through specialization, an assumption underlying the dominant conception of experience as repeated performance of the same task (Schilling, Vidal, Ployhart & Marangoni, 2003).

Although conceptual and empirical work in this direction is still very limited, the idea that variety of experience may matter is grounded in organizational research. At the individual level, Weick (1989) observed that organizational issues are often so complicated that they usually require a broad range of knowledge and frames of reference to accurately assess the situations and devise appropriate action. Bartnek and colleagues (1983) also suggested that experience in situations that provide the challenge of and exposure to multiple perspectives may help develop the capability to use and integrate multiple perspectives to deal with complex problems. Empirically, Campion,

Cheraskin and Stevens (1994) reported some suggestive evidence that rotation, which contributes to variety of experience, is associated with employee perception of increase in business knowledge and administrative skills. Goodwin and Ziegler (1998) reported that the number of full-time jobs participants have held is positively associated with the number of unique responses to a problem solving task. Beyer and Hannah's (2002) qualitative study suggests that employees who have worked in a number of different companies or different functional areas can adjust to a new job with greater ease.

Theoretical insights and empirical findings have also linked variety of prior experience to processes and outcomes in groups. Research on product development has long posited that individuals with experience in a number of different functional areas may be critical in facilitating intra-organizational communication and collaboration across functional boundaries (Griffin & Hauser, 1996). Research on learning also emphasizes that individuals with experience in multiple job functions play critical roles in facilitating the externalization and integration of individual knowledge through group interactive processes to contribute to new knowledge creation of the collective (Nonaka, 1994). Empirically, Bunderson and Sutcliff (2002), in a study of divisional management groups, reported that experience in multiple functional areas (referred to as intra-person functional diversity by the authors) by team members increases group performance, and this relationship is mediated by the extent to which knowledge and information are communicated and made known to all group members. Schilling and

colleagues (2003) studied learning of computer games in a lab setting and found that groups with experience in both the focal task and a related but different task learn faster than groups with experience in the focal task only.

A review of existing studies suggests that more theoretical and empirical work along this line is both necessary and promising. How to conceptualize the breadth or variation in prior work experience needs further consideration. The potential implications for individuals and groups are not yet fully understood. The conditions under which variety of prior experience may or may not matter also need attention. It is the objective of this chapter to further our knowledge about the above three issues. Building upon existing literature related to experience, this chapter will discuss the conceptualization of variety of prior experience, develop a theoretical model and its implications for individuals and groups, and explore factors that may delineate conditions that moderate the impact of variety of individual prior experience.

4.2 Conceptualizing variety of prior experience

The few existing studies on the breadth or variation in prior experience focused on different elements that expand the variety of individual experience. Beyer and Hannah (2002) looked at the number of organizations, functional areas and different jobs in which individuals have worked, while Goodwin and Ziegler (1998) focused on the number of different fulltime jobs individuals have ever held. Bunderson and Sutcliffe

(2002) examined diversity of functional experience, while Haas (2006a) investigated the experience working in different countries and cultures.

Some elements of experience studied are more common to work settings than others; and some are more precise than others in capturing different domains of expertise and knowledge. Variety of country or cultural experience may be particularly relevant to people working in international settings, whereas variety of experience defined in terms of knowledge boundaries such as functional area is in most organizational settings. While the boundary of knowledge and task activities may arise from other factors such as product groups and geographic locations, functional areas are most commonly used to distinguish domains of specialized expertise and task responsibilities. Alternatives such as different organizations worked in (Beyer & Hannah, 2002) and different jobs ever held (Campion, Cheraskin & Stevens, 1994) also capture diversity in experience to some extent, but moving from one organization to another or from one job to another does not necessarily involve changes in the nature of task responsibilities or the knowledge and skills used. In this chapter, for the sake of clarity and precision, we focus on variety of prior experience in terms of specialized knowledge domains such as functional areas (see Table 6 for a comparison between alternative conceptions of experience).

Table 7: Summary of different conceptions of experience

	Conception of experience	Example	Description
Quantitative aspect of experience	Time-based	Number of years worked fulltime	• N years in one area or one organization is treated the same as N years split into three different areas or organizations
	Amount-based	Number of times a task is performed	• Repetition of the same task
Variety of experience	Defined in terms of different institutional contexts	Number of countries, industries or organizations worked	• Changes in employer organization may not involve changes in functional roles or task responsibilities. • Experience in a single organization may involve changes in functional area.
	Defined in terms of specialized knowledge domain	Number of different functional areas worked in	• Directly captures experience with different functional expertise

It must be noted that that this conception of variety of prior experience does not imply any specific list of areas of expertise. While all organizations have areas critical to its operation, such as accounting, human resources, and sales, they vary in terms of the areas of expertise directly related to its product or services. In addition, the granularity of functional categories may differ across organizations or hierarchical levels. For

example, Bechky (2003) uses engineers, technicians and assemblers to classify research participants, which is much more fine-grained than Ancona and Caldwell's (1992a) classification of engineering/R&D, manufacturing, and marketing. While Bechky's (2003) classification makes sense for her study of technical specialists in the workshop of a semiconductor equipment manufacturing company, Ancona and Caldwell's (1992a) classification is common in research on product development groups. In addition, compared with managers and executives at higher levels of the organizational hierarchy, employees and work groups at lower levels are likely to use more narrowly specialized knowledge and be in charge of more narrowly specialized tasks, thus need to use functional categories that are more fine-grained.

4.2.1 Direct involvement and vicarious experience

The few studies on variety of prior experience have all focused on experience acquired through direct involvement in different domains of knowledge and skills, without attending to "indirect" experience acquired through interaction with other people (Beyer & Hannah, 2002; Bunderson & Sutcliff, 2002; Campion, Cheraskin & Stevens, 1994). For example, both Joe and Jill are working in the manufacturing department. While Joe's job is largely internal coordination, Jill's job requires her to coordinate with people in and outside of manufacturing department, such as the suppliers and the marketing specialists. The opportunity to work with people from other departments exposes Jill to a greater variety of information and knowledge.

Organizational learning and social network literatures suggest that people can acquire information and knowledge through direct involvement as well as via interactions with others who have such experience (Huber, 1991; Levitt & March, 1988; Cross & Sproull, 2004). As is the case with learning from direct involvement, the knowledge obtained from others also become an integral part of one's current stock of knowledge and capabilities to solve problems and pursue further learning.

Direct involvement in a functional area usually entails association with other people doing the same thing. One important outcome of direct involvement in different domain of expertise is the opportunity to develop work and friendship ties in those areas, which one can later seek out for task advice and emotional support (Campion, Cheraskin & Stevens, 1994). However, ties to people of different functional background can arise from sources other than direct involvement. Formal job responsibility may require an individual to collaborate or coordinate with colleagues from other areas. Similarity in other aspects, such as gender, race and national background may bring people with different functional backgrounds together. Office layout may also affect the extent people get the opportunity to interact with others from different functional areas.

In addition, direct involvement and vicarious learning may each has unique contribution toward expanding an individual's variety of experience. Direct involvement may be limited in terms of the variety it can achieve, because direct involvement in a certain domain is often very time-consuming and people have limited

time and attention. Vicarious experience through contacts, however, can increase the amount of experience one can draw upon and expands the breadth of exposition to an extent direct involvement cannot (Levitt and March, 1988). Admittedly, exposure through vicarious experience might be much shallower than through direct involvement. It has also been suggested that direct involvement is more effective than vicarious experience in acquiring tacit knowledge, while vicarious experience is sufficient for more explicit knowledge (Nonaka, 1994; Pisano, 1994).

Therefore, to fully capture the breadth and variety of experience with different domain of knowledge and task, we believe, one needs to consider both (a) the diversity of area of expertise in which one has direct involvement in the past and (b) the diversity of expertise among one's prior network contacts. Focusing on only one of them would miss an important source of variety in prior experience.

An implicit assumption of the above argument regarding vicarious experience is that the focal person and his or her contacts engage in knowledge sharing. The amount and quality of knowledge sharing between network contacts depend on the nature and quality of network ties. Advice and workflow networks are probably more likely than socializing networks to channel work-related information and knowledge, although the latter can also be used for task-related information sharing. Stronger ties may be associated with a greater amount and higher quality knowledge sharing and are more likely to have an influence on the focal person's knowledge and perceptions (Hansen,

1999; Uzzi, 1997). Because our emphasis is on the lasting impact of prior network contacts, it would be more appropriate to focus on prior networks that are the most likely to channel work-related knowledge sharing and to exert an influence on the focal person's knowledge and perspective. These would include advice networks, such as contacts with whom the focal person usually went to for work-related information and advice, and workflow networks, such as people with whom the focal person had to collaborate or coordinate.

4.2.2 Between-job and within-job variety of experience

Variety of prior experience may arise because an individual switched among jobs that required different functional expertise (e.g. switch from a software engineer to a marketing manager). It may also arise from working on a job that provides the opportunity to learn and use expertise from different domains or to work with people of different functional background. Consider the following extreme example: Dave has worked for 15 years and taken three different jobs, each requiring him to learn and use expertise from a different functional area. But for each job, his responsibility only involved knowledge and skills from that single functional area. People working with him were also largely from the same functional area as he was. He did not need to talk with people outside of his group to get his work done. Now consider Mike, who has also worked for 15 years and taken three different jobs. The first two jobs were similar. They both required Mike to be good at one area, and to have a reasonable amount of

understanding of a second area. In addition, both jobs involved a fair amount of working together with a few experts from the second area. The third job, however, not only needed his expertise from prior jobs, but also required him to develop expertise in a third area.

The total amount of variety in terms of the number of different jobs held and different functional areas worked are quite similar for Dave and Mike. However, variety in Dave's experience came largely from between jobs. Within a particular job, Dave actually had homogeneous task responsibilities and work contacts. In contrast, variety in Mike's experience came more from within a job than between jobs, resulting from tasks that required him to mobilize knowledge and perspectives from multiple areas, and to collaborate with people from different areas. Thus, while both between-job and within-job variety of work experience may be associated with the accumulation of domain specific knowledge and skills, within-job may be associated with greater learning in terms of knowledge and skills important for boundary-crossing situations.

4.2.3 Antecedents of variety of prior experience

Both contextual and individual factors may shape the accumulation of experience. Contextual factors may determine the external opportunities and need for, or impose constraint on, acquiring diverse prior experience. Such factors range from macro economic trends, such as the increasingly competitive business environment, to immediate situational factors such as job characteristics. For example, organizational

restructuring and downsizing may reduce the length of time that individuals spend in a particular job, organization or career, which means that individuals tend to work in a greater number of different jobs and companies. Characteristics of an organization matter. Organizations adopting a matrix structure or team-oriented work are able to place employees from different functional areas or organizational units in direct contact. A flatter hierarchy and decentralized decision making structure, compared with organizations with a deeper hierarchy and centralized decision making, encourage more horizontal interaction, thus providing employees more opportunity to communicate and work with people from different functional areas. Employee development programs such as rotation and cross-training may also provide opportunities for acquiring experience in multiple functional areas and broaden one's understanding of the organization and the business as a whole (Bartunek, Gordon & Weathersby, 1983; Campion, Cheraskin & Stevens, 1994).

More immediate situational factors such as characteristics of formal positions may affect the opportunity and incentive to learn the knowledge and skills from multiple domains and to work with people from different areas. For example, tasks in the middle of a workflow provide more opportunity and impose greater need to learn about upstream and downstream areas while those at the two ends have more limited reach (Bechky, 2003). Workplace layout determines the extent to which employees from different functional areas are physically close, and consequently affects the opportunity

to acquire variety in experience, as physical proximity greatly enhance communication (Allen, 1977; Bochner, Duncan, Kennedy & Orr, 1976).

Individual factors may also influence the variety in experience that people accumulate. Given the same environmental opportunity, individuals may vary in the extent to which they take full advantage of the opportunity. Individuals with higher levels of self-efficacy beliefs and motivation to learn are more likely to pursue training opportunities to update their skills (Hill, Smith, & Mann, 1987; Noe & Wilk, 1993). People with a higher score on the Openness to Experience facet of the Big Five Personality Inventory may have a broader range of interest and entertain greater curiosity about different ideas (McCrae, 1996; George & Zhou, 2001). People high on self-monitoring are more tuned to situational cues and are more inclined to behave in a way that suits the interaction partner or the situation (Mehra, Kilduff & Brass, 2001). When placed in an environment with the opportunity to learn new things and to interact with different people, individuals who are more open to diverse experience or have a high score on self-monitoring may accumulate more diverse direct and indirect experience. Individuals not only respond to their work environment, but also can shape the environment in which they find themselves, as they may actively select into an environment that suits their interests and preferences better.

Therefore, we consider prior experience as the outcome of a complex interplay between external environment and individual factors. While the antecedents of

experience is worthy of further investigation, the major objective of this chapter is to take variety of prior experience as given and explore its implications for both individuals and groups.

4.3 Implications for individuals

The importance of work experience is supported by abundant research demonstrating its implications for the development of individual capability such as knowledge and skills (e.g. Schmitde, Hunter & Outerbridge, 1986), motivation (e.g. McCauley, Ruderman, Ohlott & Morrow, 1994) and work-related attitudes and values (e.g. Kohn & Schooler, 1982) that factor into outcomes valued by organizations, such as performance. We believe that the immediate implications of variety of prior experience for individuals rest mainly in the following three areas: knowledge, boundary-crossing capability, and attitudes towards and perceptions about people from different areas. We will also discuss its implications for individual performance.

4.3.1 Variety of prior experience and knowledge

We consider two types of knowledge, namely, domain specific knowledge and integrated understanding. Domain specific knowledge includes both technical expertise and contextual knowledge in a particular domain. By technical expertise, we mean specialized knowledge and skills in a specific area of expertise. By contextual knowledge, we refer to understanding of the technical knowledge and skills, and the task and social context of a particular domain. People with contextual knowledge of an

area do not necessarily have the technical expertise in that domain, but understand what skills people in the area have, what domains they are knowledgeable in, their perspective on issues, and the way things operate. Breadth of technical expertise and contextual knowledge about different functional areas constitutes the basis for the second type of knowledge: integrated understanding (Parker & Axtell, 2001).

4.3.1.1 Variety of prior experience and domain specific knowledge

Individuals with experience in multiple areas of expertise are expected to develop a broad range of domain specific knowledge, including both technical knowledge and contextual knowledge. Work and educational experience have long been recognized as an important source of technical knowledge and capability (Campion, Cheraskin & Stevens, 1994; Huber, 1991; Tesluk & Jacobs, 1998; Quinones, Ford & Teachout, 1995; Schmidt, Hunter & Outerbridge, 1986). Educational experiences are important for acquiring more basic, established, and codified knowledge, while professional experience on the job is particularly important for acquiring more tacit or task-specific knowledge and skills (Hitt, Bierman, Shimizu & Kochhar, 2001). Goodwin and Ziegler (1998) reported a positive bi-variate correlation between variety of experience, measured as number of full-time job subjects have held, and the range of unique responses to a problem solving task. Information and knowledge flows along network ties (Granovetter, 1972). Networks connecting contacts with different backgrounds provide more diverse knowledge and information (Burt, 1992, 2004; Lin,

2001). From their network contacts, people obtain a variety of knowledge such as solution to a problem, procedure of doing a task, problem reformulation, and more general knowledge in the form of focus and framework for perceiving and judgment (Cross, Borgatti & Parker, 2001; Walker, 1985). Thus, association with people from different areas may broaden people's technical knowledge. Empirically, Erickson (1996) found a positive association between the diversity of a manager's network in terms of gender and class and the variety of his or her cultural knowledge.

Apart from technical expertise, experience in a functional area also allows individuals to learn about the task and social context in which technical problems are solved. Existing literature suggests a few important types of contextual knowledge, such as familiarity with what knowledge and skills people from different areas possess, i.e., knowledge on "who knows what" (Ancona & Caldwell, 1988; Faraj & Sproull, 2000; Liang, Moreland & Argote, 1995; Tushman, 1977), and knowledge about the orientation, preferences and norms of people from different domains of expertise, i.e., normative knowledge (Dutton & Ashford, 1993). Both direct involvement and indirect experience in a functional unit may familiarize individuals with "who knows what" as well as physical resources such as books, archives, internet discussion forums, and information repositories. Direct involvement is often regarded as the key to understanding a social system (Krackhardt, 1990) and interaction with contacts from different social groups is also important for getting to know what is going on inside of those groups (Obstfeld,

2005). Therefore, experience in multiple areas shall enhance the breadth of contextual knowledge.

Proposition 1a: *Individuals with greater variety of prior experience will have greater breadth of domain specific knowledge.*

4.3.1.2 Variety of prior experience and integrated understanding

Integrated understanding, also called business knowledge by some researchers, refers to the extent to which individuals understand the operation of the larger work system, such as knowledge about what other functional units do, how different functional units fit together, and how one's own work is related to the operation of the larger system (Campion, Cheraskin & Stevens, 1994; Dutton & Ashford, 1993). If knowledge about different functional units can be considered knowledge about the parts, integrated understanding is knowledge about the interconnection between the parts and the relationship between a part and the whole. Integrated understanding provides employees with a broader perspective through which they can make sense of their work, and contribute to the operation of the collective more effectively (Parker & Axtel, 2001).

Variety of individual prior experience may also lead to a greater level of integrated understanding. The breadth of technical and contextual knowledge in multiple domains, though does not necessarily guarantee an appreciation of the big picture, constitutes a necessary condition for integrated understanding. In addition,

experience in multiple areas may prompt reflections on the relationship between different areas, and how the system operation as a whole. The experience mobilizing knowledge from multiple areas to solve problem may push individuals to reflect upon the connections between different expertise, such as similarity and difference in the issues they are concerned with, and the aspect of organizational functioning they contribute to. The experience working with people from others areas may also help people figure out not only how people from other areas think and how other functional units operate, but also how different people's work fit together and influence one another.

Proposition 1b: *Individuals with greater variety of prior experience will have greater integrated understanding.*

4.3.2 Variety of prior experience and boundary-crossing capability

Many organizational tasks require the joint effort of people with different expertise. Such work settings is associated with a higher level of conflict, and poses cognitive and motivational barriers to effective communication and coordination, in part due to "thought worlds" differences across different domains of expertise, including difference in the fund of knowledge, in language and framing, in perception of and attitude toward issues, and in procedures and methods of doing things (March & Simon, 1958; Tushman & Katz, 1980; Lawrence & Lorsch, 1986; Dougherty, 1992). We argue that variety of individual prior experience may help individuals to function more effectively

in such settings, because it enhance individual ability to effectively share knowledge across boundaries, to consider and integrate diverse knowledge and perspectives when making decisions, and to mitigate the negative consequences associated with different opinions on task issues.

4.3.2.1 Variety of prior experience and knowledge sharing

We argue that individuals with a great deal of variety in their prior experience may find it easier to overcome barriers to knowledge sharing among people from different areas. From a knowledge recipient's perspective, cognitive research on learning suggests that knowledge sharing is easier when there is a higher level of common pre-existing knowledge to facilitate the comprehension and assimilation of new knowledge (Bower & Hilgard, 1981; Lindsay & Norman, 1977). The chance is greater that individuals with more variety in prior experience possess knowledge that is related to the knowledge of others, and consequently allow them to understand others with greater ease (Bunderson & Sutcliffe, 2002).

Variety of prior experience may also make individuals better communicators. To communicate one's knowledge successfully across functional boundaries, people have to express what they know in a language that the recipient can understand, and frame their ideas in a way that fits the audience's perspective on issues (Bechky, 2003; Carlile, 2002). Variety of prior experience may help individuals acquire the knowledge and develop the ability to do so. As pointed out earlier, "thought world" differences, such as

differences in knowledge, orientation, and language, constitute the major barrier to communication and mutual understanding across functional boundaries (Dougherty, 1992). Prior experience in multiple functional areas may help bring these differences into conscious awareness. The awareness that people with different background may have different knowledge and perspectives and speak different language is a necessary first step toward solving communication problems across boundaries. This awareness may help individuals refrain from making ego-centric assumptions that others know what themselves know (Hinds, Patterson, & Pfeffer, 2001), proactively detect possible problems and take steps to deal with them. The technical and contextual knowledge acquired via prior experience in multiple functional areas enable individuals to employ the right expression and avoid jargon, and to adopt the appropriate framing and relate their ideas to the concerns and interests of the audience. Furthermore, individuals may become more skillful in audience-oriented communication as they have had more opportunity practicing framing issues in new ways, and conveying ideas clearly to different audiences (Reagans & McEvily, 2003). Even when they are not familiar with the audience, they may be better able to quickly figure out how to talk with the audience through trial and error.

Current research has often emphasized the importance of pre-existing related knowledge in effective knowledge sharing. However, the awareness of possible communication barriers across boundaries, the reduced ego-centric assumption about

other's knowledge, and the ability to figure out appropriate framings shall all be useful even when there is little common knowledge between the source and the recipient. Thus, variety of prior experience should enhance knowledge sharing above and beyond common experience or knowledge. And when the recipient has limited common knowledge, the knowledge and capability individuals develop as a result of variety of prior experience may make an even greater difference in facilitating knowledge sharing.

Proposition 2a: *Individuals with greater variety of prior experience will find knowledge sharing across functional boundaries easier.*

4.3.2.2 Variety of prior experience and knowledge integration

We further argue that individuals with diverse prior experience may play important roles in boundary-crossing work settings because they develop greater capabilities to integrate different ideas and perspectives. The integration of knowledge from different domains has long been recognized as the source of new knowledge, creative ideas, and innovation (Burt, 2004; Grant, 1996; Perry-Smith & Shalley, 2003). Further, bringing different perspectives together to produce a thorough understanding of an issue is essential for accurate assessment of complex situations and for devising effective action strategy.

Knowledge integration is a dimension of information processing that aims to connect and organize different knowledge, ideas and perspectives into a logic whole, a process that may involve the identification of trade-offs, similarities, complementarities,

and synergistic interactions, and categorization within some super-ordinate conceptual schema (Burt, 2004; Suedfeld & Bluck, 1993; Woike, 1994). Individuals may engage in integration processes to varying degrees as a result of personal preference and the underlying concerns and requirements of the situation (Suedfeld & Bluck, 1993; Tetlock, Peterson & Berry, 1993; Woike, 1994). In work settings that involve people from different functional areas, the need for integrative thinking is often urgent. Given the same situational, however, individual differences in the capability to perceive meaningful connections may affect the speed and quality of knowledge integration. Individuals with more diverse prior experience may be more motivated and capable of knowledge integration.

Individuals with greater variety in their prior experience may be more comfortable and motivated to consider different ideas and knowledge. As discussed earlier, prior experience in multiple functional areas helps individuals to understand the task activities and expertise of different areas, and see how each contributes to the operation of the whole organization in different ways. This understanding may help them to better appreciate the value of the knowledge and perspectives associated with different areas. As Ely and Thomas (2001) reported, viewing diversity as a potentially valuable source of new learning opens up individuals' mind to integrate alternative perspectives and insights about work and to think about how best to accomplish meaningful integration. Individuals with experience in multiple functional areas may be

more motivated to accept different ideas and perspective as potentially valuable and more motivated to seriously consider a different view point when approaching an issue or solve a problem. When confronted with incongruence, they are probably less likely to stick to their own perspective or simply reject opinions that are different, but are more likely to make effort to identify connections, solve conflicts, and make trade-offs.

Individuals with greater variety in their prior experience may develop greater capability to integrate knowledge across functional areas. Familiarity with different perspectives and ideas is a pre-requisite for integration, because one cannot use and combine different information and perspectives without the basic input (Goodwin & Ziegler, 1998; Suedfeld & Bluck, 1993). People who are more familiar with activities in two groups are better able than people confined within either group to see how a belief or practice in one domain could create value in the other. People with experience in multiple groups are also better able to draw analogies between ostensibly irrelevant perspectives and ideas. Such insight is difficult to generate if people have only spent a long time inside one single group because they often look for differences between themselves and others to justify their assertion that "our situation is different" so they can feel comfortable ignoring beliefs and behaviors different from their own (Burt, 2004). They may also develop over time increasing rigidity in their problem-solving activities – a kind of functional fixedness that reduces their capacity for flexibility and openness (Katz, 1982). In contrast, the incongruence, differences, or changes that people with a

great deal of variety of prior experience have confronted may push people to reflect upon their knowledge and perspectives (Bartunek, Gordon & Weathersby, 1983; Fiske and Taylor, 1984; Mezirow, 1991). Such reflection may increase the chance that individuals see connections between apparently different domains, and help individuals become more adept at integrative thinking.

Individuals with diverse prior experience may also be in a better position to process and integrate unfamiliar information and ideas. As pointed out earlier, individuals with diverse prior experience are less likely to run into information, ideas and perspectives that are completely unrelated to prior knowledge. They would on the one hand have less new information to process, and on the other more time to learn and consider new information, which reduces the risk of overload (Dahlin, Weingart, & Hinds, 2005). As a result, they are able to engage in more thorough and comprehensive processing of unrelated information and more likely to see links between different ideas and approaches.

Proposition 2b: *Individuals with greater variety of prior experience will engage in more comprehensive knowledge integration.*

4.3.3 Variety of prior experience and person perception

In addition to its influence on the accumulation, sharing and integration of knowledge, variety of prior experience may also influence the way individuals perceive and relate to other people. Social categorization theory maintains that individuals tend

to classify themselves and others into social groups defined in terms of characteristics such as age, race, and occupation and so forth (Turner, 1987). As a result, a person acquires a social identity as a member of one social category as compared to members of other groups. Once categorization take place, people strive for a higher self-esteem by perceiving in-group members in more favorable light, such as more trustworthy, honest, and cooperative, than members of the out-group (Brewer, 1979; Kramer, 1991), and engage in stereotyping, distancing and disparaging of out-group members (Tajfel, 1982).

We argue that individuals with greater variety in their experience shall be less susceptible to biases and negative perception of others based on membership in different area of expertise. Having spent time in a number of areas, individuals can acquire more accurate knowledge about the goals, interests, values and preferences of people in those areas. In addition, individuals with experience working in multiple functional areas can claim membership in multiple groups, and may be able to identify with people of different functional background (Bunderson & Sutcliffe, 2002). Individuals with experience working with people from multiple functional areas may also come to like and identify with people from those areas beyond simply learning more about those groups (Pettigrew, 1997). In short, individuals who have had prior experience working in or working with people from multiple areas may have less bias or negative stereotype, more trust and positive perceptions of people from those areas. In other

words, there will be less difference in terms of favorability between perceptions of the in-group and out-group based on current membership in different domain of expertise.

Proposition 3. *Individuals with greater variety of prior experience will display more positive perceptions of out-group members defined on the basis of current membership in different domain of expertise.*

4.3.4 Implications for individual job performance

As discussed earlier, greater variety of prior experience may be associated with greater breadth of knowledge and the ability to effectively share and integrated knowledge across boundaries. The learning, however, does not necessarily translate into better individual task performance. Acquiring diverse experience is not without its cost. Variety of prior experience may enhance individual performance only when the benefit outweighs the cost.

Because prior related knowledge enhances subsequent learning (Bower & Hilgard, 1981), specializing in a single domain of skills and knowledge is efficient, while learning across boundaries has a steeper curve, particularly when the structure of knowledge is highly differentiate and when new knowledge is from a very different area (Cohen & Levinthal, 1990). In organizations, the structure of knowledge can be considered as highly differentiated. Meant to deal with different segments of the external environment and the demands of different tasks, different areas have different organizational responsibility, use highly differentiated knowledge and skills, develop

different language and culture, and perceive different reality (Lawrench & Lorsch, 1976; Dougherty, 1992; Carlile, 2002). Thus learning in a new domain would be more difficult than further learning within the same area.

In addition, as people have limited attention and time, what is spent on one area cannot be used on another. Superior expertise in a domain usually takes years of intense and experience (Ericsson & Lehmann, 1996). Given the same amount of total experience, people with extensive experience in a single functional area may develop deep specialist capability in that area, but may have limited exposition to other areas. In contrast, people with experience distributed into multiple functional areas may obtain adequate understanding about the task and social dynamics, and acquire limited technical expertise from multiple areas, but may not be able to reach the same degree of depth in any functional area as narrow specialists can (Hayes, 1989; Postrel, 2002). Thus, people with limited variety of experience may experience greater difficulty in settings that require communication and coordination with people from diverse functional areas. But when it comes to solving difficult technical problems specific to a domain, people with extended experience in that single domain may be better off than those with more diverse but shallower experience in multiple domains. Consistent with the above analyses, Hayward (2002) pointed out, in the context of acquisition, that persistent entry into new market prevents the acquirer from fully learning about advantage that resides

in specific markets and may consequently experience adverse performance in such acquisitions.

There are conditions under which acquiring variety of experience may not necessarily take away from depth of specialist capability or compromise efficiency in a particular domain. Research on learning curves suggests that repeated experience in the same or similar tasks generates diminishing return, that is, experience improves efficiency at a decreasing rate (Argote, 1999; Argote & Epple, 1990). When individuals have achieved great depth and more experience can no longer improve performance in the focal domain, spending time on a different area should not compromise task performance in that domain. That is, knowledge from different but related areas and understanding of different perspectives and practices may shed new light on the focal area and generate insights that can improve task performance. Nevertheless, depth in the focal domain is also required in order to contextualize and apply knowledge from other areas in a way that improve performance. Thus, individuals who have already had greater depth of expertise in their focal domain may be in a better position to benefit from experience in different areas of expertise than those with less experience in the focal area. Consistent with this point, Morisett and Hoveland (1959) suggested that preliminary training that gives the learner opportunity to fully learn a particular type of problem before experiencing several types of problems yields maximum transfer.

Individuals with extended experience in a particular area may need exposition to different areas to avoid falling victim to competence trap or becoming overly rigid in problem solving activities (Katz, 1982; Levitt & March, 1988). Therefore, even when it does not directly contribute to one's task performance, experience in multiple domains or with people of diverse background would be beneficial to individuals who have had extended experience in a single area, because it helps sustain their flexibility and openness.

The above discussion suggests that the tension between developing deep specialized expertise in a focal domain and acquiring experience across different domains may be particularly intense when individuals are early in their career and when they have limited working experience in their focal domain. Distributing one's time into multiple areas is likely to slow down learning in the focal area, and negatively influence job performance in the focal area. However, later in their career, individuals might have already become experts in their focal areas, spending time in other different domains may turn out to be beneficial (or at least not harmful) to task performance (Please see the bottom panel of Figure 12 for a graphic presentation of our model on the implication of variety of prior experience at the individual level).

Proposition 4. *Variety of prior experience will be more beneficial to individual task performance in a focal area when it is acquired after the individual has gained extensive experience in the focal area.*

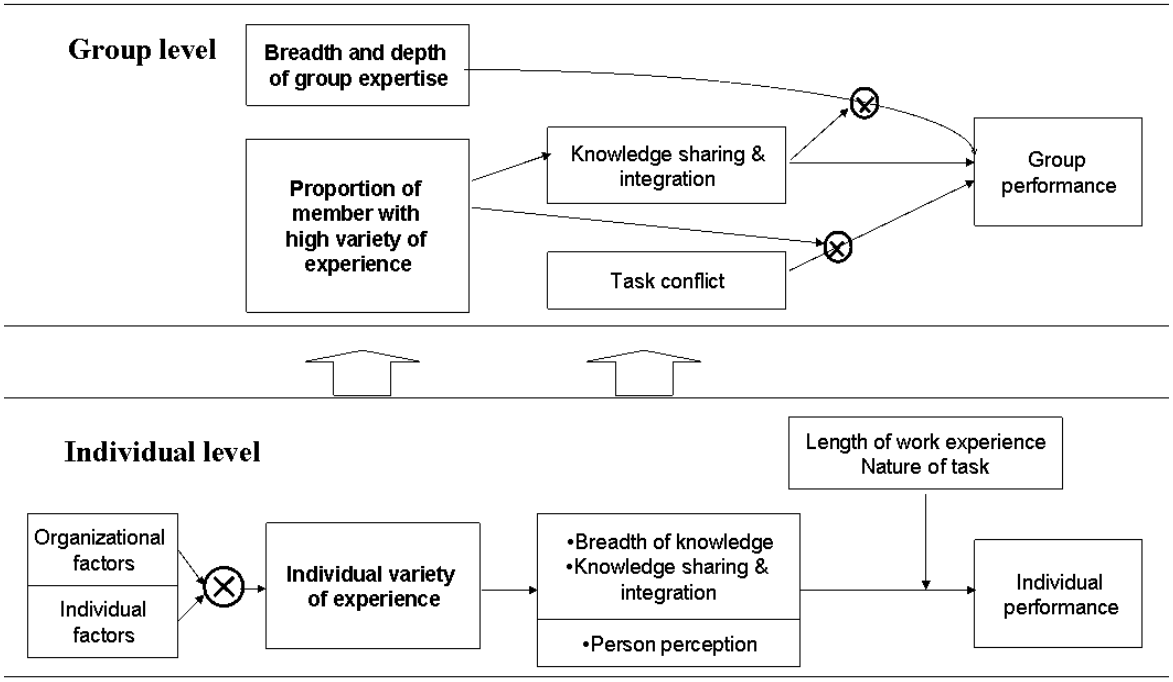


Figure 12: Conceptual model of variety of prior experience, knowledge process, and group performance.

4.4 Implications for groups

Building upon discussion at the individual level, we further consider how individual variety of prior experience may affect group level processes and outcomes. A few factors make the move from individual to group a natural step to take. First, researchers have noted that complex knowledge-intensive work is taking up a greater portion of the economy (Alvesson, 2004), and that organizations have dramatically expanded the use of groups to complete a variety of work such as recommending improvements, designing new products, and making strategic decisions and so on (Cohen & Bailey, 1997). Second, groups constantly acquire, transmit, and combine

knowledge to develop a group level decision or problem solution. Some stages of group information processing may rely primarily on information processing that take place within individuals and other stages are at the group level but operate through inter-personal processes that individuals engage in from day to day (Huber, 1991; Larson and Christensen, 1993; Schilling, Vidal, Polyhart & Marangoni, 2003). Our earlier discussion suggests that variety of prior experience is very relevant to group information processing as it helps develop individual capability to effectively share knowledge and integrate knowledge across functional boundaries. Third, with few exceptions (Bunderson & Sutcliff, 2002; Haas, 2006a), current research on groups has not paid adequate attention to group members' prior experience, particularly variety of prior experience. Theoretical and empirical work investigating variety of prior experience at the group level would enrich our understanding of experience as well as group effectiveness.

We adopt an input-process-outcome framework to guide the discussion of the implication of variety of prior experience for groups. Prevalent in current research on groups, this framework provides a useful lens to organize the different factors contributing to group dynamics. Inputs are structural and compositional characteristics of the group that exist prior to group activity. Inputs usually determine the pool of resources such as expertise that groups possess and potentially have access to from outside. Processes describe how inputs are transferred into outcomes, and can be

broadly classified into social and task-related process, and internal and external processes (Ancona & Caldwell, 1992; Jehn, 1995). Outcomes are the results of group activity that are valued by the group and the organization in which the group resides, such as group performance. While inputs can have a direct effect on group performance outcomes, more often, their effects are mediated by processes (e.g. Bunderson & Sutcliffe, 2002; Pelled, Eisenhardt, & Xin, 1999). In addition, processes can also moderate the association between inputs and outcome by facilitating or hampering the translation of inputs into desired outcomes (e.g. Simons, Pelled & Smith, 1999; Van Der Vegt & Bunderson, 2005; Zhu & Cummings, 2007).

We have defined variety of prior experience at the individual level as the extent to which individuals have experience in multiple area of expertise. We further define variety of prior experience at the group level as the proportion of group members possessing greater variety of prior experience. Grounded on earlier discussion at the individual level, we posit two paths through which variety of prior experience affect groups. First, groups that have more members with greater variety of prior experience will have more effective task process, which in turn may affect group performance. Second, groups that have more members with greater variety of prior experience will be able to derive greater benefits from expertise possessed by members or acquired from external sources, as more effective processes allow expertise to be fully shared and considered when making decisions or solving problems.

4.4.1 Variety of prior experience, group processes and group performance

Researchers have investigated two broad categories of processes: task-related processes such as task-conflict (e.g. Jehn, 1995) and knowledge sharing (e.g. Bunderson & Sutcliffe, 2002), and social relationships among group members, such as relationship conflict (e.g. Pelled, Eisenhardt & Xin, 1999) and cohesion (e.g. O'Reilly, Caldwell & Barnette, 1989; Beal, Cohen, Burke & McLendon, 2003). Parallel to earlier discussion at the individual level, we focus on how variety of prior experience shape task processes in groups, including knowledge sharing, knowledge integration and task conflict. To perform effectively, groups need to utilize knowledge and information possessed by group members and acquired from external sources (Ancona & Caldwell, 1992). Task processes such as task conflict, knowledge sharing and integration are critical for the utilization of expertise.

4.4.1.1 Variety of prior experience and intra-group knowledge sharing

Knowledge sharing is the process whereby group members communicate to one another information and knowledge, and opinions and thoughts regarding task issues. It is a critical step in group learning and decision making (Huber, 1991). Individual expertise will not be able to have any impact on group performance unless it is shared and incorporated into group decisions or task solutions. While groups are often put together with a view to taking advantage of diverse knowledge and skills that members possess or acquire from external sources, "thought world" differences among

individuals with different expertise, such as differences in knowledge, perspectives, language and orientations, often make it hard for individuals to communicate and achieve mutual understanding (Carlile, 2002; Dougherty, 1992; Lawrence & Lorsch, 1986; Williams, & O'Reilly, 1998).

Individual variety of prior experience may be particularly important in this situation. As discussed earlier, individuals with greater variety of prior experience may acquire greater breadth of knowledge, and develop the ability to effectively convey knowledge and ideas across different fields. This proposition shall hold at the group level as well. First, when individual members have had prior experience in multiple area of expertise, the chance is higher that they will have experience and knowledge in common. As pre-existing knowledge facilitates the comprehension and assimilation of new knowledge, common knowledge among members make knowledge sharing easier (Bower & Hilgard, 1981; Lindsay & Norman, 1977; Bunderson & Sutcliffe, 2002). Further, as we have argued earlier, variety of prior experience may help individuals to become more effective communicators. Members with experience in multiple functional areas may also contribute to effective knowledge sharing by serving as a translator and facilitate knowledge sharing between members who do not have much overlap in experience and expertise. Therefore, groups that have more members with greater variety of prior experience should collectively have less difficulty in knowledge sharing.

Existing research has invoked the common knowledge rationale to explain why variety of prior experience facilitates knowledge sharing (e.g. Bunderson & Sutcliffe, 2002; Cohen & Levinthal, 1990). This rational predicts that overlap in knowledge mediates the positive association between variety of prior experience and ease of knowledge sharing. The second rationale has received much less attention. The skills and awareness developed via experience in multiple functional areas may promote ease of knowledge sharing above and beyond overlap in knowledge. When group members share a high level of common knowledge, the difficulty in achieving mutual understanding is low. Without making much effort in terms of careful wording or framing, or without even fully spelling out their thoughts, two members who are from the same functional area can understand each other well, because their shared knowledge provides a rich context against which they make sense of abstract expressions or interpret expressions with rich connotations specific to their own area. Thus, the skills and awareness developed as a result of experience in multiple areas may become more important when there is less overlap in knowledge. Therefore, the following hypotheses emerge (Please see the top panel of Figure 12 for graphic presentation of the model on the implication of variety of prior experience for groups),

> **Proposition 5a**. *Variety of prior experience at the group level, i*.e., p*roportion of group members with greater variety of prior experience, will be positively associated with ease of knowledge sharing in groups.*

Proposition 5b. *Common knowledge among group members will partially mediate the positive association between variety of prior experience at the group level and ease of knowledge sharing in groups.*

Proposition 5c. *The association between variety of prior experience at the group level and ease of group knowledge sharing will be stronger with a decrease in common knowledge among group members.*

4.4.1.2 Variety of prior experience and knowledge integration

Knowledge integration is the process whereby groups organize the different knowledge, ideas and perspectives members bring into a coherent whole by prioritizing issues, identifying similarities, resolving discrepancies, and making trade-offs and so on, so as to converge on a group decision or task solution. Groups are often formed to capitalize on the diverse knowledge and information that members bring. However, as is the case with knowledge sharing, "thought world" differences across specialized domains of expertise often give rise to cognitive barriers to knowledge integration in groups composed of individuals who are experts in different areas (Dougherty, 1992; Dahlin, Weingart, & Hinds, 2005).

We argue that at the group level, variety of prior experience will also enhance knowledge integration. First, research on information sampling suggests that knowledge are more easily retrieved and given more attention when they are commonly held, and that uniquely held knowledge has a greater chance of being considered if there is one

other member that can corroborate (Stasser and Titus 1985, 1987; Stasser et al, 1995). When a group has more members with a high level of variety of prior experience, a greater proportion of information and knowledge are commonly held, and can be more easily recalled and considered in decision making. Knowledge and information held by minority group members (in terms of area of expertise) are also more likely to be corroborated by at least one other member, and consequently be taken seriously in group decision making.

While shared knowledge is one important reason that groups can better integrate member's knowledge, we have earlier argued that individuals with greater variety of prior experience may be more motivated and develop superior ability to consider and integrate diverse information and views, even when they are unfamiliar. And when there is a high degree of common knowledge, knowledge integration is easy, as the information and views that members bring are likely to be similar and consistent. The motivation and ability associated with variety of prior experience may become unnecessary. However, when group members have little common knowledge to draw upon, motivation and ability may play a more important role in determining how much unique information and knowledge can be considered and integrated into group decisions and task solutions.

Proposition 5c. *Variety of prior experience at the group level, i.e., the proportion of members with greater variety of prior experience, will be positively associated with*

group knowledge integration comprehensiveness.

Proposition 5d. *Common knowledge among group members will partially mediate the association between variety of prior experience at the group level and group knowledge integration comprehensiveness.*

Proposition 5e. *The association between variety of prior experience at the group level and group knowledge integration comprehensiveness will be stronger with a decrease in common knowledge among group members.*

4.4.1.3 Variety of prior experience and task conflict

Task conflict is another component of group task process that has received extensive attention. It is posited to stimulate deep and thorough examination of issues, and consequently have the potential to generate better decisions and improve group performance (Jehn, 1995; 1997). However, while studies in experimental settings did provide supportive evidence, research in realistic organizational settings suggests the opposite, that is, task conflict has a predominantly negative impact on group performance (Dreu & West, 2001; De Dreu & Weingart, 2003). Task conflict consumes cognitive resources, thus may interfere with group information processing capacity and impedes group performance. In addition, task conflict is often misattributed as relationship conflict, which is detrimental to group performance (De Dreu & Weingart, 2003; Simons and Peterson, 2000). Researchers have started to identify conditions under

which groups can realize the potential benefit of task conflict. We posit that variety of prior experience may allow task conflict to run a more positive course.

First, as discussed earlier, variety of prior experience may enhance group capability in integrating different knowledge and perspectives, which should allow groups to resolve disagreements on task issues more effectively. As a result, task conflict is kept in check before it takes up too much time and depletes the group's cognitive energy.

Second, variety of prior experience can attenuate the association between task conflict and relationship conflict. Task conflict is often interpreted as personal attacks, sinister in intension or resulting from disagreeable disposition, leading to relationship conflict (Simmons & Peterson, 2000). Underlying the misattribution of task conflict is the lack of knowledge about the "thought worlds" of others and the circumstances surrounding others' work, and the lack of trust in other's motive (Dougherty, 1992; Cramton, 2001; Simons & Peterson, 2000). We have argued earlier that prior experience in multiple areas generates information and knowledge about the technical and social context of different areas, which serves to broaden the potential explanatory field when individuals interpret other's different views and attitudes (Jones & Nisbett, 1971). Further, as we posited earlier, individuals with prior experience in multiple areas simply have fewer functionally-based out-groups, and may even be able to identify with people of different background, and perceive them in more favorable light, such as more

trustworthy, honest, and cooperative (Brewer, 1979; Kramer, 199; Pettigrew, 1997). It follows that variety of prior experience may help individuals develop a general awareness that disagreements may simply reflect differences in professional experience rather than anything dispositional or personal.

To sum up, individuals with greater variety of prior experience may be better able to resolve task conflict, and are less likely to perceive task conflict as personal friction with sinister intention. Therefore, we posit that groups that have more members with greater variety of prior experience will be in a better position to mitigate the downside of task conflict and realize its potential benefits, allowing task conflict to run a more positive or less negative course.

Proposition 6. *Task conflict will have a more positive (or less negative) association with group performance when more members of the group have greater variety of prior experience.*

4.4.2 Variety of prior experience, group expertise, and group performance

A critical resource for groups with knowledge intensive tasks is the expertise (i.e. skills and knowledge) that group members bring to the group (Faraj & Sproull, 2000; Ancona & Caldwell, 1992). While breadth (i.e. range of different areas of expertise represented in a group) and depth of expertise (i.e., level of knowledge and skill in a particular area) can potentially improve group performance, groups need to put them to use when making decisions and devising problem solutions for them to have an impact

(Haas, 2006b). For groups working on pooled tasks (Thompson, 1967), putting expertise to use may simply require members individually applying their knowledge and skills to complete tasks. However, more often, groups are charged with tasks that are complicated and interdependent, and require smooth intra-group interaction through which members retrieve, communicate and combine their knowledge and perspectives into a group decision or problem solution (Dahlin, Weingart, and Hinds, 2005; Huber, 1991). Without this process, expertise possessed by members will remain an untapped resource with no impact on group decisions and task solutions.

Research on cross-functional groups has investigated the impact of breadth of expertise on group performance. While groups with multiple areas of expertise can draw on non-redundant knowledge and skills, and access information and resources from diverse external sources (Ancona & Caldwell, 1992; Cummings, 2004; Reagans & Zuckerman, 2001), they often experience greater difficulty in communication and coordination due to differences in knowledge and perspectives (Dougherty, 1992; Bunderson & Sutcliffe, 2002; Dahlin, Weingart & Hinds, 2005). As a result, groups area often unable to fully exploit the potential benefits associated with breadth of expertise. Recent research has consequently shifted to explore when and how groups can overcome difficulties associated with breadth and take advantage of its benefits (Simons, Pelled & Smith, 1999; Van Der Vegt & Bunderson, 2005).

We have argued earlier that variety of prior experience may help groups to overcome the cognitive and motivational barriers to knowledge sharing and integration across different areas of expertise. We further suggest that by enhancing knowledge sharing and integration, variety of prior experience may allow breadth of expertise to have a more positive (or less negative) impact on group performance.

Proposition 7a. *Breadth of group expertise will have a more positive (or less negative) association with group performance with an increase in variety of prior experience at the group level, i.e. when a greater proportion of group members have a high level of variety of prior experience.*

Research focusing on depth of expertise suggests that people with greater depth of expertise in a particular area have superior problem solving skills and more advanced knowledge in that area, and groups composed of individuals with greater depth of expertise tend to perform better (Tziner & Eden, 1985; Neumann & Wright, 1999; Devine & Philips, 2001). While existing literature has generally documented a positive association between depth of group expertise and group performance, groups often fail to live up to its full potential given the resources available, due to bumpy group processes (Baumann & Bonner, 2003; Bonner, 2004; Haas, 2006). As we argued earlier, variety of prior experience enhances knowledge sharing and knowledge integration, and may allow groups to more fully consider and incorporate member expertise when making decisions and solving problems. Therefore, groups may be able to derive greater

benefits from greater depth of expertise when a greater proportion of group members have a high level of variety of prior experience.

> **Proposition 7b.** *Depth of group expertise will have a more positive association with group performance with an increase in variety of prior experience at the group level, i.e. when a greater proportion of group members have a high level of variety of prior experience.*

4.5 Summary and conclusion

The purpose of this article has been to explore variety of prior experience conceptually. While prior experience has been an extensively studied topic in organizational research, much of the existing literature has focused on the quantitative aspect of experience, such as years worked full time and company tenure. This chapter focuses on one important qualitative dimension of experience, namely, the variety of prior experience, in hopes of contributing to a richer understanding of learning from experience, and stimulating further research on this important yet understudied topic. As today's workers change jobs frequently (Beyer & Hannah, 2002), and the importance of lateral mobility to career development has been increasing (Karaevli & Hall, 2006), more research on variety of prior experience is also important for understanding the impact of current trend in career development. This chapter constitutes one small step forward towards better understanding variety of prior experience. The propositions put forth in the chapter provide a specific agenda for future studies.

This chapter speaks to research on individual learning. The lack of attention to variety of prior experience is in part due to the implicit assumption that learning is maximized through specialization in a narrowly defined task or a single domain (Schilling et al, 2003). This assumption seems to hold well in sittings where domain specific knowledge and skills are concerned, and increases in productivity or efficiency on a task is the goal. Our discussion suggests that when dealing with boundary-crossing situations, variety of prior experience may be important for developing the knowledge and ability important for individuals to effectively share and integrate knowledge. Existing research suggests that variety of prior experience may have an impact on such outcomes as changes in perception of self in relation to others and adaptability to changes and new situation (Beyer & Hannah, 2002; Karaevli & Hall, 2006). Taking note of the increase in knowledge-intensive work in contemporary economy and the expansion in the use of work groups to translate employee diverse expertise into organizational competitiveness, this chapter has focused on knowledge workers and competence in knowledge sharing and integration across boundaries at the individual and group level. We acknowledge that variety of prior experience likely have implications beyond those described here. For example, one important avenue of further research is to study variety of experience of managers and top executives, which may potentially link individual experience to outcomes at the organizational levels, such as organizational strategy (White, Smith & Barnett, 1994).

This chapter also speaks to research on group diversity. As pointed out earlier, this literature has used individual current or dominant area to compute a diversity measure that captures the distribution of group members into different functional area, and paid little attention to the fact that people classified into the same area may differ a great deal as to their prior experience in multiple different functional areas. Our discussion suggests the need to incorporate prior experience. This chapter suggests that variety of prior experience may moderate the association between breadth of functional expertise in groups and group performance. While we have focused on variety of prior experience defined in relation to in areas of expertise, it can also be defined with reference to social category such as race. People of the same race may differ a great deal in terms of the experience they have had interacting with people from other racial groups. Network ties and social encounters across racial boundary may reduce negative stereotypes about other racial groups, and reduce in-group favoritism based on racial differences. Following the argument developed in the chapter, it is reasonable to suggest that groups with the same level of racial ethnic diversity may experience more positive social dynamics when members have had experience interacting with people from different racial groups. It is therefore important that future research take into account prior experience and assess the possibility that variety of prior experience moderates the association between group functional and racial diversity and group processes and performance.

Variety of prior experience also has implications for organizational absorptive capacity. As Cohen and Levinthal (1990) suggests, absorptive capacity (AC) consists of an outward-looking, referring to the capacity to acquire and assimilate external knowledge, and an inward-looking component, defined as the capacity to put knowledge to use through sharing and combination of knowledge across different organizational units. Organizational diversity in knowledge is a key factor promoting outward-looking AC, but does so at the cost of inward-looking absorptive capacity. This article suggests that variety of prior experience of organizational members may enhance inward-looking absorptive capacity while maintaining the capacity to acquire diverse external knowledge. Organizations can staff key positions such as those at the interface of different functional units with people who have had experience in multiple functional areas. Alternatively, organizations can rotate employees across major areas of functional expertise so that they acquire cross-specialist understanding as well as develop horizontal network ties to facilitate the sharing and combination of knowledge from different parts of the organization.

Attending to variety of prior experience also has great practical implications, particularly for organizations that emphasize complex knowledge-intensive work. It has implication for human resource practices and employee career development. Many organizations rotate new employees during the first couple of years, which is an important mechanism through which employee expand the variety of their experience.

Knowing the benefits and potential downside of variety of experience, organizations may be better positioned to design rotation programs in a way that provides variety without overwhelming new employees. Rotating employees too early and too fast may result in superficial learning. In addition, organizations may want to think about rotating employees that have been working in a specialized area for a long time so that they have the opportunity to obtain fresh perspectives and avoid the development of functional rigidity. Our discussion further suggests that organizations can become better positioned to take advantage of knowledge from external sources and from different organizational units by focusing on recruiting or cultivating the right type of human capital, in addition to shaping formal and informal communication networks and devising formal roles and policies. Placing employees with experience in multiple functional areas at the interfaces between functional units or in cross-functional task forces may enhance synergistic knowledge sharing across boundary and promote task performance.

5. An empirical study of variety of experience and dyadic ease of knowledge sharing

5.1 Background

As emphasized in previous chapters, knowledge sharing is critical for effective group operation. The quantity and quality of knowledge sharing may determine the extent to which groups can translate member expertise into better decisions or more effective task solution. In Chapter 4, I have argued that individuals with greater variety of experience may be able to communicate more effectively across functional boundaries, and consequently promote knowledge sharing and utilization of expertise in groups. This chapter presents an empirical study designed to test a set of hypotheses based on part of the theoretical discussion in Chapter 4.

This chapter focuses on testing hypotheses on variety of individual experience and dyadic knowledge sharing. Dyads are not only the simplest form of social interaction, but they are also by far the most common in naturalistic social interaction (Bakeman & Beck 1974, James 1953). Group processes, to a great extent, hinges upon interactions at the dyadic level. As a matter of fact, dyads are considered by some researchers as the smallest group (Kenny, 1996). Studying dyadic knowledge sharing helps to unpack the micro-dynamics in groups.

The study reported in this chapter focuses on an important aspect of knowledge sharing: ease of knowledge sharing. Empirically, existing studies have paid more

attention to the frequency or quantity of knowledge sharing than to the quality of knowledge sharing (such as ease, or effectiveness, of knowledge sharing). Theoretically, my discussion in Chapter 3 suggests that variety of individual experience may influence the quality of knowledge sharing, as it helps individuals to accumulate the knowledge and skills that make them better able to communicate across functional boundaries. As knowledge transfer follows the path of least resistance, ease of knowledge sharing is often the explanation for why individuals share knowledge with some, but not others (Cross & Borgatti, 2003; Reagans & McEvily, 2003a).

The study addresses three issues. First, it attempts to test the positive association between variety of individual experience and ease of dyadic knowledge sharing, and assess if and to what extent this positive association is accounted for by dyadic common experience. Dyadic common experience refers to the extent to which the two individuals have worked on tasks involving the same domain of expertise. It does not require that the two persons work side by side physically, or be affiliated with the same functional unit. As long as the tasks they have ever worked on required the same domain of expertise, they are considered to have some common experience. In other words, common experience as defined in this chapter refers to similarity in prior experience in terms of task expertise.

Second, the study in this chapter also constructs proxies for depth and breadth of expertise, and tests if variety moderates the association between depth and ease of

knowledge sharing and between breadth and ease of knowledge sharing. The proxy for depth of expertise is individual experience in one's current functional department as a percentage of total work experience (called functional department experience in this study). The proxy for breadth is dyadic functional difference, that is, whether the two persons are currently affiliated with the same or different functional department.

Finally, the study assesses the interrelationship between variety and dyadic tie strength in shaping knowledge sharing. Existing literature on interpersonal knowledge sharing, i.e. knowledge sharing at the dyadic level, has highlighted the importance of social relationship. Our understanding is very limited as to how human capital factors such as individual working experience may influence knowledge sharing. I examine the interrelationship between a social capital factor, tie strength, and a human capital factor, variety of experience, in shaping interpersonal knowledge sharing.

5.2 Literature review

5.2.1 Research on interpersonal knowledge sharing

The study reported in this chapter builds upon and contributes to existing scholarship on interpersonal knowledge sharing. Existing research has investigated several sets of factors that may affect interpersonal knowledge sharing. Characteristics of knowledge, such as knowledge codifiability or degree of tacitness (Szulanski, 1996; Hansen, 1999) have been cited as important in determining the level of difficulty in knowledge sharing. Even more prevailing is the absorptive capacity perspective, which

suggests the importance of common experience and knowledge in facilitating knowledge sharing (Cohen & Levinthal, 1990; Szulanski, 1996). However, the most extensively studied perspective is the network perspective that focuses on dyadic tie and relational characteristics such as tie strength (Granovetter, 1973) and trust (Levin & Cross, 2004). In sum, dyadic level variables such as social relationship and dyadic difference have dominated existing research on interpersonal knowledge sharing.

A few recent studies, however, suggest that human capital, such as individual expertise and working experience, also play important roles in the flow of knowledge in organizations. Bunderson and Sutcliffe (2002) reported that individual experience in multiple functional areas facilitated knowledge sharing in groups. Cross and Sproull (2004) found that expertise of both the source and the recipient predicts reception of knowledge. Haas (2006a) also reported that variation in the degree of individual experience with multiple cultures and countries is associated with the acquisition and utilization of different type of knowledge from outside of groups.

Both Haas (2006a) and Bunderson and Sutcliffe (2002) have investigated how individual experience, aggregated to the group level, affects knowledge sharing and utilization at the group level. However, in Bunderson and Sutcliffe (2002), knowledge sharing focuses more on the outcome, that is, the extent that information and knowledge are made known to all members. How individual experience affects the qualitative aspect of knowledge sharing process, such as ease of knowledge sharing, is not studied.

In the study by Haas (2006a), the moderating effect of variety of cultural experience (the extent to which group members have experience in multiple countries) is assessed. A positive interaction between variety of cultural experience and member technical knowledge in predicting group performance is regarded as evidence in support of the argument that variety of cultural experience facilitates effective utilization of member knowledge. How variety of cultural experience influence processes critical to knowledge utilization, such as knowledge sharing, is not studied. Finally, while knowledge sharing in groups relies heavily on interpersonal knowledge sharing, how individual work experience affects interpersonal knowledge sharing has not been directly studied. In addition, our understanding of the interrelationship between factors across individual and dyadic levels in shaping interpersonal knowledge sharing is very limited. Extending existing studies on experience and knowledge sharing, the study in this chapter tests the relationship between variety of individual experience and dyadic knowledge sharing, and examines the interaction between variety of individual experience and dyadic level variables.

Existing research on knowledge sharing at the dyadic level has investigated different aspects of knowledge sharing, such as frequency of knowledge seeking (Borgatti & Cross, 2003), perceived reception of knowledge (Cross et al., 2004), usefulness of knowledge acquired (Levin & Cross, 2004), and amount of knowledge shared (Tesluk & Jacobs, 1998). This study will focus on perceived ease of knowledge

sharing at the dyadic level. As has been pointed out by Reagans and McEvily (2003), knowledge sharing represents a cost for the source in terms of time and effort spent helping others to understand the source's knowledge. As knowledge flows along the path of least resistance (Levinthal & March, 1993), the less time and effort required, the more likely knowledge sharing will occur. Thus understanding factors influencing perceived ease of knowledge sharing will shed light on why individuals choose to share knowledge with some people but not others, which is an important precursor to successful knowledge sharing. Additionally, the focus on a qualitative aspect of knowledge sharing is very much theoretically derived. My discussion in Chapter 4 has suggested that variety of individual experience may influence the quality of knowledge sharing, as it helps individuals to accumulate the knowledge and skills that make them better able to communicate across functional boundaries.

5.2.2 Research on individual experience

This study also contributes to current literature on individual work experience. Experience, as an important source of knowledge and skills, has attracted substantial attention among organizational researchers (Argote, 1999; Huber, 1991; Tesluk & Jacobs, 1998). Much of the existing research on individual experience, however, has focused on the quantitative aspect, such as amount of time on a task, number of years holding a job or a position, tenure in a company, or years of fulltime working experience. As I have analyzed in Chapter 4, such a conception of experience is inadequate because it fails to

capture the richer qualitative aspect of experience such as variety (Tesluk & Jacobs, 1998). With the same amount of work experience, people could face drastically different challenges and opportunities, which is not reflected in years of experience in a job, position or organization. A few recent studies have started to investigate the implication of variety of individual experience for individuals and groups (Bunderson & Sutcliffe, 2002; Goodwin & Ziegler, 1998; Schilling, Vidal, Ployhart, & Marangoni, 2003). However, as pointed out earlier, how variety of individual experience affects knowledge sharing at the dyadic level has not been directly studied.

Membership in a functional department has often been used in research on group diversity and relational diversity as delineating the boundary of knowledge domain or a proxy for the nature of prior work experience. It has been suggested that different functional departments have different knowledge, perspectives and practices, and the longer individuals have worked in their functional department, the more they become accustomed to the "thought worlds" of the department, and the less open they become in their perspectives and approaches to problem solving (Dougherty, 1992; Geletkanycz & Black, 2001; Katz, 1982). In other words, too much time spent in a particular functional department may be associated with narrower experience. While area of expertise and organizational unit often overlaps, it is possible that people with the same amount of experience in their functional department have had and/or are currently experiencing task opportunities and challenges involving, to a varying degree,

multiple areas of expertise. Thus, to be more precise, it is important to distinguish experience in an area of expertise from membership in an organization unit.

The study reported in this chapter will examine both variety of experience directly defined and measured in terms of area of expertise, and current membership in a functional department of the organization, hereafter referred to as functional department experience.

5.3 Theory and hypotheses

The few existing studies relevant to variety of individual experience have focused on different elements that expand the variety of experience, such as the number of different organizations or functional departments worked in, number of different jobs ever had (Goodwin & Ziegler, 1998; Beyer & Hannah, 2002), number of national country and cultures worked in (Haas, 2006a), and distribution of total work experience into different functional areas (Bunderson & Sutcliffe, 2002). While all seem to highlight the variety of task opportunities and challenges, and sources of knowledge and information, functional area is most commonly used to distinguish domains of specialized task expertise and responsibilities.

However, the term functional area can refer to both an organizational unit and an area of expertise within an organization, and existing literature often uses affiliation with functional department as a proxy for the type of expertise an individual possess. However, as pointed out earlier, although individuals are usually affiliated with one

organizational unit, they can have experience in or work on tasks requiring multiple areas of expertise. For example, the organization under investigation consists of eight functional departments, but defines thirteen distinct areas of expertise based on the needs of services and solutions provided to the customers. While employees belong to one department, rarely do they possess just a single area of expertise or work on tasks that require only one type of expertise. Thus, to be precise, I use areas of expertise when referring to domains of specialized task expertise and responsibilities, and use functional department when referring an organizational unit. Variety of individual experience in this chapter is defined as the extent that individual have experience in different areas of expertise.

5.3.1 Variety of individual experience and ease of knowledge sharing

I adopt a learning perspective. Research on learning from experience suggests two types of learning: learning of domain knowledge, and "learning to learn", i.e. learning of the learning process independent of the knowledge content (Schilling et al., 2003). The former refers to learning of knowledge content, while the latter indicates learning of general approaches to problem solving or "modes of attack" (Ellis, 1965). Individuals become better at learning over time because they transfer their previous learning about how to assimilate or process particular kinds of information to the new situation. I argue that experience in multiple domain of expertise would allow both types of learning to occur, and that consequently, individuals with a great deal of variety

in prior experience may accumulate knowledge and develop the capability to better overcome barriers to knowledge sharing.

Research on associative learning suggests that people learn new ideas by associating those ideas with what they already know (Bower & Hilgard, 1981; Lindsay & Norman, 1977). Consequently, it is easier for people to understand and absorb new ideas in areas in which they have some knowledge. Knowledge sharing is therefore easier when the source and the recipient have common experience and knowledge (Cohen & Levinthal, 1990b). Experience is a critical source of knowledge and skills (Argote, 1999; Huber, 1991; Tesluk & Jacobs, 1998). Individuals with experience in multiple area of expertise may acquire the technical knowledge and skills, and develop an understanding of the task and social environment in those different areas (Bunderson & Sutcliffe, 2002; Zhu & Cummings, 2007). Consequently, individuals with greater variety of experience have a greater chance of sharing common experience and knowledge with others, and will likely find it easier to share knowledge with.

The second type of learning from experience may also take place in that individuals with greater variety of experience may develop a general approach to knowledge sharing that allows them to be more effective communicators regardless of the background of the target audience. To communicate one's knowledge successfully, people have to express what they know in a language that the recipient can understand, and frame their ideas in a way that fits the audience's perspective on issues (Bechky,

2003; Carlile, 2002). Communication across functional boundaries is particularly difficult, due to "thought world" differences, such as differences in knowledge, orientation, and language (Cohen & Levinthal, 1990; Dougherty, 1992). Prior experience in multiple functional areas may help bring these differences into conscious awareness. Individuals not only will become familiar with "thought world" differences across areas in which they have experience, but also become more sensitive to potential differences when interacting with any people. Such awareness and sensitivity is a necessary first step toward solving communication problems across boundaries. This awareness and sensitivity may help individuals refrain from making ego-centric assumptions that others know what they themselves know (Hinds, Patterson, & Pfeffer, 2001), proactively detect potential problems, and take steps to deal with them.

The knowledge and understanding about different areas of expertise acquired from prior experience enable individuals to employ the right expression and avoid jargon, and to adopt the appropriate framing and relate their ideas to the concerns and interests of the audience. Individuals may also develop a general approach that makes them more skillful in figuring out through trial and error how to adapt their expression, frame issues and convey ideas when confronted with an audience from unfamiliar areas, as they have had more opportunity to learn and practice in such situations (Reagans & McEvily, 2003).

In sum, the above analysis suggests individual with greater variety of prior experience may perceive knowledge sharing to be less costly in time and effort, because they are more likely to have common knowledge with the audience, and have the capability to communicate effectively with others. Common experience has been cited as the mechanism accounting for the positive association between variety of individual experience and knowledge sharing (Bunderson & Sutcliffe, 2002). The common experience argument hinges upon the first type of learning, i.e., learning of knowledge content. I have argued that variety of experience may allow learning above and beyond knowledge content of different domain, that is, learning of general approaches that make them more effective in knowledge sharing regardless of the background of the target audience. Therefore, while common experience is expected to mediate the positive association between variety of experience and ease of knowledge sharing, the mediation should be at most partial. In other words, variety of individual experience should have a positive effect on ease of knowledge sharing even after controlling for dyadic common experience.

Hypothesis 1a. *Everything else being equal, more variety of individual experience will be associated with greater ease of dyadic knowledge sharing.*

Hypothesis 1b. *Dyadic common experience will partially mediate the effect of variety of individual experience on ease of dyadic knowledge sharing.*

5.3.2 Variety of individual experience, individual functional department experience, dyadic functional difference and ease of knowledge sharing

In this section, I examine the interplay between variety of individual experience, individual functional department experience, and dyadic functional difference. As pointed out earlier, individuals are often affiliated with one organizational unit, but can have experience working on tasks requiring multiple areas of expertise. Existing literature often uses current functional affiliation as a proxy for the type of expertise an individual possesses, and current functional composition of groups as a proxy for the breadth of expertise available in the group. To be precise, I use areas of expertise when referring to domains of specialized task expertise and responsibilities, and use functional department when referring an organizational unit. Variety of individual experience is defined as the extent that individual have experience in different areas of expertise. Functional department experience refers to the extent to which a focal individual's full time working experience is confined within the current functional department. Dyadic functional difference captures whether the dyad are currently affiliated with different functional department.

Assuming that experience is an important source of knowledge, functional department experience can be a proxy for depth of individual expertise in that functional area; dyadic functional difference can be a proxy for breadth of expertise at the dyad level. Therefore, studying the interplay between variety of individual experience, functional department experience, and relational functional difference in

shaping dyadic knowledge sharing may shed light on the interplay between variety, depth and breadth in shaping group knowledge sharing.

5.3.2.1 Variety of individual experience and functional department experience

To the extent that experience in a particular functional department is associated with experience with a single area of expertise, extended experience within a particular functional department may be associated with greater difficulty in knowledge sharing. As individuals spend more time in a particular functional department, they develop greater expertise in the skills, tools, and practices of that department, but at the same time, their views and perspectives become increasingly narrowed (March & Simon, 1958; Beyer et al., 1997). With a narrow basis of experience and knowledge, individuals may lack the absorptive capacity to effectively source knowledge, especially when it is from people who work in a different functional department and have difference expertise.

Extended experience in a particular functional department may also make it harder for individuals to explain ideas and theories of their functional department to people from a different department (Zhu & Cummings, 2007). People with advanced expertise in a functional area follow a more abstract conceptual model in approaching problems (Gitomer, 1988). They articulate their thoughts in a more abstract way, for example, by skipping steps, using short cuts in describing how to solve a problem, using language with connotations specific to their area, or using more abstract statements in communication (Blessing & Anderson, 1996; Hinds et al., 2001). This may not be a

serious concern when experts are communicating with people from the same area, as shared experience provides a rich context for people to figure out the skipped steps, to appropriately interpret jargon, and to make sense of abstract expressions, but may create a comprehension problem for people from a different area who lack the background knowledge[1].

In addition, staying in a single department for an extended period of time may also restrict the opportunity to communicate with people from outside of the functional unit. Motivation to seek knowledge from outside of the functional department may also be reduced, because as experience in a particular area mounts, individuals may become so accustomed to practices and behaviors typical to that department to the point that they become less open to new knowledge and perspectives, and less open to change (Geletkanycz et al., 2001; Katz, 1982). As a result, individuals become more confined within their current department and less motivated to engage in knowledge sharing with people from other departments. Consequently, they do not get much opportunity to learn and practice communicating across organizational and knowledge boundaries. The above analysis thus suggests the following hypothesis,

Hypothesis 2a. *Everything else being equal, extended functional department*

---

[1] This point would suggest an interaction between functional department experience and dyadic functional difference in predicting ease of dyadic k knowledge sharing. However, my focus in this section is on the moderating role of variety of individual experience. Therefore, while fully aware of the possibility, I will not hypothesize on the interaction between functional department experience and relational functional difference. When analyzing data, I tested the interaction between functional department experience and functional difference. The coefficient estimate is not significant.

experience will be associated with less ease of knowledge sharing.

Although individuals with extended experience in a particular functional department tend to have limited variety in experience with different areas of expertise, extended membership in a functional department does not preclude the possibility that one has been involved in tasks and responsibilities that require expertise from multiple areas. As discussed earlier, extended experience in a functional department may have a negative impact on ease of knowledge sharing mainly because a narrow basis of experience reduces the chance of common experience and knowledge, and restricts the opportunity and dampens the motivation for people to learn and practice communicating across boundaries. However, if an individual with extended experience in a functional department do manage to gain working experience in multiple areas of expertise, the above argued negative association may become weaker. In other words, variety of experience may mitigate the negative association between functional department experience and ease of knowledge sharing.

Hypothesis 2b. *The association between functional department experience and ease of knowledge sharing will become less negative with an increase in variety of experience.*

5.3.2.2 Variety of individual experience and dyadic functional difference

As defined earlier, dyadic functional difference captures if the two individuals come from two different functional departments. Different functional departments in

organizations tend to develop different specialized knowledge and conceptual framework in defining and interpreting organizational issues, as well as norms and values specific to their respective task and social context (Lawrence & Lorsch, 1967; Van Maanen & Katz, 1979). Charged with different tasks and responsibilities, different functional departments tend to have diverging goals and interests, and idiosyncratic language and vocabularies that are unfamiliar to outsiders (March & Simon, 1958; Tushman, Scanlan, 1981). Researchers have characterized highly differentiated functional departments as "thought worlds" (Dougherty, 1992). Communication within a thought world is ease as individuals have similar knowledge, common conceptual framework, and shared context. However, communication across thought worlds is made difficult by the multiple barriers to mutual understanding cited above. Therefore, dyadic functional difference should be associated with greater difficulty in knowledge sharing.

Hypothesis 3a. *Everything else being equal, dyadic functional difference will be associated with less ease of knowledge sharing.*

As pointed out earlier, the fact that an individual is currently working in a certain functional department does not preclude the possibility that this individual has previously worked in other different functional departments or been charged with jobs and responsibilities that requires knowledge and perspectives from multiple "thought worlds". When an individual has had prior experience in multiple functional

departments or area of functional expertise, the difficulty in sharing knowledge with someone from a different "thought world" shall be reduced. As I have argued earlier, it is likely that the focal individual has some familiarity with the knowledge, conceptual framework, norms, values, and languages of the other person. Additionally, the focal individual may have developed the capability to convey ideas and thoughts originated from his or her area in a way that is easy to understand by outsiders. Therefore, variety of individual experience may help break down the barriers to knowledge sharing associated with functional difference.

Hypothesis 3b. *The association between dyadic functional difference and ease of knowledge sharing will become less negative with an increase in variety of experience.*

5.3.3 Variety of individual experience, strength of ties and ease of knowledge sharing

It is commonly accepted that knowledge flows along network ties (Granovetter, 1972; Hansen, 1999; Szulanski, 1996). Strong ties have been found to have a positive effect on interpersonal knowledge sharing (Levin et al., 2004; Reagans et al., 2003a; Uzzi, 1996). Knowledge sharing is easier between individuals with strong ties, because people who communicate frequently and have a longer history of relationship may develop relationship-specific heuristics that facilitate knowledge sharing (Uzzi, 1997). Relationship-specific domain may develop as a result of mutual adjustment based on learning about each other, and about what has worked or has not via trial and error. For

example, individuals with stronger ties may know more about each other's domain of expertise, such as what each other knows and does not know, differences and similarities in the goals and values of each other's domain, and language and jargons in each other's domain; they may also have a better understanding of each other's unique communication style. Mutual knowledge and repeated experience in task communication allow individuals to develop approaches and practices specific to the particular dyadic relationship that enable effective dyadic knowledge sharing.

Knowledge sharing is more likely to happen between two individuals who communicate more often and who are emotionally close to each other. Strong ties are also associated with stronger motivation to help, as emotionally close individuals are more willing to put forth time and effort on behalf of each other, including sharing knowledge (Granovetter, 1982). In addition, strong ties are also more likely to foster the trust needed for individuals to give out useful information to each other, or to seek knowledge from each other without worrying about the truthfulness of the information and the loss of reputation (Levin et al., 2004). Consequently, an individual will bear less cost in terms of time and effort when sharing knowledge with a strongly connected tie, and perceive knowledge sharing with that person to be easier.

Hypothesis 4a. *Everything else being equal, stronger dyadic ties will be associated with higher levels of ease of knowledge sharing.*

Existing research on knowledge sharing has highlighted the importance of social relationship, while my previous discussion emphasized the potential importance of human capital (i.e., variety of individual experience). However, no study has investigated how social relationship and human capital may jointly influence knowledge sharing. Previous discussion suggests that stronger ties and greater variety of experience each can sufficiently reduce difficulty in knowledge sharing across boundaries. I further argue that dyadic tie strength and variety of individuals experience may substitute for each other in promoting ease of knowledge sharing, that is, the positive association between dyadic ties (or variety of individual experience) and ease of knowledge sharing may become weaker when there is a higher level of variety of experience (or when the dyadic ties are stronger).

As was pointed out earlier, individuals with stronger ties may develop relationship-specific heuristics that they can draw upon when sharing knowledge, as a result of learning about each other's expertise, learning of approaches and practices for effective knowledge sharing via trail and error. Variety of experience will also enhance ease of knowledge sharing because individuals with greater variety of experience tend to have a broader set of knowledge, and develop general approaches and skills in communication across boundaries. The functionality of dyadic social relationship and variety of experience seem to be mutual substitutes.

An individual with prior experience in multiple domain expertise is more likely to already have some understanding of his or her communication partner's domain, even if the individual has a limited prior relationship with the partner. Two individuals become knowledgeable about each other when they have known each other for a long time, or have communicated frequently. They do not need a high level of variety to increase the chance that they know about each other's expertise. Similarity, two individuals will have developed convergent tacit understanding and expectations regarding how to communicate in an effective manner. Thus, they will find knowledge sharing quite easy, even when they have worked only in a single functional domain. An individual with experience in multiple domains may find it easy to communicate with a stranger, because he or she can do so without dyadic specific heuristic by drawing upon the general approaches and skills developed via prior working. Therefore, to a certain extent, the existence of strong ties may render variety of experience redundant, and vice versa.

Additionally, rating of ease of knowledge sharing can not increase as if there are no upper bounds. When individual rating of ease of knowledge sharing has reached a high level, additional factors enhancing knowledge sharing will generate diminishing return. Therefore, when variety of experience is greater, ease of knowledge sharing would also be at a higher level, stronger dyadic ties are likely to have a smaller positive impact on ease of knowledge sharing than when variety of experience is low. Following

the same line of logic, variety should have a smaller positive impact on ease of knowledge sharing when there are strong dyadic ties. Consistent with the above discussion, I propose the following hypothesis:

Hypothesis 4b. *Tie strength will be less positively associated with ease of knowledge sharing as the variety of individual experience increases.*

Figure 13 is a graphic presentation of the hypothesized relationships. To summarize, I have hypothesized that variety of individual experience would have a positive effect on ease of dyadic knowledge sharing (H1a), which will be partially mediated by dyadic common experience (H1b). I have also hypothesized about the moderating role of variety of individual experience: (1) variety of individual experience will mitigate the negative association between functional department experience and ease of knowledge sharing, and between dyadic functional difference and ease of knowledge sharing; (2) variety of individual experience may to a certain extent substitute for the positive influence that strong ties have on ease of knowledge sharing, and consequently weaken the positive association between tie strength and ease of knowledge sharing.

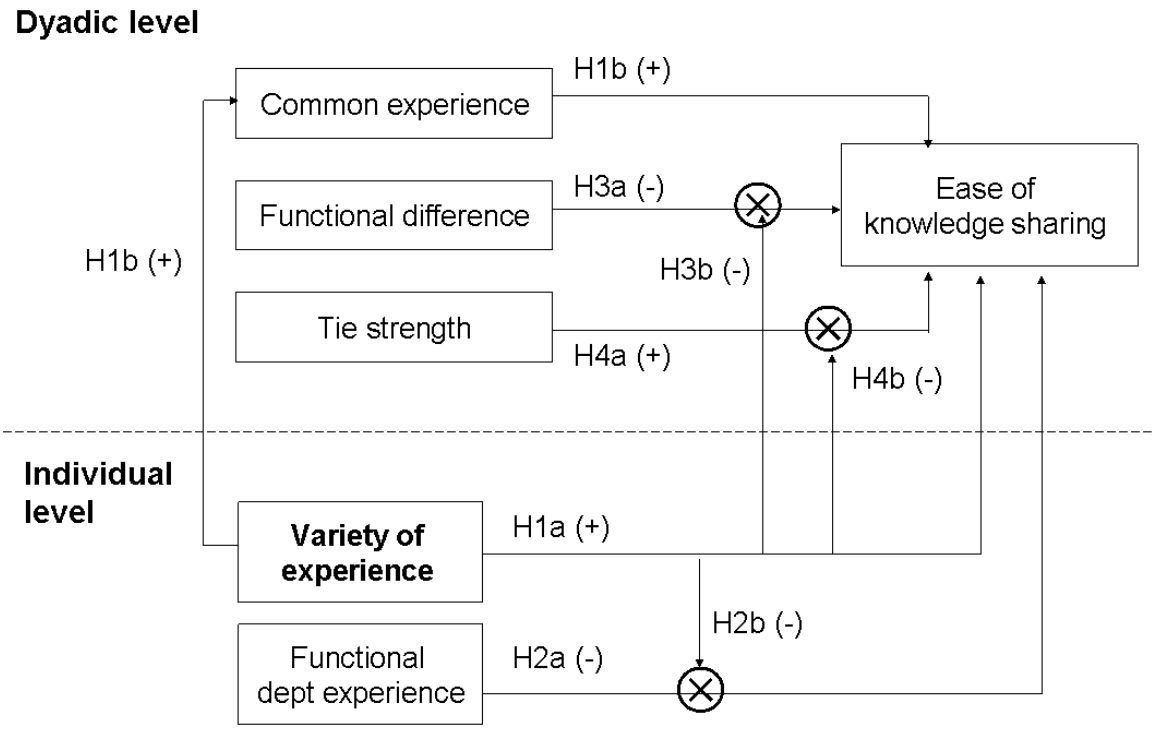


Figure 13: Model of individual variety of experience and ease of knowledge sharing.

5.4 Methods

The setting for the study is a division of a Fortune 500 IT service and consulting corporation that focuses on integrated supply chain services. This division provides supply chain management solutions to internal customers (namely, other corporate divisions) as well as consulting services to external clients. It offers services such as supply chain optimization, IT and data infrastructure for business process transformation, implementing ERP applications such as SAP and i2 and so on, with sustained support and service throughout the supply chain management life cycle. It

takes an integrated approach to project management, with substantial overlap between different stages of a project to ensure that early preparation and planning of projects are well articulated with the execution and implementation stages. As a project moves through the different stages, employees from different functional units are brought in as necessary. Thus knowledge sharing between people from different functional units working on different stages of a project is important for project success. At the time of the study, the organization consisted of eight functional departments employing a total of 74 employees.

Data for hypotheses testing were collected from a number of separate sources. Multiple interviews were conducted with the division director and a manager knowledgeable of the organization to understand how it is organized and how work is done. These interviews allowed me to understand the nature of work and to identify major areas of expertise within the organization. Employee background information, such as gender and functional department affiliation, were obtained from a company database. Reports of variety of prior experience, dyadic tie strength, ease of knowledge sharing and other control variables were collected using a survey instrument. The survey took about 30 minutes, and was emailed to a total of seventy employees and managers in all eight functional departments, excluding the division director and three senior managers. To motivate employees to respond to the survey, the manager working with me on the project emailed the employee about the study before I emailed the

survey out. The letter briefly introduced the purpose of the research and assured the employees of the voluntary nature of the research and management support of the confidential nature of all data collected. 44 of the 70 (63%) employees responded. All those responded completed the entire survey.

5.4.1 Network data

The survey gathered information on participant's social network within the organization to assess ease of knowledge sharing, common experience and tie strength. I combined two approaches to network data collection: the sociometric approach and the ego-centric approach (Wasserman, Faust, & Zaheer, 1994). The sociometric approach provides each respondent with a list of all actors in the network (e.g. an organization) under investigation, and a respondent can describe his or her relationship with every individual on the list. While the sociometric approach collects information on all interactions within a network, it tends to be very time consuming. In addition, it is very likely that many contacts on the list will be outside of the respondent's frame of reference, resulting in inaccurate information (Krackhardt & Kilduff, 1999). The ego-centric approach asks the participants to name individuals with whom they have specific kinds of relationship, resulting in a list of contacts (Burt, 2004). The respondent next describes the relationship with each cited contact. This approach is more efficient and focuses on contacts that participants are familiar with. However, participants may

tend to recall contacts with strong ties, and may also make errors in recalling all important contacts.

In this study, the ego-centric approach is supplemented with a list of all employees in the organization to facilitate recalling. Participants were asked to name up to 15 employees within the organization with whom they have one or more of the following relationships: (1) People who have acted as important sources of work-related knowledge and advice for the respondent, or have regularly turned to the respondent for knowledge and advice during the past six months, and (2) People with whom the respondent spent their free time and see socially during the past six months, such as lunch, dinner, drinks, films, visiting one another's homes, and so on. Participants were then asked to rate ease of knowledge sharing and strength of relationship with each contact.

5.4.2 Variables

5.4.2.1 Dependent variable

The dependent variable, ease of knowledge sharing, is assessed at the dyadic level. As described earlier, participants first identified a list of contacts within the organization. They then rated the extent to which they agree or disagree with three items (See Table 7 for the items) about knowledge sharing with each of the cited contact on a 7-point scale, ranging from 1, "strongly disagree" to 7, "strongly agree". The items are adapted from the 5-item ease of knowledge transfer scale developed by Reagans and

McEvily (2003). The scale assessed participants' perception of the extent to which knowledge sharing between the dyad is easy or difficult. The items define a single knowledge transfer variable. The Cronbach's alpha among the three items is 0.84, supporting the internal consistency of these items as reflecting a single underlying construct. The first principle component from a factor analysis of the items explains 76 percent of the variance. The mean of the three items was computed to form a single indicator of ease of knowledge sharing.

Table 8: Items for ease of knowledge sharing and knowledge codifiability.

Items	Mean	SD	Loading
Ease of knowledge sharing			
Overall, it is very ease to share with each other knowledge and information from our respective area of expertise.	5.86	1.28	0.88
We were able to explain clearly to each other key ideas, concepts or theory in our respective area of expertise.	5.87	1.32	0.90
*We have difficulty understanding each other's ideas and thoughts.	6.05	1.33	0.83
Knowledge codifiability			
A useful manual or document describing my area of expertise could be easily written.	3.32	2.02	0.90
Extensive documentation describing critical parts of my area of expertise is available.	3.80	2.19	0.89
Extensive documentation describing how to apply my area of expertise to address applied problems is available.	3.25	2.10	0.93

5.4.2.2 Independent variables

The focal independent variable is variety of individual experience. Bunderson and Sutcliffe (2002) provided subjects with a list of functional areas, and then asked subjects to indicate the number of years of their work experience in each of the functional areas and then calculated a Blau (1977) heterogeneity index to measure diversity of experience for each subject. I adapted this approach to fit the context of the research site. Initial interviews reveal that while the organization consists of eight functional departments, each department does not necessarily correspond to a single area of expertise, and employees tend to be affiliated with a single functional department during their tenure in the organization. In addition, employees usually work in the same functional department throughout their tenure in the organization. Therefore, functional department affiliation cannot adequately capture different area of expertise. Working together with a knowledgeable manager, I defined thirteen areas of expertise within the organization, including accounting, business development/strategic planning, customer service, finance, manufacturing, materials management, personnel/HR, procurement, production planning, project management, sales, scheduling, and warehouse/distribution. Participants were asked to think about their entire full-time work experience, and indicate the percentage of their full-time work experience that involved tasks and responsibilities in each of the thirteen area of expertise. An indicator of variety of prior experience is computed using Blau's

heterogeneity index, $1-\sum_{j=1}^{m} p_j^{\,2}$, where p_j equals the percentage of work involving knowledge and skills in the *j*th area of expertise and *m* indicates the number of areas, i.e. thirteen.

Another important independent variable is dyadic common experience. As pointed out earlier, participants indicated the percentage of their full-time work experience that involved tasks and responsibilities in each of the thirteen area of expertise. To capture the extent to which two individuals within a dyad had similar experience. I computed the correlation between the ratings of the sender and receiver within the dyad. A higher correlation suggests a greater degree of dyadic similarity in prior working experience. An alternative would be the number of areas where both individuals within a dyad have experience. However, I believe the correlation measure captures more information. It not only accounts for the number of areas in which both individuals have experience, but also assesses if the focal person has more experience where his or her contact has more[2]. Therefore, the correlation measure is more precise in capturing the extent to which two individuals have commonality in their prior working experience.

---

[2] The correlation measure of dyadic common experience is therefore expected to be more strongly associated with ease of knowledge sharing than the number of areas in which both individuals have experience. Additional analysis not reported in this chapter shows that the number of areas in which both individuals have experience is not significantly associated with ease of knowledge sharing, while the correlation measure of dyadic common experience is.

Functional department experience is measured as tenure in the current functional department divided by the total number of years worked fulltime. Participants indicated the number of years they have worked fulltime, and in their current functional department. A percentage measure is used because it better captures the extent to which an individual's experience is confined to a single department. Dyadic functional difference is based the current functional affiliation of participants obtained from company record. For each dyad, functional difference will have a value of one if the two individuals within the dyad work in two different functional departments, and zero if they work in the same functional department.

The final independent variable is tie strength. As described earlier, after identifying their network contacts within the organization, participants were asked to describe tie strength. Granovetter (1973) suggested three components of tie strength: closeness, duration and frequency of communication. To assess closeness, respondents were asked, "How close are you with this person?" (1-Very distant, 2-Distant, 3-Less than close, 4-Close, 5-Very close). To assess duration, respondents were asked, "How long have you known this person?" Finally, to assess frequency of communication, participants were asked, "On average, how often do you talk with him/her on task issues?" (1-Several times a day, 2-Several times a week, 3-Several time a month, 4-Once a month, 5-Less often).

There is no consensus as to whether or not closeness, duration and frequency should be combined. Granovetter holds that while all three are necessary components for tie strength, each may operate somewhat independently. Empirically, Marsden and Campbell (1984) provided evidence suggesting that closeness, frequency, and duration were not unitary dimensions. In the existing literature, some researchers used multiple indicators of tie strength (e.g. Hansen, 1999), while others analyzed the three components separately (Perry-Smith, 2006), still others used a single component to indicate tie strength, such as closeness (Lin, Ensel, & Vaughn, 1981; Seibert, Kraimer, & Liden, 2001) or frequency (Granovetter, 1973; Nelson, 1989). In this study, the Cronbach's alpha for the three dimensions is 0.49, and does not warrant combining the three. Therefore, I used the three measures separately.

5.4.2.3 Control variables

I controlled for two sets of variables. One set is dyadic level variables, including tenure difference, educational difference, gender difference, and reciprocity. Tenure difference is measured by the absolute difference in number of years worked in the organization. Gender difference is one if the respondent and network contact are different in gender, and zero otherwise. Reciprocity is one if the dyadic relationship is corroborated by the cited contact, and zero if the relationship is only named by the participant but not by the contact.

I also controlled for a few variables at the individual level, including level of education, number of years worked fulltime and knowledge codifiability. Participants reported the total number of years they have worked fulltime, and the highest level of education they have achieved. Knowledge codifiability is measured by three items (Please see Table 7 for details) adapted from a scale used by Reagans and McEvily (2003). Participants were asked to think about the expertise important to their current job, and rate the degree of agreement or disagreement with the three items on a 7-point scale ranging from 1, "strongly disagree", to 7, "strongly agree". The Cronbach's alpha among the three items is 0.89, supporting the internal consistency of these items as reflecting a single underlying construct. The first principle component from a factor analysis of the items explains 83 percent of the variance. The mean of the three items was computed to form a single indicator of knowledge codifiability.

5.4.3 Analysis

As mentioned earlier, the survey instrument was emailed to 70 out of the 74 employees in the organization (the division director and three senior managers were not included). 44 out of 70 (63%) responded to the survey. An average of 13 contacts was identified for each respondent. A tie exists from the respondent to the contact if the respondent reports a relationship. A total of 576 relationships were reported. After excluding relationships involving non-respondents and missing values, 341 dyads were left as the observations for analysis.

I did not require that the contact corroborate the tie[3]. 170 of the 341 dyads (50%) are reciprocated dyads. Thus, excluding non-reciprocated ties would greatly reduce the power to detect any significant relationship. More importantly, advice relationships inherently entail a certain degree of non-reciprocity (Kilduff & Krackhardt, 1994), because an individual may seek information and knowledge from another person, but not necessarily the other way around. In my study, 61% of the socializing ties (or socializing and advice ties) are reciprocated, while only 44% of the advice ties (non-socializing ties) are reciprocated. Therefore, excluding non-reciprocated ties tend to exclude advice ties. Excluding non-reciprocated ties also restricts the variation of the dependent variable. The standard deviation of ease of knowledge sharing is 1.22 for non-reciprocated dyads, in contrast with 0.94 for reciprocated dyads. Restricted variation in the dependent variable would make it harder to detect any significant relationship. Therefore, instead of dropping non-reciprocated dyads from analysis, I explicitly control for dyad reciprocity in the analysis.

The dependent variable is the respondent's rating of ease of knowledge sharing with the contact. Thus the unit of analysis is dyadic. However, because each respondent and each contact can appear in multiple dyads, the observations are not entirely independent. Error terms in the regression will be correlated across dyads involving the

[3]Analysis based on reciprocated dyads generated little significant results across the board due to reduced variation in the dependent variable and number of observations.

same individual, which will artificially reduce the standard errors of the estimates. To deal with the violation of independence, I followed prior research and employed the least-squares-with-dummy variables approach (Mizruchi, 1989; Mizruchi & Koenig, 1988; Reagans & McEvily, 2003). A dummy variable is created for each individual who sent or received a tie. Within a particular dyad, the dummy variables for the focal respondent and the focal contact are set equal to one, and all other dummy variables are set equal to zero. The fixed effects estimation also serves as a control for any unobserved heterogeneity among respondents and contacts, such as any tendency for respondents to rate themselves high on ease of knowledge sharing, or differences in their inherit ability to absorb knowledge and information (Reagans & McEvily, 2003).

5.5 Results

5.5.1 Variety of experience, dyadic common experience, and ease of knowledge sharing

Table 8 present descriptive statistics for main variables. Table 9 and Table 10 present regression analysis testing H1a and H1b. The dependent variable is ease of knowledge sharing, and the focal independent variables in the analysis are variety of individual experience and dyadic common experience. Models 1 to 3 in Table 9 regressed the dependent variable on control variables, including 44 dummies, each representing a participant, total work experience, knowledge codifiability, level of education, functional difference, tenure difference, gender difference, educational

difference, and tie strength. As pointed out earlier, the three dimensions of tie strength are analyzed separately. Model 1 has tie length, Model 2 has closeness, and Model 3 has frequency of communication. Knowledge codifiability has a significant positive association with ease of knowledge sharing in all three models. Functional difference has a significant negative association with ease of knowledge sharing in Model 1 only. Gender difference has a significant negative positive effect in Model 3. Finally, tie duration, closeness and frequency of communication all have a significant positive association with ease of knowledge sharing. The results for control variables are very much consistent with expectations. Differences in background reduce ease of knowledge sharing, while stronger ties facilitate knowledge sharing.

Table 9 (To be continued): Correlations between main variables

		Mean	Std. Dev.	1	2	3	4	5	6	7
1	Ease of knowledge sharing	5.91	1.12	1.00						
2	Common experience	0.18	0.34	0.16	1.00					
3	Variety of experience	0.32	0.25	0.16	-0.03	1.00				
4	Functional department experience	0.35	0.16	-0.04	-0.03	-0.06	1.00			
5	Duration	4.52	1.98	0.27	-0.04	-0.06	0.12	1.00		
6	Closeness	3.33	1.02	0.39	0.09	-0.13	0.08	0.46	1.00	
7	Frequency of communication	3.10	1.22	0.29	0.17	-0.07	0.03	0.05	0.38	1.00
8	Functional difference	0.65	0.48	-0.16	-0.14	-0.01	0.00	0.05	-0.27	-0.32
9	Educational difference	0.83	0.81	-0.02	-0.02	0.08	-0.05	0.13	-0.05	0.06
10	Tenure difference	3.33	2.85	-0.03	0.07	0.00	0.01	-0.13	-0.15	-0.17
11	Gender difference	0.23	0.42	-0.06	0.05	0.00	0.06	-0.18	-0.04	0.08
12	Reciprocity	0.50	0.50	0.21	0.06	-0.13	0.03	0.07	0.25	0.28
13	Type of relationship	1.65	0.91	0.18	-0.04	-0.12	0.07	0.13	0.29	0.19
14	Level of education	4.11	0.84	-0.02	0.07	-0.07	0.10	-0.17	-0.09	-0.01
15	Knowledge codifiability	3.48	1.83	0.13	0.01	0.19	-0.36	-0.02	-0.02	-0.03
16	Number of years worked	21.35	8.61	-0.02	0.00	0.02	-0.39	0.41	0.22	-0.03

$|r| >= 0.14$, $p < 0.05$; $|r| >= 0.16$, $p < 0.01$

Table 9 (Continued): Correlations between main variables

		8	9	10	11	12	13	14	15	16
7	Frequency of communication									
8	Functional difference	1.00								
9	Educational difference	0.05	1.00							
10	Tenure difference	0.05	0.02	1.00						
11	Gender difference	-0.08	-0.14	0.06	1.00					
12	Reciprocity	-0.19	-0.15	0.00	0.09	1.00				
13	Type of relationship	-0.10	-0.06	-0.16	-0.06	0.17	1.00			
14	Level of education	-0.15	-0.18	-0.01	-0.04	0.09	0.07	1.00		
15	Knowledge codifiability	0.04	0.05	0.16	0.02	-0.04	0.01	-0.13	1.00	
16	Number of years worked	0.06	0.17	-0.05	-0.13	-0.01	-0.04	-0.24	0.07	1.00

$|r|>=0.14$, $p<0.05$; $|r|>=0.16$, $p<0.01$

Table 10 (To be continued): Predicting ease of knowledge sharing from variety of individual experience and dyadic common experience

Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Level of education	-0.11	-0.07	-0.09	-0.12	-0.08	-0.10
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Number of years worked	-0.00	-0.01	0.00	-0.01	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Knowledge codifiability	0.09*	0.09*	0.09*	0.06	0.05	0.05
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Type of relationship	0.13*	0.09	0.13*	0.15*	0.11+	0.15*
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Reciprocity	0.36**	0.29*	0.25*	0.36**	0.29*	0.24*
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Gender difference	-0.31	-0.26	-0.42*	-0.31+	-0.25	-0.42*
	(0.19)	(0.18)	(0.18)	(0.19)	(0.18)	(0.18)
Educational difference	0.03	0.02	-0.06	0.01	0.00	-0.08
	(0.09)	(0.09)	(0.09)	(0.09)	(0.08)	(0.08)
Tenure difference	-0.01	-0.01	-0.02	-0.00	-0.00	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Functional difference	-0.25*	-0.14	-0.12	-0.26*	-0.14	-0.12
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Tie duration	0.15**			0.14**		
	(0.05)			(0.05)		
Closeness		0.32**			0.33**	
		(0.07)			(0.07)	
Frequency of communication			0.24**			0.26**
			(0.05)			(0.05)
Variety of experience				0.89**	1.01**	1.06**
				(0.30)	(0.29)	(0.29)
Common experience						
Variety*common experience						
Constant	7.04**	6.07**	6.34**	7.47**	6.57**	6.86**
	(0.84)	(0.83)	(0.82)	(0.84)	(0.82)	(0.82)
Adjusted R^2	0.400	0.422	0.418	0.417	0.444	0.442
Observations	341	341	341	341	341	341

Standard errors in parentheses; + p< 10%; * p< 5%; ** p< 1%

Table 10 (Continued): Predicting ease of knowledge sharing from variety of individual experience and dyadic common experience

	DV: Ease of knowledge sharing		
Independent variables	(7)	(8)	(9)
Level of education	-0.13	-0.08	-0.10
	(0.09)	(0.09)	(0.09)
Number of years worked	-0.00	-0.01	0.00
	(0.01)	(0.01)	(0.01)
Knowledge codifiability	0.09*	0.08*	0.09*
	(0.04)	(0.04)	(0.04)
Type of relationship	0.14*	0.10	0.14*
	(0.06)	(0.06)	(0.06)
Reciprocity	0.35**	0.30*	0.26*
	(0.12)	(0.12)	(0.12)
Gender difference	-0.29	-0.25	-0.41*
	(0.19)	(0.18)	(0.18)
Educational difference	0.05	0.03	-0.05
	(0.09)	(0.09)	(0.09)
Tenure difference	-0.01	-0.01	-0.02
	(0.02)	(0.02)	(0.02)
Functional difference	-0.22+	-0.12	-0.11
	(0.12)	(0.12)	(0.12)
Tie duration	0.16**		
	(0.05)		
Closeness		0.31**	
		(0.07)	
Frequency of communication			0.22**
			(0.06)
Variety of experience			
Common experience	0.47**	0.37*	0.31+
	(0.16)	(0.16)	(0.16)
Variety*common experience			
Constant	7.25**	6.25**	6.50**
	(0.83)	(0.82)	(0.82)
Adjusted R^2	0.416	0.431	0.423
Observations	341	341	341

Standard errors in parentheses; + p< 10%; * p< 5%; ** p< 1%

Table 10 (Continued): Predicting ease of knowledge sharing from variety of individual experience and dyadic common experience

	DV: Ease of knowledge sharing					
Independent variables	(10)	(11)	(12)	(13)	(14)	(15)
Level of education	-0.14	-0.09	-0.11	-0.13	-0.09	-0.11
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Number of years worked	-0.01	-0.01	0.00	-0.01	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Knowledge codifiability	0.05	0.04	0.05	0.05	0.04	0.05
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Type of relationship	0.17**	0.13*	0.16**	0.17**	0.13*	0.16**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Reciprocity	0.35**	0.29*	0.25*	0.35**	0.29*	0.25*
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Gender difference	-0.29	-0.25	-0.40*	-0.29	-0.24	-0.40*
	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
Educational difference	0.03	0.01	-0.06	0.03	0.02	-0.06
	(0.09)	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)
Tenure difference	-0.01	-0.00	-0.01	-0.00	-0.00	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Functional difference	-0.22+	-0.12	-0.11	-0.22+	-0.12	-0.11
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Tie duration	0.15**			0.15**		
	(0.05)			(0.05)		
Closeness		0.31**			0.32**	
		(0.07)			(0.07)	
Frequency of communication			0.23**			0.23**
			(0.05)			(0.05)
Variety of experience	0.92**	1.03**	1.07**	0.90**	1.02**	1.06**
	(0.29)	(0.29)	(0.29)	(0.29)	(0.29)	(0.29)
Common experience	0.49**	0.39*	0.32*	0.50**	0.40*	0.34*
	(0.16)	(0.15)	(0.16)	(0.16)	(0.16)	(0.16)
Variety*common experience				-0.45	-0.45	-0.49
				(0.56)	(0.55)	(0.56)
Constant	7.70**	6.77**	7.03**	7.64**	6.71**	6.96**
	(0.83)	(0.82)	(0.82)	(0.84)	(0.82)	(0.82)
Adjusted R^2	0.434	0.454	0.448	0.433	0.453	0.448
Observations	341	341	341	341	341	341

Standard errors in parentheses; + p< 10%; * p< 5%; ** p< 1%

Variety of experience is introduced in Models 4 to 6. In all three models, variety of experience has a highly significant positive coefficient, providing support to Hypothesis 1a. Dyadic common experience is introduced in Models 7 to 9. As expected, common experience has a significant positive effect on ease of knowledge sharing in Model 7 and 8, and a positive effect significant at 0.1 level in Model 9. Both variety of experience and common experience are included in Models 10 to 12. Common experience is positive and significant in all three models as well. However, it does not seem to mediate the association between variety of experience and ease of knowledge sharing, as the coefficients for variety of experience in Models 10 to 12 are identical to those in Models 4 to 6. Hypothesis 1b is not supported. To further understand the relationship between variety of experience and dyadic common experience, I also predicted common experience with variety of individual experience (See Table 11). However, inconsistent with my expectation, the regression coefficient for variety of experience is insignificant, further invalidating Hypothesis 1b.

Table 11: Predicting dyadic common experience from variety of experience.

	Dependent variable: Dyadic common experience					
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Level of education	0.03	0.04	0.04	0.03	0.04	0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Number of years worked	0.00	-0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Knowledge codifiability	0.01	0.01	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Type of relationship	-0.03	-0.04+	-0.04+	-0.03	-0.04+	-0.04+
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Gender difference	-0.04	-0.02	-0.05	-0.04	-0.02	-0.05
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Educational difference	-0.04	-0.03	-0.04	-0.04	-0.03	-0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Tenure difference	0.00	0.01	0.01	0.00	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Functional difference	-0.08+	-0.05	-0.02	-0.08+	-0.05	-0.02
	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)	(0.05)
Tie duration	-0.01			-0.01		
	(0.02)			(0.02)		
Closeness		0.05+			0.05+	
		(0.02)			(0.03)	
Frequency of communication			0.07**			0.07**
			(0.02)			(0.02)
Variety of experience				-0.06	-0.06	-0.04
				(0.11)	(0.11)	(0.11)
Constant	-0.20	-0.48	-0.55+	-0.21	-0.49	-0.56+
	(0.31)	(0.33)	(0.31)	(0.31)	(0.33)	(0.31)
Adjusted R^2	0.158	0.166	0.192	0.156	0.164	0.189
Observations	341	341	341	341	341	341

Standard errors in parentheses; + p< 10%; * p< 5%; ** p< 1%

5.5.2 Variety of experience, functional department experience, functional difference, and ease of knowledge sharing

As I have argued earlier, variety of experience may also exert an impact on ease of knowledge sharing by moderating the effect of other variables. Table 12 presents regression results for the interaction between variety of experience and functional department experience, and between variety of experience and dyadic functional difference in predicting ease of knowledge sharing. Models 1 to 3 show that functional department experience has a significant negative effect on ease of knowledge sharing, supporting Hypothesis 2a. Models 4 to 6 shows that the regression coefficient for dyadic functional difference is negative in all three models, but is only significant at 0.1 level in Model 7. Therefore, Hypothesis 3a is not supported. Models 7 to 9 included variety of experience, functional department experience and functional difference. Further supporting Hypothesis 2a, functional department experience remains negative and significant. Inconsistent with Hypothesis 3a, functional difference is only significant in Model 10 at 0.1 level. Finally, Models 10 to 12 in Table 12 test if variety of experience moderates the effects of functional department experience and dyadic functional difference on ease of knowledge sharing. In support of Hypothesis 2b, the interaction between variety of experience and functional department experience is positive and significant in all three models. The interaction between variety of experience and dyadic functional difference is positive and significant at 0.1 level in Models 10 and 12, providing partial support to Hypothesis 3b.

Table 12 (To be continued): Interaction between variety of experience and functional department experience, and between variety of experience and functional difference.

	DV: Dyadic ease of knowledge sharing (N=341)					
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Level of education	-0.15+	-0.11	-0.13	-0.13	-0.08	-0.10
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Number of years worked	-0.02*	-0.02*	-0.02	-0.00	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Knowledge codifiability	0.05	0.05	0.05	0.09*	0.08*	0.09*
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Type of relationship	0.16*	0.11+	0.14*	0.14*	0.10	0.14*
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Reciprocity	0.40**	0.32**	0.28*	0.35**	0.30*	0.26*
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Gender difference	-0.27	-0.24	-0.40*	-0.29	-0.25	-0.41*
	(0.18)	(0.18)	(0.18)	(0.19)	(0.18)	(0.18)
Educational difference	0.04	0.03	-0.05	0.05	0.03	-0.05
	(0.09)	(0.08)	(0.08)	(0.09)	(0.09)	(0.09)
Tenure difference	-0.01	-0.01	-0.02	-0.01	-0.01	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Tie duration	0.17**			0.16**		
	(0.05)			(0.05)		
Closeness		0.32**			0.31**	
		(0.07)			(0.07)	
Frequency of communication			0.24**			0.22**
			(0.05)			(0.06)
Common experience	0.50**	0.38*	0.31+	0.47**	0.37*	0.31+
	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)
Functional department experience	-1.53**	-1.49**	-1.59**			
	(0.54)	(0.53)	(0.53)			
Functional difference				-0.22+	-0.12	-0.11
				(0.12)	(0.12)	(0.12)
Variety of experience						
Variety*functional dept. experience						
Variety*functional difference						
Constant	6.65**	5.32**	5.92**	6.44**	5.16**	5.77**
Adjusted R^2	0.426	0.444	0.439	0.416	0.431	0.423

Standard errors in parentheses; + p< 10%; * p< 5%; ** p< 1%

Table 12 (Continued): Interaction between variety of experience and functional department experience, and between variety of experience and functional difference.

	DV: Dyadic ease of knowledge sharing (N=341)					
Independent variable	(7)	(8)	(9)	(10)	(11)	(12)
Level of education	-0.18*	-0.13	-0.15+	-0.19*	-0.15+	-0.17+
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Number of years worked	-0.02*	-0.03*	-0.02+	-0.02*	-0.03*	-0.02*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Knowledge codifiability	0.00	-0.01	-0.01	-0.01	-0.02	-0.02
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Type of relationship	0.17**	0.13*	0.17**	0.18**	0.13*	0.16**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Reciprocity	0.36**	0.30**	0.26*	0.35**	0.28*	0.23+
	(0.11)	(0.11)	(0.12)	(0.11)	(0.11)	(0.12)
Gender difference	-0.29	-0.25	-0.41*	-0.31+	-0.26	-0.42*
	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.17)
Educational difference	0.03	0.02	-0.06	0.04	0.00	-0.08
	(0.09)	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)
Tenure difference	-0.01	-0.01	-0.02	-0.01	-0.01	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Tie duration	0.15**			0.06**		
	(0.04)			(0.02)		
Closeness		0.32**			0.31**	
		(0.07)			(0.07)	
Frequency of communication			0.24**			0.25**
			(0.05)			(0.05)
Common experience	0.49**	0.39*	0.32*	0.49**	0.39*	0.32*
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
Functional department experience	-1.73**	-1.74**	-1.86**	-1.74**	-1.78**	-1.91**
	(0.53)	(0.52)	(0.52)	(0.53)	(0.52)	(0.52)
Functional difference	-0.21+	-0.11	-0.09	-0.22+	-0.13	-0.10
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Variety of experience	1.04**	1.15**	1.20**	0.47	0.71+	0.63+
	(0.29)	(0.28)	(0.28)	(0.38)	(0.37)	(0.37)
Variety*functional dept. experience				3.50*	3.48*	3.52*
				(1.66)	(1.63)	(1.63)
Variety*functional difference				0.77+	0.56	0.80+
				(0.42)	(0.41)	(0.41)
Constant	7.27**	5.99**	6.57**	7.44**	6.00**	6.54**
Adjusted R^2	0.452	0.473	0.470	0.459	0.480	0.481

Standard errors in parentheses; + p< 10%; * p< 5%; ** p< 1%

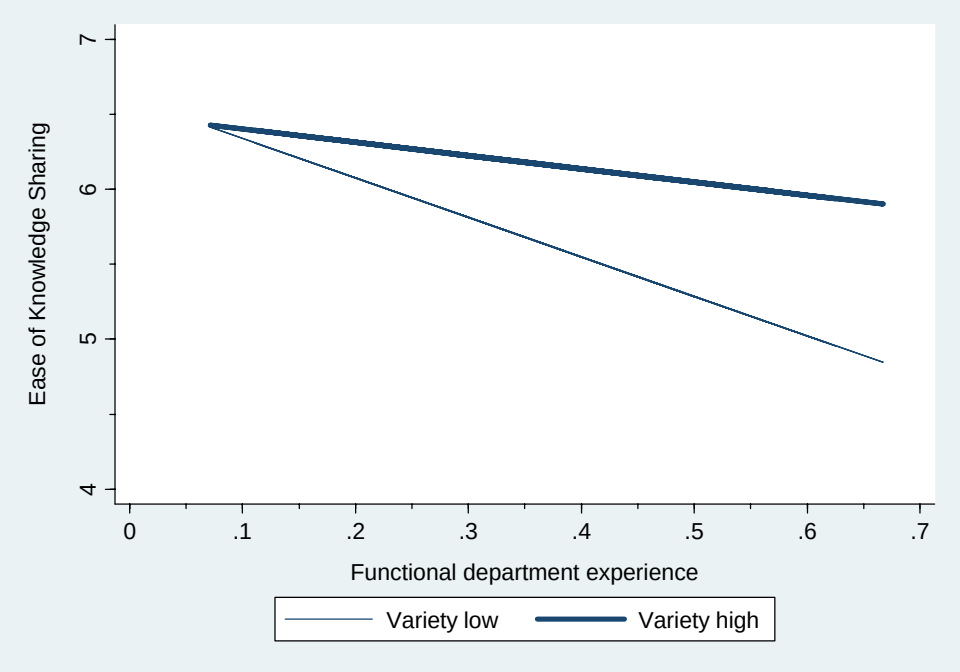


Figure 14: Predicting ease of knowledge sharing from variety of experience and functional department experience.

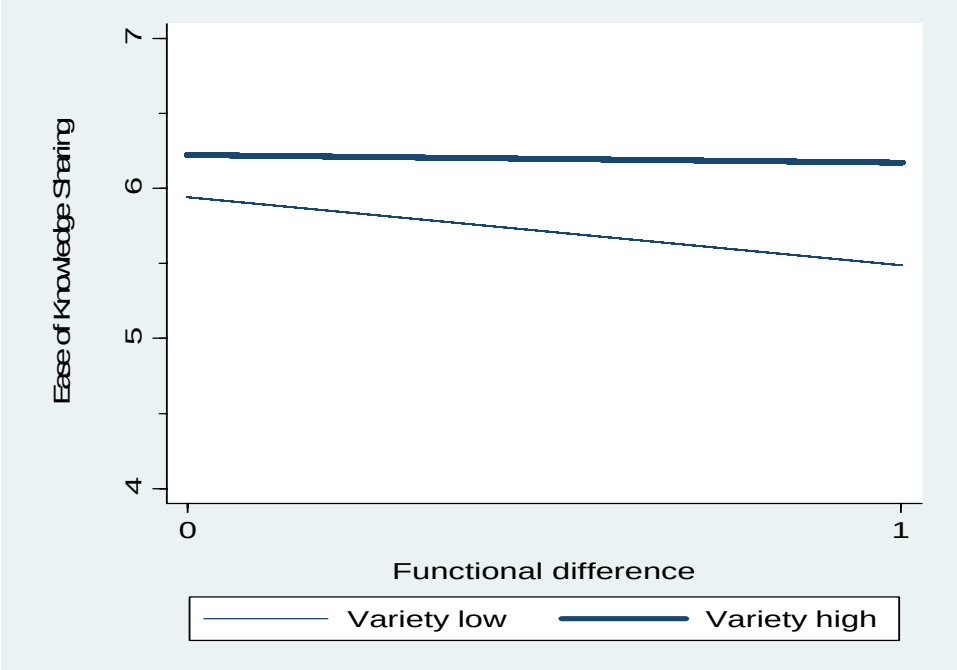


Figure 15: Predicting ease of knowledge sharing from variety of experience and dyadic functional difference.

To facilitate interpretation, I plotted the interactions between variety of experience and functional department experience in Figure 14[1], and the interaction between variety of experience and dyadic functional difference in Figure 15[2]. Figure 14 shows that functional department experience has a steeper downward slope when variety of experience is low, supporting the hypothesis that functional department experience has a more negative impact on ease of knowledge sharing when variety is low. The same pattern emerges in the plot for dyadic functional difference. Dyadic functional difference has a more negative impact on ease of knowledge sharing when variety of experience is low, as is indicated by the steeper downward slop of the thinner regression line in Figure 15.

5.5.3 Variety of experience, dyadic tie strength, and ease of knowledge sharing

Finally, Table 13 presents results on the interaction between variety of experience and dyadic tie strength. Models 1 to 3 are intended to refresh our memory on the main effects of variety of experience and tie strength on ease of knowledge sharing. Consistent with Hypothesis 4a, the main effect of tie strength is positive and significant. The interaction terms between variety of experience and each of the three components of tie

---

[1] Figure 14 plots the interaction between variety of experience and functional department experience in Model 11. Because the graphs for the interaction in Models 10 and 12 are identical to Figure 14 and largely redundant, I did not include them.

[2] Figure 15 plots the interaction between variety of experience and functional department experience in Model 10. Because the graphs for the interaction in Model 12 are identical to Figure 15 and largely redundant, I did not include it.

are introduced in Models 4 to 6 respectively. In support of Hypothesis 4b, the interaction terms are all negative and significant at least at 0.1 level, suggesting that the positive association between tie strength and ease of knowledge sharing becomes weaker when there is a higher level of variety of experience. To facilitate interpretation, I plotted the interactions in Figures 16 to 18. As the figures show, when variety of experience is high, duration, closeness and frequency of communication all have a flatter upward slope than when variety of experience is low, suggesting that the positive effect of tie strength on ease of knowledge sharing becomes weaker with the increase of variety of experience.

Table 13: Predicting ease of knowledge from variety of experience and tie strength.

	Dependent variable: Dyadic ease of knowledge sharing					
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Level of education	-0.14	-0.09	-0.11	-0.15+	-0.12	-0.12
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Number of years worked	-0.01	-0.01	0.00	-0.01	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Knowledge codifiability	0.05	0.04	0.05	0.07	0.05	0.03
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Type of relationship	0.17**	0.13*	0.16**	0.17**	0.13*	0.17**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Reciprocity	0.35**	0.29*	0.25*	0.35**	0.31**	0.22+
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Gender difference	-0.29	-0.25	-0.40*	-0.30	-0.23	-0.38*
	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
Educational difference	0.03	0.01	-0.06	0.02	-0.00	-0.09
	(0.09)	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)
Tenure difference	-0.01	-0.00	-0.01	-0.01	-0.01	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Functional difference	-0.22+	-0.12	-0.11	-0.23+	-0.12	-0.10
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Tie duration	0.15**			0.15**		
	(0.05)			(0.04)		
Closeness		0.31**			0.29**	
		(0.07)			(0.07)	
Frequency of communication			0.23**			0.26**
			(0.05)			(0.05)
Common experience	0.49**	0.39*	0.32*	0.47**	0.38*	0.31*
	(0.16)	(0.15)	(0.16)	(0.16)	(0.15)	(0.16)
Variety of experience	0.92**	1.03**	1.07**	0.82**	1.00**	1.09**
	(0.29)	(0.29)	(0.29)	(0.29)	(0.28)	(0.28)
Variety*duration				-0.28*		
				(0.11)		
Variety*closeness					-0.44+	
					(0.23)	
Variety*frequency						-0.51**
						(0.15)
Constant	7.70**	6.77**	7.03**	7.73**	6.80**	7.14**
	(0.83)	(0.82)	(0.82)	(0.82)	(0.82)	(0.81)
Adjusted R^2	0.434	0.454	0.448	0.445	0.459	0.467
Observations	341	341	341	341	341	341

Standard errors in parentheses; + p< 10%; * p< 5%; ** p< 1%

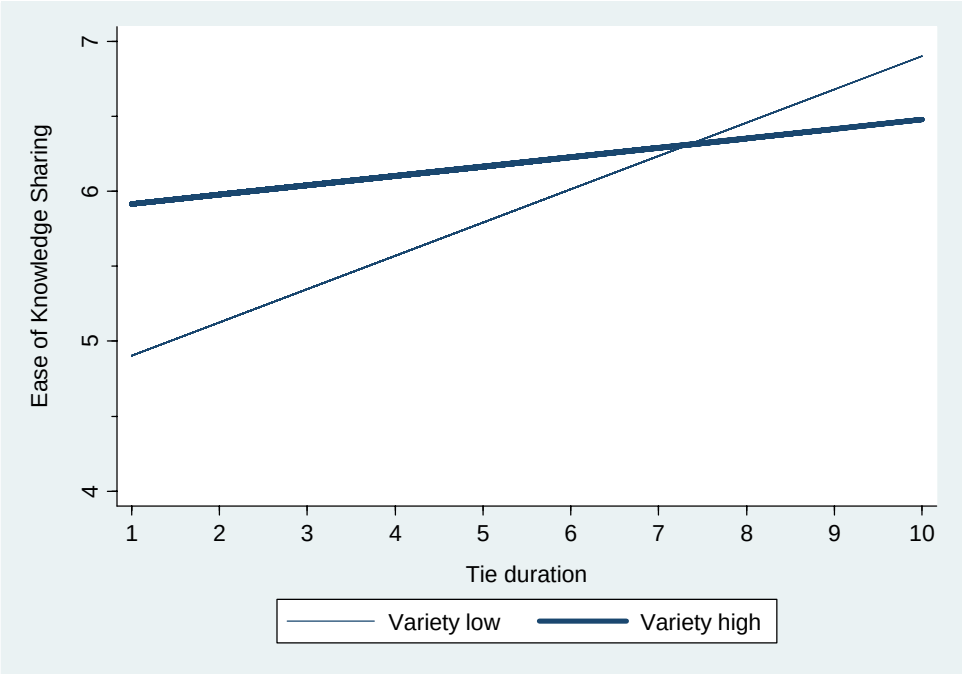


Figure 16: Predicting ease of knowledge sharing from variety of experience and tie duration.

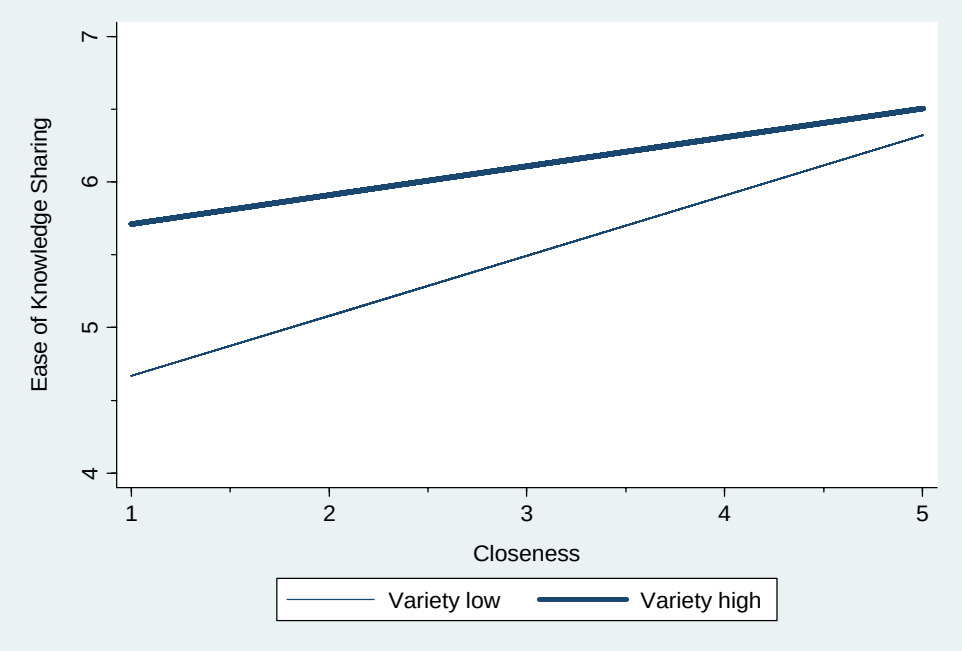


Figure 17: Predicting ease of knowledge sharing from variety of experience and closeness.

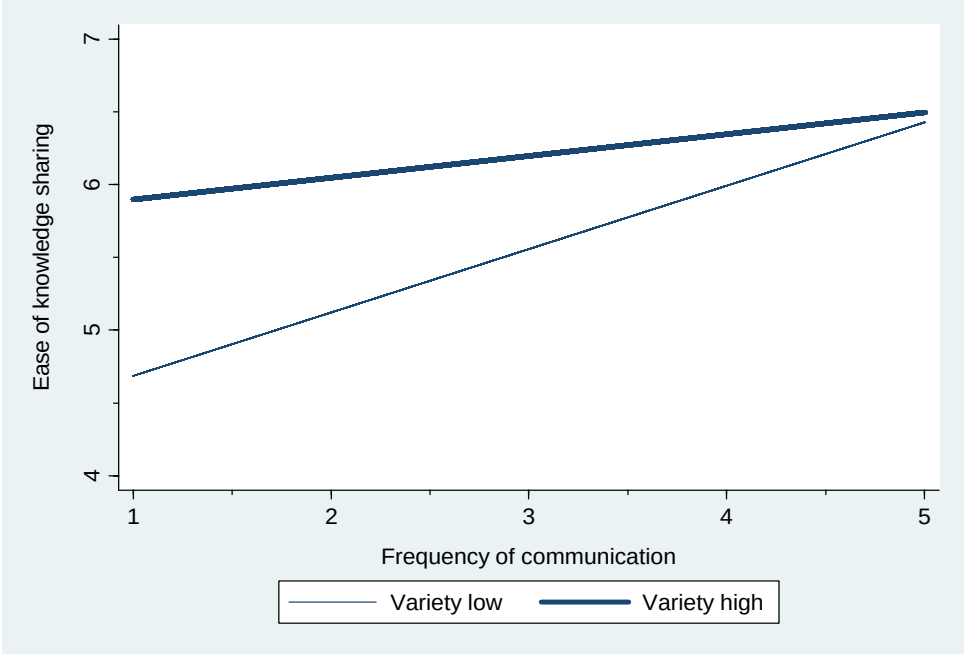


Figure 18: Predicting ease of knowledge sharing from variety of experience and frequency of communication.

In summary, the results reported above suggests that variety of experience has a significant positive effect on ease of knowledge sharing, mitigates the negative association between functional department experience and ease of knowledge sharing, and can substitute for the positive effect of strong ties on ease of knowledge sharing. The hypothesis that variety of experience may mitigate the negative effect of dyadic functional difference on ease of knowledge sharing received partial support. Inconsistent with my hypothesis, dyadic common experience, though positively influence ease of knowledge sharing, does not seem to mediate the effect of variety of

experience. Variety of experience is not significantly associated with dyadic common experience.

5.6 Discussion

The chapter starts with two observations, namely, there has been limited research on the impact of individual experience on interpersonal knowledge sharing, and the scarce attention paid to variety of experience in the current literature on individual work experience. The study aims to shed light on both issues by investigating the impact of variety of individual experience on ease of knowledge sharing at the dyadic level.

Two sets of results are empirically and theoretically important. The first set of theoretically interesting results is those related to different dimensions of work experience. The study provides evidence that variety of experience promotes ease of knowledge sharing controlling for dyadic level variables such as common experience and tie strength. In contrast, functional department experience has a negative association with ease of knowledge sharing. Finally, there is little support that dyadic functional difference reduces ease of knowledge sharing. As I have pointed out earlier, existing literature on individual experience has tended to think of experience in terms of length, such as time in a job or tenure in a company. The addition of the variety dimension is an important step towards a complete conceptualization of experience. The results in this

chapter demonstrate the importance of the variety dimension of individual work experience.

In Chapter 2, I proposed a three-dimensional conception of group expertise, including variety, depth and breadth of functional expertise. In this chapter, I constructed three different dimensions of work experience, namely, variety of individual experience, individual functional department experience, and dyadic functional difference. Functional department experience captures the extent to which an individual's working experience is confined to the current functional department, thus indicating depth of experience in that functional department. To the extent that experience is the most critical source of expertise, functional department experience can serve as a proxy for depth of expertise. Dyadic functional difference essentially measures whether there is one or two different functional department between the dyad, equivalent to breadth of expertise in groups. The results in this chapter demonstrate that different dimensions of experience (or expertise) have different impact on ease of knowledge sharing.

More importantly, I have argued that it is important to consider the multiple dimensions of expertise simultaneously because there are theoretical reasons to suspect multiplicative effects between the dimensions. In Chapter 3, I find support for a negative interaction between depth and breadth of expertise in predicting group performance. This chapter uncovers evidence fully consistent with a positive interaction between

variety of experience and functional department experience (depth), and partially consistent with a positive interaction between variety and dyadic functional difference (breadth) in predicting eases of knowledge sharing. These results encourage further investigation into the interplay between different dimensions of experience and experience in future studies on groups.

These results also contribute to the organizational learning literature and the knowledge-based view of organizations. "Thought world" differences among different functional areas have been considered a key barrier to effective communication across boundaries. The presence of experts from different functional areas with diverse expertise results in difficulty in knowledge sharing (Cohen & Levinthal, 1990; Van der Vegt & Bunderson, 2005). While researchers have conceptually entertained the potential important role that variety of experience and expertise within individuals may play in crucial organization process (e.g. Bartunek, Gordon, & Weathersby, 1983), empirical study has been limited. This chapter provides evidence in support of the positive effect that variety of experience has on dyadic knowledge sharing, clarifying one of the most crucial linkage from the learning of individuals to the learning of groups and organizations. An interesting direction to pursue is to examine the role of variety of experience in the acquisition and utilization of knowledge in groups. While Bunderson and Sutcliffe (2002) have demonstrated the positive impact that variety of experience

(within-person diversity in their terminology) has on knowledge sharing in groups, empirical investigation of its implication for groups is very limited.

The second set of results is the interaction between variety of experience and dyadic tie strength in predicting ease of knowledge sharing. While a network perspective has gained dominance in existing research on knowledge sharing, the results in this chapter suggests that individual experience may substitute for network ties to a certain degree, as is evident in the negative interaction between variety of experience and dyadic tie strength. Placed within a broader context, the interaction between experience and tie strength is suggestive of potential interplays between social capital and human capital in an organizational learning context. Existing literature has reported interesting results along this line. For example Haas (2006b) found that knowledge acquired from outside of project teams (at least in part via network contacts) requires internal capability to utilize it before it becomes beneficial to project performance, and the prior working experience of project members constitutes a critical component of this capability. While I focused on variety of experience and found a compensating relationship in knowledge sharing setting, Haas (2006b) looked at length of experience and reported a complementary relationship in the situation of knowledge utilization. Systematic research along this line is required to further understand the nature of the interplay between social capital and human capital, probably as a function of the kind of human capital, type of social capital, and nature of outcomes.

Some of the results reported in this chapter are in need of further explanation. Common experience or knowledge has been cited as an important reason why increasing variety of experience may enhance knowledge sharing. For example, research on absorptive capacity suggests that breadth of expertise within an organization shall enable the organization to source knowledge from the external environment more effectively because the chance is greater that the organization has pre-existing knowledge that is related to the external knowledge it is seeking (Cohen & Levinthal, 1990). The same logic is adopted to argue for the importance of variety of experience within an individual for knowledge sharing in groups (Bunderson & Sutcliffe, 2002; Boh, Slaughter, & Espinosa, 2007). In my study, variety of experience and dyadic common experience independently predict ease of knowledge sharing. However, variety of experience is not significantly associated with dyadic common experience in this study, and there is no evidence that dyadic common experience mediates the association between variety of experience and ease of knowledge sharing (See Table 10).

This result suggests that the mechanisms linking variety of experience to ease of knowledge sharing is more complicated than the routinely cited common experience. Though my study did not directly assess other learning outcomes of variety of experience, the result is consistent with my earlier arguments that individuals with experience in multiple areas learn more than just the content of domain-specific knowledge. They may acquire general skills and approaches to communication in

boundary-crossing situations that make them more effective in knowledge sharing even without the assistance of common experience.

Nevertheless, one would still expect variety of experience to have some impact on dyadic common experience. The lack of a significant association between variety of experience and dyadic common experience may be due to the way I measured common experience. As I have described earlier, I computed the correlation between two individuals' rating of their experience across all thirteen areas of expertise to measure common experience. This approach does not simply count the number of areas in which both individuals have experience, but further assess if the patterns of distribution of the two individuals' experience are similar. A higher correlation would suggest that the focal individual and his or her contact have more in common: not only they have experience in the same areas, but also the relative weights of those areas within the expertise experience profile are similar, in other words, the focal person has more experience where his or her contact has more. It seems to me that greater variety of experience will be more highly correlated with increases in the number of areas in which two individuals have some experience, but will be much less predictive of how similarly or differently the two individuals distribute their experience into those areas. Additional

analysis predicting the number of common areas with variety of experience provides some suggestive evidence to the speculation[1].

While this research advances our knowledge on experience and knowledge sharing, it is not without limitation. I attributed the observed association between experience and ease of knowledge sharing to the accumulation of diverse knowledge and development of the capability to communicate more effectively (e.g., take different perspectives and flexible framing). However, the results cannot completely rule out the alternative that individuals with greater variety of experience and who can share knowledge easily have greater absorptive capacity and communication skills, and those who are confined within a single area do not. I want to point out the fact that the models included a fixed effect for each individual involved, which should help account for individual differences in innate absorptive capacity and ability to communicate. Therefore, while variety of experience both requires and cultivates absorptive capacity

[1] To probe into this speculation, I computed the number of areas in which both individuals in the dyad have experience (number of common areas). I then examined the correlation between variety of experience, dyadic common experience (the correlation measure), and the number of common areas. As expected, the correlation measure of dyadic common experience and number of common areas are significantly and positively correlated ($r=0.22$, $p<0.01$), as they both aim to capture dyadic common experience. The correlation between variety of experience and the correlation measure of dyadic common experience is not significant, while the correlation between variety of experience and number of common areas is ($r=0.51$, $p<0.01$). I next replaced the dependent variable, i.e., the correlation measure of dyadic common experience, in Model 4, 5 and 6 presented in Table 11 with the number of common areas. In other words, I tried to predict the number of common areas using variety of experience. In all three models, the coefficients for variety of experience are positive, but are not significant. The p values for the coefficient in the three models are 0.11, 0.15, and 0.18 respectively.

and the ability to communicate across boundaries, the emphasis of the study is learning from experience.

Another important limitation has to do with the mechanism underlying the positive association between variety of experience and ease of knowledge sharing. I argued for two mechanisms, namely, common experience and expertise resulting from the learning of knowledge content, and capability and skills to communicate effectively regardless of the target audience resulting from the learning of general approaches from prior experience. The study directly measured dyadic common experience, but has no direct measure of the second type of learning. The result that variety of experience has a positive effect on ease of knowledge sharing controlling for common experience suggests the existence of additional learning beyond learning of knowledge content, it is by no means an evidence for the learning of general approach. Future studies are necessary to directly test the different mechanisms discussed in this chapter.

References

Allen, T. 1977. *Managing the Flow of Technology*. Cambridge, MA: MIT Press.

Alvesson, M. 2004. *Knowledge Work and Knowledge-Intensive Firms*. Oxford, UK: Oxford University Press.

Ancona, D. G., & Caldwell, D. F. 1988. Beyond task and maintenance - Defining external functions in groups. *Group & Organization Studies*, 13(4): 468-494.

Ancona, D. G., & Caldwell, D. F. 1992a. Demography and design: Predictors of new product team performance. *Organization Science*, 3(3): 321-341.

Ancona, D. G., & Caldwell, D. F. 1992b. Bridging the boundary - External activity and performance in organizational teams. *Administrative Science Quarterly*, 37(4): 634-665.

Argote, L. 1993. Group and organizational learning-curves - Individual, system and environmental components. *British Journal of Social Psychology*, 32: 31-51.

Argote, L. 1999. *Organizational Learning: Creating, Retaining and Transferring Knowledge*. Norwell, MA: Kluwer Academic Publishers Group.

Argote, L. 1999. *Organizational learning: Creating, retaining and transferring knowledge*. Norwell, MA: Kluwer Academic Publishers Group.

Argote, L., & Epple, D. 1990. Learning-curves in manufacturing. *Science*, 247(4945): 920-924.

Argote, L., Insko, C. A., Yovetich, N., & Romero, A. A. 1995. Group learning-curves - the effects of turnover and task complexity on group-performance. *Journal of Applied Social Psychology*, 25(6): 512-529.

Arthur, M. B., & Rousseau, D. M. 1996. Introduction: The boundaryless career as a new employment principle., *The boundaryless career: A new employment principle for a new organizational era.* New York: Oxford University Press.

Austin, J. R. 2003 "Transactive memory in organizational groups: The effects of content, consensus, specialization, and accuracy on group performance." *Journal of Applied Psychology*, 88: 866-878.

Bakeman, R. & Beck, S. 1974. The size of informal groups in public. *Environmental and Behavior*, (6): 378-390.

Barrick, M. R., Stewart, G. L. Neubert, M. J. & Mount, M. K. 1998. Relating member ability and personality to work-team processes and team effectiveness. *Journal of Applied Psychology*, 83: 377-391.

Bartunek, J. M., Gordon, J. R., & Weathersby, R. P. 1983. Developing complicated understanding in administrators. *Academy of Management Review*, 8(2): 273-284.

Baumann, M. R., & Bonner, B. L. 2003. The effects of variability and expectations on utilization of member expertise and group performance. *Organizational Behavior and Human Decision Processes*, 93: 89-101.

Bechky, B. A. 2003. Sharing meaning across occupational communities: The transformation of understanding on a production floor. *Organization Science*, 14(3): 312-330.

Beyer, J. M., & Hannah, D. R. 2002. Building on the past: Enacting established personal identities in a new work setting. *Organization Science*, 13(6): 636-652.

Beyer, J. M., Chattopadhyay, P., George, E., Glick, W. H., Ogilvie, D., & Pugliese, D. 1997. The selective perception of managers revisited *Academy of Management Journal*, 40(3): 716-737.

Blau, P. 1977. A macrosociological theory of social structure. *The American Journal of Sociology*, 83(1): 26-54.

Blessing, S. B. & Anderson, J. R. 1996. How people learn to skip steps. *Journal of Experimental Psychology-Learning Memory and Cognition*, 22(3): 576-598.

Bochner, S., Duncan, R., Kennedy, E., & Orr, F. 1976. Acquaintance links between residents of a high rise building - Application of small world method. *Journal of Social Psychology*, 100(2): 277-284.

Boh, W. F., Slaughter, S. A., & Espinosa, J. A. 2007. Learning from experience in software development: A multilevel analysis. *Management Science,* 53(8): 1315-1331.

Bonner, B. L. 2004. Expertise in group problem solving: Recognition, social combination, and performance. *Group Dynamics-Theory Research and Practice*, 8: 277-290.

Borgatti, S. P. & Cross, R. 2003. A relational view of information seeking and learning in social networks. *Management Science*, 49(4): 432-445.

Borman, W. C., Hanson, M. A., Oppler, S. H., Pulakos, E. D., & White, L. A. 1993. Role of early supervisory experience in supervisor performance. *Journal of Applied Psychology*, 78(3): 443-449.

Bower, G. H. & Hilgard, E. R. 1981. *Theories of learning*. Englewood Cliffs, NJ: Prentice-Hall.

Bradley, G. W. 1978. Self-serving biases in attribution process – Re-examination of fact or fiction question. *Journal of Personality and Social Psychology*, 36: 56-71.

Brewer, M. B. 1979. In-group bias in the minimal intergroup situation: A cognitive-motivational analysis. *Psychological Bulletin*, 86: 307-324.

Bromme, R., Rambow, R., & Nuckles, M. 2001. Expertise and estimating what other people know: The influence of professional experience and type of knowledge. *Journal of Experimental Psychology-Applied*, 7(4): 317-330.

Brown, S. L., & Eisenhardt, K. M. 1995. Product development - Past research, present findings, and future directions. *Academy of Management Review*, 20(2): 343-378.Bunderson, J. S. 2003. Recognizing and utilizing expertise in work groups: A status characteristics perspective. *Administrative Science Quarterly*, 48: 557-591.

Bunderson, J. S., & Sutcliffe, K. M. 2002. Comparing alternative conceptualizations of functional diversity in management teams: Process and performance effects. *Academy of Management Journal*, 45(5): 875-893.

Burt, R. S. 2004. Structural holes and good ideas. *American Journal of Sociology*, 110(2): 349-399.

Burt, R. S., Jannotta, J. E., & Mahoney, J. T. 1998. Personality correlates of structural holes. *Social Networks*, 20(1): 63-87.

Campion, M. A., Cheraskin, L., & Stevens, M. J. 1994. Career-related antecedents and outcomes of job rotation. *Academy of Management Journal*, 37(6).

Cannella, A. A., Park, J. H., & Lee, H. U. 2008. Top management team functional background diversity and firm performance: Examining the roles of team member co-location and environmental uncertainty. *Academy of Management Journal*, 51(4): 768-784.

Carlile, P. R. 2002. A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organization Science*, 13(4): 442-455.

Cohen, S. G., & Bailey, D. E. 1997. What makes teams work: Group effectiveness research from the shop floor to the executive suite. *Journal of Management*, 23: 239-290.

Cohen, W. M., & Levinthal, D. A. 1990. Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly* 35: 128-152.

Cramton, C. D. 2001. The mutual knowledge problem and its consequences for dispersed collaboration. *Organization Science*, 12(3): 346-371.

Crano, W. D., and R. Prislin. 2006 "Attitudes and persuasion." Annual Review of Psychology, 57: 345-374.

Cross, R., & Sproull, L. 2004. More than an answer: Information relationships for actionable knowledge. *Organization Science*, 15(4): 446-462.

Cross, R., Borgatti, S. P., & Parker, A. 2001. Beyond answers: Dimensions of the advice network. *Social Networks*, 23(3): 215-235.

Crossan, M. M., Lane, H. W., & White, R. E. 1999. An organizational learning framework: From intuition to institution. *Academy of Management Review*, 24(3): 522-537.

Cummings, J. N. 2004. Work groups, structural diversity, and knowledge sharing in a global organization. *Management Science*, 50(3): 352-364.

Cummings, J.N., & Haas, Martine. 2009. Does nationality matter in transnational teams? The effects of structural, demographic, and nationality differences on knowledge seeking. Working paper.

Dahlin, K. B., Weingart, L. R., & Hinds, P. J. 2005. Team diversity and information use. *Academy of Management Journal*, 48(6): 1107-1123.

Darr, E. D., Argote, L., & Epple, D. 1995. The acquisition, transfer, and depreciation of knowledge in service organizations: Productivity in franchises. *Management Science*, 41(11): 1750-1762.

Day, E. A., Arthur, W., Miyashiro, B., Edwards, B. D., Tubre, T. C., & Tubre, A. H. 2004. Criterion-related validity of statistical operationalizations of group general

cognitive ability as a function of task type: Comparing the mean, maximum, and minimum. *Journal of Applied Social Psychology*, 34(7): 1521-1549.

De Dreu, C. K. W., & West, M. A. 2001. Minority dissent and team innovation: The importance of participation in decision making. *Journal of Applied Psychology*, 86(6): 1191-1201.

Devine, D. J., and Philips. J. L. 2001. Do smarter teams do better - A meta-analysis of cognitive ability and team performance. *Small Group Research*, 32: 507-532.

Dougherty, D. 1992. Interpretive barriers to successful product innovation in large firms. *Organization Science*, 3(2): 179-202.

Dutton, J. E., & Ashford, S. J. 1993. Selling issues to top management. *Academy of Management Review*, 18(3): 397-428.

Ellis, H. 1965. *The Transfer of Learning*. New York: The Macmillan Company.

Epple, D., Argote, L., & Devadas, R. 1991. Organizational learning curves: A method for investigating intra-plant transfer of knowledge acquired through learning by doing. *Organization Science*, 2(1): 58-70.

Erickson, B. H. 1996. Culture, class and connections. *American Journal of Sociology*, 102(1): 217-251.

Ericsson, K. A., & Lehmann, A. C. 1996. Expert and exceptional performance: Evidence of maximal adaptation to task constraints. *Annual Review of Psychology*, 47: 273-305.

Ettenson, R., Shanteauand, J. and Krogstad, J. 1987. Expert judgment - Is more information better. *Psychological Reports*, 60: 227-238.

Faraj, S., & Sproull, L. 2000. Coordinating expertise in software development teams. *Management Science*, 46(12): 1554-1568.

Fiske, S. T., & Taylor, S. E. 1984. *Social Cognition*. New York: Random House.

Franz, T. M., and Larson, J. R. 2002. The impact of experts on information sharing during group discussion. *Small Group Research*, 33: 383-411.

Galbraith, J. R. 1973. *Designing complex organizations*. MA: Addison-Wesley.: Reading.

Geletkanycz, M. A. & Black, S. S. 2001. Bound by the past? Experience-based effects on commitment to the strategic status quo. *Journal of Management*, 27(1): 3-21.

George, J. M., & Zhou, J. 2001. When openness to experience and conscientiousness are related to creative behavior: An interactional approach. *Journal of Applied Psychology*, 86(3): 513-524.

Gibson, C. B. & Gibbs, J. L. 2006. Unpacking the concept of virtuality: The effects of geographic dispersion, electronic dependence, dynamic structure, and national diversity on team innovation. *Administrative Science Quarterly*, 51(3): 451-495.

Gitomer, D. H. 1988. Individual differences in technical troubleshooting. *Human Performance*, 1(2): 111-131.

Goodwin, V. L., & Ziegler, L. 1998. A test of relationships in a model of organizational cognitive complexity. *Journal of Organizational Behavior*, 19(4): 371-386.

Granovetter, M. S. 1973. The strength of weak ties. *American Journal of Sociology*, 78: 1360-1380.

Grant, R. M. 1996. Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. *Organization Science*, 7(4): 375-387.

Griffin, A., & Hauser, J. R. 1996. Integrating R&D and marketing: A review and analysis of the literature. Journal of Product Innovation Management, 13(3): 191-215.

Guzzo, R. A. & Dickson, M. W. 1996. Teams in organizations: Recent research on performance and effectiveness. Annual Review of Psychology, 47: 307-338.

Haas, M. R. 2006a. Acquiring and applying knowledge in transnational teams: The roles of cosmopolitans and locals. Organization Science, 17(3): 367-384.

Haas, M. R. 2006b. Knowledge gathering, team capabilities, and project performance in challenging work environments. *Management Science*, 52(8): 1170-1184.

Hackman, J. R., and Morris, C. G. 1975. Group tasks, group interaction process, and group performance effectiveness: A review and proposed integration. In L. Berkowitz (ed.), *Advances in experimental social psychology*: 45-99. New York: Academic Press.

Hambrick, D. C., Cho, T. S. & Chen M. J. 1996. The influence of top management team heterogeneity on firms' competitive moves. *Administrative Science Quarterly*, 41: 659-684.

Hansen, M. T. 1999. The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly*, 44(1): 82-111.

Hatch, N. W., & Mowery, D. C. 1998. Process innovation and learning by doing in semiconductor manufacturing. *Management Science*, 44(11): 1461-1477.

Hayward, M. L. A. 2002. When do firms learn from their acquisition experience? Evidence from 1990-1995. *Strategic Management Journal*, 23(1): 21-39.

Hill, T., Smith, N. D., & Mann, M. F. 1987. Role of efficacy expectations in predicting the decision to use advanced technologies: The case of computers. *Journal of Applied Psychology*, 72(2): 307-313.

Hinds, P. J. 1999. The curse of expertise: The effects of expertise and de-biasing methods on predictions of novice performance. *Journal of Experimental Psychology-Applied*, 5: 205-221.

Hinds, P. J., Patterson, M., & Pfeffer, J. 2001. Bothered by abstraction: The effect of expertise on knowledge transfer and subsequent novice performance. *Journal of Applied Psychology*, 86(6): 1232-1243.

Huber, G. 1991. Organizational learning: The contributing processes and the literatures. *Organization Science*, 2(1): 88-116.

James, J. 1953. The distribution of free-forming small group size. *American Sociological Review*, (18): 569-570.

Jarvenpaa, S. L. & Leidner, D. E. 1999. Communication and trust in global virtual teams. *Organization Science*, 10(6): 791-815.

Jehn, K. A., Northcraft, G. B., & Neale, M. A. 1999. Why difference make a difference: A field of diversity, conflict, and performance in workgroups. *Administrative Science Quarterly*, 44(4): 741-763.

Jones, E. E., & Nisbett, R. E. 1971. *The actor and the observer: Divergent perceptions of the causes of behavior*. New York: General Learning Press.

Karaevli, A., & Hall, D. T. T. 2006. How career variety promotes the adaptability of managers: A theoretical model. *Journal of Vocational Behavior*, 69(3): 359-373.

Katz, R. 1982. Managing careers: the influence of job and group longevities. In R. Katz (Ed.), (pp. 154–181). Paramus, NJ: Prentice Hall. In R. Katz (Ed.), *Career issues in human resource management*. NJ: Prentice Hall.

Katz, R. 1982. The effects of group longevity on project communication and performance. *Administrative Science Quarterly*, 27(1): 81-104.

Keller, R. T. 2001. Cross-functional project groups in research and new product development: Diversity, communications, job stress, and outcomes. *Academy of Management Journal*, 44(3): 547-555.

Klein, K. J., and Kozlowski, S. W. J. 2000. From micro to meso: Critical steps in conceptualizing and conducting multilevel research. *Organizational Research Methods*, 3: 211-236.

Kogut, B. & Zander, U. 1992. Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology. *Organization Science*, 3(3): 383-397.

Kogut, B. & Zander, U. 1996. What firms do? Coordination, identity, and learning. *Organization Science*, 7(5): 502-518.

Kohn, M. L., & Schooler, C. 1982. Job conditions and personality: A longitudinal assessment of their reciprocal effects. *American Journal of Sociology*, 87(6): 1257-1286.

Krackhardt, D. & Kilduff, M. 1999. Whether close or far: Social distance effects on perceived balance in friendship networks. *Journal of Personality and Social Psychology*, 76(5): 770-782.

Krackhardt, D. 1990. Assessing the political landscape - Structure, cognition, and power in organizations. *Administrative Science Quarterly*, 35(2): 342-369.

Kramer, R. M. 1991. Intergroup relations and organizational dilemmas: The role of categorization processes. In L. L. Cummings, & B. M. Stow (Eds.), *Research in organizational behavior*, Vol. 14: 191-207. Greenwich, CT: JAI Press.

Larkin, J. H., McDermott, J., Simon, D. P., & Simon, H. A. 1980. Models of Competence in Solving Physics Problems. *Cognitive Science*, 4: 317-345.

Larson, J. R., & Christensen, C. 1993. Groups as problem-solving units - Toward a new meaning of social cognition. *British Journal of Social Psychology*, 32: 5-30.

Lawrence, P.L., & Lorsch, J.W. 1967. *Organization and Environment: Managing Differentiation and Integration.* Cambridge, MA: Harvard Business School Press.

Leavitt, H. 1951. Some effects of certain communication patterns on group performance. *Journal of Abnormal Social Psychology*, 46: 38-50.

Levin, D. Z. & Cross, R. 2004. The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer. *Management Science*, 50(11): 1477-1490.

Levinthal, D. A., & March, J. G. 1993. The myopia of learning. *Strategic Management Journal*, 14: 95-112.

Liang, D. W., Moreland, R., & Argote, L. 1995. Group versus individual training and group-performance - The mediating role of transactive Memory. *Personality and Social Psychology Bulletin*, 21(4): 384-393.

Lin, N., Ensel, W. M., & Vaughn, J. C. 1981. Social resources and strength of ties: Structural factors in occupational status attainment. *American Sociological Review*, 46: 393-405.

Lindsay, P. H., & Norman, D. A. 1977. *Human Information Processing*. Orlando, FL: Academic Press.

Littlepage, G., W. Robison, & Reddington, K. 1997. Effects of task experience and group experience on group performance, member ability, and recognition of expertise. Organizational Behavior and Human Decision Processes, 69: 133-147.

March, J. & Simon, H. A. 1993. *Organizations* (2 ed.). Cambridge, Massachusetts: Blackwell Publishers.

Mazur, J. E., & Hastie, R. 1978. Learning as accumulation: A reexamination of the learning curve. *Psychological Bulletin*, 85: 1256-1274.

McCauley, C. D., Ruderman, M. N., Ohlott, P. J., & Morrow, J. E. 1994. Assessing the developmental components of managerial jobs. *Journal of Applied Psychology*, 79(4): 544-560.

McCrae, R. R. 1996. Social consequences of experiential openness. *Psychological Bulletin*, 120(3): 323-337.

McGrath, J. E. 1984. *Groups: Interaction and performance*. Englewood Cliffs, NJ: Prentice Hall.

Mehra, A., Kilduff, M., & Brass, D. J. 2001. The social networks of high and low self-monitors: Implications for workplace performance. *Administrative Science* Quarterly, 46(1): 121-146.

Meyerson, D., Weick, K. E., & Kramer, R. M. (1996). *Swift trust and temporary groups*. In R. M. Kramer & T. R. Tyler (Eds.), Trust in organizations: Frontiers of theory and research (pp. 166-195). Thousand Oaks, CA: Sage.

Mezirow, J. 1991. *Transformative Dimensions of Adult Learning*. San Francisco, CA: Jossey-Bass.

Mizruchi, M. S. & Koenig, T. 1988. Economic concentration and corporate political behavior: A cross-industry comparison. *Social Science Research*, 17: 287-305.

Mizruchi, M. S. 1989. Similarity of political behavior among large American corporations. *American Journal of Sociology*, 95: 401-424.

Morrisett, L., Jr., & Hovland, C. L. 1959. A comparison of three varieties of training in human problem solving. *Journal of Experimental Psychology*, 58: 52-55.

Nelson, R. E. 1989. The strength of strong ties: Social networks and intergroup conflict in organizations. *Academy of Management Journal*, 32: 377-401.

Neuman, G. A., & Wright, J. 1999. Team effectiveness: Beyond skills and cognitive ability. *Journal of Applied Psychology*, 84: 376-389.

Noe, R. A., & Wilk, S. L. 1993. Investigation of the factors that influence employees participation in development activities. *Journal of Applied Psychology*, 78(2): 291-302.

Nonaka, I. 1994. A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1): 14-37.

Nonaka, I., & Takeuchi, I. 1995. *The Knowledge-Creating Organization*. Oxford, U.K.: Oxford Press.

Obstfeld, D. 2005. Social networks, the Tertius lungens and orientation involvement in innovation. *Administrative Science Quarterly*, 50(1): 100-130.

Obrien, G. E. & Owens, A. G. 1969. Effects of Organizational Structure on Correlations between Member Abilities and Group Productivity. *Journal of Applied Psychology*, 53(6): 525-530.

Parker, S. K., & Axtell, C. M. 2001. Seeing another viewpoint: Antecedents and outcomes of employee perspective taking. *Academy of Management Journal*, 44(6): 1085-1100.

Pelled, L. H., Eisenhardt, K. M., & Xin, K. R. 1999. Exploring the black box: An analysis of work group diversity, conflict, and performance. *Administrative Science Quarterly*, 44(1): 1-28.

Perry-Smith, J. E. 2006. Social yet creative: The role of social relationships in facilitating individual creativity. *Academy of Management Journal*, 49(1): 85-101.

Perry-Smith, J. E., & Shalley, C. E. 2003. The social side of creativity: A static and dynamic social network perspective. *Academy Of Management Review*, 28(1): 89-106.

Pettigrew, T. F. 1997. Generalized intergroup contact effects on prejudice. *Personality and Social Psychology Bulletin*, 23(2): 173-185.

Polanyi, M. 1966. *The Tacit Dimension*. New York: Anchor Day Books.

Postrel, S. 2002. Islands of shared knowledge: Specialization and mutual understanding in problem-solving teams. *Organization Science*, 13(3): 303-320.

Quinones, M. A., Ford, J. K., & Teachout, M. S. 1995. The relationship between work experience and job performance: A conceptual and meta-analytic review. *Personnel Psychology*, 48(4): 887-910.

Reagans, R., & McEvily, B. 2003. Network structure and knowledge transfer: The effects of cohesion and range. *Administrative Science Quarterly*, 48(2): 240-267.

Rulke, D. L., & Galaskiewicz, J. 2000. Distribution of knowledge, group network structure, and group performance. *Management Science*, 46: 612-625.

Saunders, C. S. & Ahuja, M. K. 2006. Are all distributed teams the same? Differentiating between temporary and ongoing distributed teams. *Small Group Research*, 37(6): 662-700.

Schilling, M. A., Vidal, P., Ployhart, R. E., & Marangoni, A. 2003. Learning by doing something else: Variation, relatedness, and the learning curve. *Management Science*, 49(1): 39-56.

Schmidt, F. L., Hunter, J. E., & Outerbridge, A. N. 1986. Impact of job experience and ability on job knowledge, Work Sample Performance, and Supervisory Ratings of Job-Performance. *Journal of Applied Psychology*, 71(3): 432-439.

Seibert, S. E., Kraimer, M. L., & Liden, R. C. 2001. A social capital theory of career success. *Academy of Management Journal*, 44(2): 219-237.

Shaw, M. E. 1981. *Group Dynamics: The Psychology of Small Group Behavior*, 3rd ed. New York: McGraw-Hill.

Simons, T., L. H. Pelled, & Smith, K. A. 1999. Making use of difference: Diversity, debate, and decision comprehensiveness in top management teams. *Academy Of Management Journal*, 42: 662-673.

Smith, K. G., Smith, K. A., Olian, J. D., Sims, H. P., O'Bannon, P., & Scully, J. A. 1994. Top Management Team Demography and Process - The Role of Social Integration and Communication. *Administrative Science Quarterly*, 39: 412-438.

Snyder, M., Gangestad, S. & Simpson, J.A. 1983. Choosing friends as activity partners: The role of self-monitoring. *Journal of Personality and Social Psychology*, 51(181-190).

Stasser, G., & Titus, W. 1985. Pooling of unshared information in group decision making: Biased information sampling during discussion. *Journal of Personality and Social Psychology*, 48(6): 1467-1478.

Stasser, G., & Titus, W. 1987. Effects of information load and percentage of shared information on the dissemination of unshared information during group discussion. *Journal of Personality and Social Psychology*, 53(1): 81-93.

Stasser, G., Stewart, D. D., & Wittenbaum, G. M. 1995. Expert roles and information exchange during discussion: The importance of knowing who knows what. *Journal of Experimental Social Psychology*, 31: 244-265.

Steiner, I. D. 1972. *Group process and productivity.* New York: Academic Press.

Suedfeld, P., & Bluck, S. 1993. Changes in integrative complexity accompanying significant life events - Historical evidence. *Journal of Personality and Social Psychology*, 64(1): 124-130.

Szulanski, G. 1996. Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal*, 17: 27-43.

Tajfel, H. 1982. *Social identity and intergroup relations*. Cambridge, England: Cambridge University Press.

Tesluk, P. E., & Jacobs, R. R. 1998. Toward an integrated model of work experience. *Personnel Psychology*, 51(2): 321-355.

Tetlock, P. E., Peterson, R. S., & Berry, J. M. 1993. Flattering and unflattering personality portraits of integratively simple and complex managers. *Journal of Personality and Social Psychology*, 64(3): 500-511.

Thompson, J. D. 1967. *Organizations in Action*. New York: McGraw-Hill.

Turner, J. C. 1987. *Rediscovering the Social Group: A Self-categorization Theory*. Oxford: Blackwell.

Tushman, M. L. 1977. Special boundary roles in innovation process. *Administrative Science Quarterly*, 22(4): 587-605.

Tushman, M. L., & Katz, R. 1980. External communication and project performance - An investigation into the role of gatekeepers. *Management Science*, 26(11): 1071-1085.

Tziner, A., & Eden, D. 1985. Effects of crew composition on crew performance - Does the whole equal the sum of its parts. *Journal of Applied Psychology*, 70: 85-93.

Uzzi, B. 1997. Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative Science Quarterly*, 42(1): 35-67.

Van der Vegt, G. S. & Bunderson, J. S. 2005. Learning and performance in multidisciplinary teams: The importance of collective team identification. *Academy of Management Journal*, 48(3): 532-547.

Van Maanen, J. & Katz, R. 1979. Cognitive organization of police perceptions of their work environment. *Sociology of Work and Occupations,* 6: 31.

Walker, G. 1985. Network position and cognition in a computer software firm. *Administrative Science Quarterly*, 30(1): 103-130.

Wasserman, S., Faust, K., & Zaheer, A. 1994. *Social Network Analysis: Methods and Application.* Cambridge: Cambridge University Press.

White, M. C., Smith, M., & Barnett, T. 1994. A typology of executive career specialization. *Human Relations*, 47(5): 473-486.

Williams, K. Y., & O'Reilly, C. A. 1998. Demography and diversity in organizations: A review of 40 years of research, *Research in Organizational Behavior*, Vol. 20: 77-140.

Woike, B. A. 1994. The use of differentiation and integration processes – Empirical studies of separate and connected ways of thinking. *Journal of Personality and* Social Psychology, 67(1): 142-150.

Woolley, A. W., Hackman, J. R., Jerde, T. E., Chabris, C. F., Bennett, S. L., & Kosslyn, S. M. 2007. Using brain-based measures to compose teams: How individual capabilities and team collaboration strategies jointly shape performance. *Social Neuroscience*, 2(2): 96-105.

Wong, S. S. 2004. Distal and local group learning: Performance trade-offs and tensions. *Organization Science*, 15: 645-656.

Zhu, X., & Cummings, J.N. (2007). A conceptual model of prior experience diversity, knowledge processes, and group performance. Best Paper Proceedings, Academy of Management

Biography

Xiumei Zhu was born March 8, 1976 in Sichuan Province, People's Republic of China. She attended Beijing University, where she majored in English and graduated in July 1999 with a Bachelor of Arts. She came to the United States for graduate study in August 1999, and received a Master of Arts in Sociology in 2001 from Johns Hopkins University, and a Master of Science in Management Information System in 2002 from University of Arizona. She started work on a doctoral degree in Business Administration at Duke University's Fuqua School of Business in August 2003, and will graduate in September, 2009.

She was interested in organizational groups, knowledge work and expertise utilization, social networks, and cultural issues in organizations. Her paper with Dr. Sherry Thatcher titled "Changing identities in a changing workplace: Identification, identity enactment, self-verification, and telecommuting" appeared in Academy of Management Review in 2006. Her paper with Dr. Jonathon Cumming titled "A conceptual model of prior experience diversity, knowledge processes, and group performance. Best Paper Proceedings, Academy of Management" appeared in 2007 Academy of Management Best Paper Proceedings.