Transactive Knowledge Systems, Shared Leadership Style, and Team Effectiveness

Christine L. Baker

The Graduate Center, City University of New York

How does access to this work benefit you? Let us know!

Follow this and additional works at: http://academicworks.cuny.edu/gc_etds

Part of the Industrial and Organizational Psychology Commons

Recommended Citation

http://academicworks.cuny.edu/gc_etds/1548

This Dissertation is brought to you by CUNY Academic Works. It has been accepted for inclusion in All Graduate Works by Year: Dissertations, Theses, and Capstone Projects by an authorized administrator of CUNY Academic Works. For more information, please contact deposit@gc.cuny.edu.
TRANSACTION KNOWLEDGE SYSTEMS, SHARED LEADERSHIP STYLE, 
AND TEAM EFFECTIVENESS

by

CHRISTINE L. BAKER, M.A., M.PHIL

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

2016
Transactive Knowledge Systems, Shared Leadership Style, and Team Effectiveness

by

Christine L. Baker, M.A., M.Phil

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

Date

Elisabeth Brauner, PhD
Chair of Examining Committee

Date

Richard J. Bodnar, PhD
Executive Officer

Supervisory Committee:
  Dr. Cheryl Carmichael
  Dr. Jennifer Feitosa
  Dr. Christine Gockel
  Dr. Aaron Kozbelt

THE CITY UNIVERSITY OF NEW YORK

iii
Abstract

Transactive Knowledge Systems, Shared Leadership Style, and Team Effectiveness

by

Christine L. Baker

Advisor: Professor Elisabeth Brauner, PhD

Increased understanding of teams as complex, dynamic systems existing in larger systemic contexts has emerged, transitioning from studying questions of what predicts team effectiveness to more complex questions of why some teams are more effective than others. This dissertation proposes an IMOI model to examine relationships between transactive knowledge systems, shared leadership style, and team effectiveness outcomes, moderating effects of perspective-taking and motivation, and temporal development of transactive knowledge systems.

Two studies tested the proposed IMOI model and temporal development of transactive knowledge systems in a longitudinal field study of students in teams and a cross-sectional sample representative of the general working population in the United States. Surveys included: The Questionnaire for Transactive Knowledge Systems (Q-Tracks) (Bohnenkamp, 2016; Brauner & Robertson, 2009; Robertson, Gockel, & Brauner, 2013); Vertical and Shared Leadership Survey (Pearce & Sims, 2002); The Perspective-taking scale from the Interpersonal Reactivity Index (IRI) (Davis, 1980, 1983); The Situational Motivation Scale (SIMS) (Guay, Vallerand, & Blanchard, 2000); and team effective measures from the Team Diagnostic Survey (Wageman, Hackman, & Lehman, 2005).

This dissertation answers questions about the influence of situational factors on development of team cognitive structures, increasing understanding of how shared leadership
style affects development of transactive knowledge systems: how the relationship between shared leadership style and transactive knowledge systems influence team effectiveness: how shared leadership styles act on transactive knowledge systems development over time: and how individual team member characteristics of perspective-taking and motivation influence the relationship between shared leadership style and transactive memory. Results provided general support for the proposed IMOI model. Study 1 and 2 provided support for shared leadership style as a predictor of transactive knowledge systems development for some leadership styles. They also provided support for shared leadership style and transactive memory systems as predictors of team effectiveness. Both studies supported transactive knowledge systems as mediating the relationship between shared leadership style and team effectiveness with Study 2 finding transactive knowledge systems fully mediate the relationship between shared leadership style and some measures of team effectiveness. Neither study supported perspective-taking or motivation as moderators and no support emerged for situational factors influencing transactive knowledge systems development over time. Overall, findings showed that situational factors influence cognitive structures such as transactive memory in teams, consequently influencing team effectiveness outcomes.
Acknowledgements

This work was a deeply rewarding, but also long and somewhat disjointed, process. Along the way, many people supported me both in spirit and in practical matters. I would not have started this journey if my parents had not instilled in me a love of learning and respect for education. Their example provided energy when I was exhausted at my task. Thank you, Mom and Dad, for always being available with open hearts, encouragement, and pride. Thank you a second time to my mother for her many cross-country visits to care for her grandchildren so that I could focus more fully on my work. I’m forever grateful for her selflessness and ever present commitment to helping me attain my goals. Thank you to other caregivers who lovingly looked after my children, especially Maria Torres. Thank you to my brother, Doug, and other dear friends who provided encouragement and joy along the way. A special thank you to my husband, Tom, for his love, laughter, and extreme patience in the face of many starts, stops, and obstacles and for always putting my manuscript on the top of his reading pile. Thank you to my children, Meghan and Clare, for their encouragement and love. The hugs, kisses, ‘love you’ notes, and ‘good mommy’ pats on the back kept me going late at night.

I would like to thank my fellow Brooklyn College graduate students for their friendship, and especially Leib Litman for guidance with TurkPrime and Rommel Robertson for paving the way. Thank you to my committee, Dr. Cheryl Carmichael, Dr. Jennifer Feitosa, Dr. Aaron Kozbelt, and especially Dr. Christine Gockel, for their guidance and their ‘keep-swimming’ encouragement. Their contributions greatly improved this dissertation. A special thank you to my research assistants, Jasmin Bohnenkamp, Christopher Surita, and Ashley Wong, who worked diligently and kept my research moving when I had a pressing family commitment. Their dedication and get-it-done approach was crucial and is very greatly appreciated.
This dissertation would not have been possible without my advisor, Dr. Elisabeth Brauner. She bravely accepted me back after a long break and never lost faith in my ability to complete this project. I am eternally grateful for her knowledge, guidance, and support, which enabled me to achieve the doctoral students’ dream of creating something of quality. Her example inspired me to keep going and her flexibility, understanding, and encouragement, made it possible. I am awed by her unfailing commitment to each one of her students, a shining example for all educators. I feel so very fortunate to have been her student and to always be her friend.
# Table of Contents

Abstract ........................................................................................................................................ iv  

Acknowledgements ..................................................................................................................... vi  

List of Tables ................................................................................................................................ xv  

List of Figures .............................................................................................................................. xviii  

Chapter 1: Introduction ............................................................................................................... 1  

Chapter 2: Transactive Memory and Transactive Knowledge Systems ................................. 4  

  Transactive Memory, Origins .................................................................................................. 4  

  Structure of Transactive Memory ............................................................................................ 5  

    Wegner’s structure. ................................................................................................................ 5  

    Moreland and colleagues’ structure ..................................................................................... 7  

    Brauner’s structure .............................................................................................................. 8  

  Processes of Transactive Memory Systems ........................................................................ 11  

    Wegner’s transactive processes. ........................................................................................ 11  

    Directory updating ............................................................................................................. 11  

    Information allocation ...................................................................................................... 12  

    Retrieval coordination ..................................................................................................... 12  

    Rulke and Rau’s transactive processes. ........................................................................... 13  

    Brauner’s transactive processes. ....................................................................................... 13  

  Transactive Memory: Research Past and Present ............................................................... 14  

    Dyads. ................................................................................................................................. 14  

    Groups in laboratory settings. ........................................................................................... 16  

    Work teams in organizations. ............................................................................................ 18
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teams</td>
<td>41</td>
</tr>
<tr>
<td>Measures</td>
<td>42</td>
</tr>
<tr>
<td>Transactive memory and transactive knowledge systems</td>
<td>43</td>
</tr>
<tr>
<td>Shared leadership style</td>
<td>44</td>
</tr>
<tr>
<td>Perspective-taking</td>
<td>45</td>
</tr>
<tr>
<td>Motivation</td>
<td>45</td>
</tr>
<tr>
<td>Objective measures of effectiveness</td>
<td>46</td>
</tr>
<tr>
<td>Self-report measures of effectiveness</td>
<td>46</td>
</tr>
<tr>
<td>Internal consistency</td>
<td>48</td>
</tr>
<tr>
<td>Demographic information</td>
<td>49</td>
</tr>
<tr>
<td>Procedure</td>
<td>49</td>
</tr>
<tr>
<td>Incentives</td>
<td>50</td>
</tr>
<tr>
<td>Multilevel linear models</td>
<td>50</td>
</tr>
<tr>
<td>Overview of statistical analysis, hypotheses 1 through 4</td>
<td>52</td>
</tr>
<tr>
<td>Overview of statistical analysis, hypothesis 5</td>
<td>52</td>
</tr>
<tr>
<td>Results</td>
<td>52</td>
</tr>
<tr>
<td>Descriptive statistics</td>
<td>52</td>
</tr>
<tr>
<td>Hypotheses 1a–d: Time 2 shared leadership style (restrictive and constructive) predicting time 3 transactive knowledge systems</td>
<td>54</td>
</tr>
<tr>
<td>Hypotheses 2a–f: Time 2 shared leadership style (restrictive and constructive) and transactive knowledge systems predicting time 3 effectiveness</td>
<td>55</td>
</tr>
<tr>
<td>GPA</td>
<td>55</td>
</tr>
<tr>
<td>Course grade</td>
<td>56</td>
</tr>
</tbody>
</table>
Productive output (PO)-effort related. ................................................................. 57
Productive output (PO)-strategy related. .......................................................... 58
Productive output (PO)-knowledge and skill related. ........................................ 60
Social processes, satisfaction with team relationships ...................................... 61
Individual learning and well-being. ..................................................................... 62
Hypothesis 2g–j: Transactive knowledge systems mediate the relationship between shared leadership style (restrictive and constructive) and effectiveness. .................. 65
Hypothesis 3a–d: Time 1 perspective-taking moderating the relationship of time 2 shared leadership style (restrictive and constructive) on time 3 transactive knowledge systems... 66
Hypothesis 3a–h: Time 1 motivation moderating the relationship of time 2 shared leadership style (restrictive and constructive) on time 3 transactive knowledge systems. ............ 67
Hypothesis 5a: Change in transactive knowledge systems over time ..................... 69
Hypothesis 5b and 5c: Shared leadership style (restrictive and constructive) as predictors of change in transactive knowledge systems over time. ................................................ 70
Summary of Results, Study 1............................................................................. 71
Chapter 6: Cross-sectional Study using Amazon Mechanical Turk (Study 2) .......... 76
Method ................................................................................................................. 76
Participants .......................................................................................................... 76
Teams ..................................................................................................................... 77
Measures .............................................................................................................. 78
Transactive memory and transactive knowledge systems. ................................. 79
Shared leadership style. ....................................................................................... 80
Perspective-taking ............................................................................................... 81
Motivation.................................................................................................................. 81
Self-report measures of effectiveness........................................................................ 82
Boundedness and stability............................................................................................ 82
Work unit questions..................................................................................................... 83
Demographic information............................................................................................. 83
Hidden and self-report attention questions.................................................................. 83
Procedures.................................................................................................................. 83
Crowdsourcing: Steps to ensure data quality.............................................................. 84
MTurk screening.......................................................................................................... 85
Response time.............................................................................................................. 85
Instructed items............................................................................................................ 86
Self-report indices of data quality.............................................................................. 86
Mahalanobis distance................................................................................................... 86
Overview of Statistical Analyses ................................................................................ 87
Multiple linear regression............................................................................................ 87
Results......................................................................................................................... 87
Descriptive statistics.................................................................................................... 87
Hypothesis 1a and c: Shared leadership style (restrictive and constructive) predicting
transactive knowledge systems.................................................................................... 87
Hypothesis 2a, c, and e: Shared leadership style (restrictive and constructive) and
transactive knowledge systems predicting effectiveness.............................................. 88
Productive output (PO)–effort related.......................................................................... 88
Productive output (PO)–strategy related...................................................................... 89
Productive output (PO)–knowledge and skill related........................................................................90

Hypothesis 2g–j: Transactive knowledge systems mediate the relationship between shared
leadership style (restrictive and constructive) and effectiveness.............................................91

Hypothesis 3a and c: Perspective-taking moderates the relationship between shared
leadership style (restrictive and constructive) and transactive knowledge systems.............93

Hypothesis 4a, c, e, g, i, and k: Motivation moderates the relationship between shared
leadership style (restrictive and constructive) and transactive knowledge systems............94

Summary of Results, Study 2........................................................................................................96

Chapter 7: General Discussion....................................................................................................100

Summary of Findings: IMOI Model.............................................................................................100

Shared leadership style predicts transactive knowledge systems.............................................100

Shared leadership style and transactive knowledge systems predict team effectiveness for
objective measures (Study 1)...........................................................................................................102

Shared leadership style predicts team effectiveness for self-report measures....................102

Transactive knowledge systems predict team effectiveness for self-report measures........104

Transactive knowledge systems mediate the relationship between constructive shared
leadership style and team effectiveness......................................................................................105

Perspective-taking and motivation as moderators...................................................................107

Transactive Knowledge Systems over Time (Study 1)............................................................108

Implications for Theory and Practice......................................................................................109

Strengths and Limitations..........................................................................................................109

Future Research Directions......................................................................................................111

Conclusion................................................................................................................................112

xiii
List of Tables

Table 1. Participant's Demographics, Study 1 ..........................................................42

Table 2. Hypotheses 1–4: Means, Standard Deviations, Interscale Correlations, and Consistency Reliability Estimates (Cronbach’s Alpha) .........................................................53

Table 3. Hypothesis 5: Means, Standard Deviations, Interscale Correlations, and Consistency Reliability Estimates (Cronbach’s Alpha) .................................................................53

Table 4. Time 2 Shared Leadership Style Predicting Time 3 Transactive Knowledge Systems...54

Table 5. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for GPA ..................................................................................................56

Table 6. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for Course Grade ..................................................................................57

Table 7. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for PO-Effort Related ...............................................................58

Table 8. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for PO-Strategy Related ..............................................................59

Table 9. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for PO-Knowledge and Skill Related ......................................................61

Table 10. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for Social Processes, Satisfaction with Team Relationships ..............62

Table 11. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for Individual Learning and Well-being .....................................64

Table 12. Time 1 Perspective-taking as Moderator of the relationship between Time 2 Shared Leadership Style and Time 3 Transactive Knowledge Systems ................................66
Table 13. Time 1 Intrinsic/Identified Regulation Motivation as Moderator of the relationship between Time 2 Shared Leadership Style and Time 3 Transactive Knowledge Systems .....68

Table 14. External Regulation Motivation and Amotivation as Moderator of the relationship between Time 2 Shared Leadership Style and Time 3 Transactive Knowledge Systems .....68

Table 15. Unconditional Model: Change in Transactive Knowledge Systems over Time..........69

Table 16. Conditional Model: Group-Level Shared Leadership Style Restrictive and Constructive as Predictors of Change in Transactive Knowledge Systems over Time........71

Table 17. Participant's Demographics, Study 2 ..........................................................77

Table 18. Summary of Data Quality Screening Methods and Participants Removed .............85

Table 19. Means, Standard Deviations, Interscale Correlations, and Consistency Reliability Estimates (Cronbach’s Alpha) .................................................................................................88

Table 20. Predicting the impact of Shared Leadership Style on Transactive Knowledge Systems ..................................................................................................................88

Table 21. Predicting the impact of Shared Leadership Style and Transactive Knowledge Systems on Effectiveness for Productive Output–Effort Related........................................89

Table 22. Predicting the impact of Shared Leadership Style and Transactive Knowledge Systems on Effectiveness for Productive Output–Strategy Related.................................90

Table 23. Predicting the impact of Shared Leadership Style and Transactive Knowledge Systems on Effectiveness for Productive Output–Knowledge and Skill Related...............91

Table 24. Transactive Memory and Transactive Knowledge Systems Mediate the Relationship between Constructive Shared Leadership Style and Productive Output–Effort Related...........................................................................................................................................92
Table 25. Transactive Memory and Transactive Knowledge Systems Mediate the Relationship between Constructive Shared Leadership Style and Productive Output-
Knowledge and Skill Related..........................................................93

Table 26. Predicting a moderating effect of Perspective-taking on the relationship between Shared Leadership Style (restrictive and constructive) and Transactive Knowledge Systems .................................................................94

Table 27. Predicting a moderating effect of Motivation (Intrinsic/Identified Regulation, External, Amotivation) on the relationship between Shared Leadership Style (restrictive and constructive) and Transactive Knowledge Systems.................................................95
List of Figures

Figure 1. Illustration of transactive memory systems as computer network models. ..................6

Figure 2. Representation of five dimensions of transactive knowledge systems. ..................10

Figure 3. Proposed IMOI model. ...........................................................................................................30

Figure 4. Hypothesis 1: Time 2 shared leadership style predicting time 3 transactive
knowledge systems. .................................................................................................................................55

Figure 5. Hypothesis 2a-d: Summary of results for time 2 shared leadership style predicting
time 3 effectiveness..................................................................................................................................64

Figure 6. Hypothesis 2e and f: Summary of results for time 2 transactive knowledge systems
predicting time 3 effectiveness. ..................................................................................................................65

Figure 7: Mean and standard deviation for transactive knowledge systems at time 1, 2, and 3...70

Figure 8. Transactive memory and transactive knowledge systems mediate the relationship
between constructive shared leadership style and productive output-effort related. ...........92

Figure 9. Transactive memory and transactive knowledge systems mediate the relationship
between constructive shared leadership style and productive output-knowledge and skill
related.........................................................................................................................................................93

Figure 10. Post hoc analysis of low, moderate, and high levels of identified/intrinsic
regulation motivation on the relationship between SLS restrictive and transactive
knowledge systems. .................................................................................................................................95

Figure 11. Statistically significant paths, Study 2.................................................................................97
Chapter 1: Introduction

“The command-and-control approach to management has in recent years become less and less viable. Globalization, new technologies, and changes in how companies create value and interact with customers have sharply reduced the efficacy of a purely directive, top-down model of leadership. What will take the place of that model? Part of the answer lies in how leaders manage communication within their organizations—that is, how they handle the flow of information to, from, and among their employees. Traditional corporate communication must give way to a process that is more dynamic and more sophisticated.”

-Groysberg and Slind, 2012

The last three decades have seen a worldwide reorganization of work from being structured around individual jobs to being structured around teams (Kozlowski, Grand, Baard, & Pearce, 2015) and teams are now required at all hierarchical levels for many organizations (DeChurch & Mesmer-Magnus, 2010). The flattening of relationships within organizational structures alters dynamic aspects of organizational environments. A new understanding of teams as complex, dynamic systems existing in larger systemic contexts is developing. Information flow and leadership influence are two dynamic aspects of organizations that are affected by increased reliance on teams. Although Groysberg and Slind (2012) do not use the terms transactive knowledge systems or shared leadership, conceptually they described exactly these properties of teams as foundations for future organizational success.

Transactive memory and transactive knowledge systems provide one explanation for the advantage teams create in organizations. Transactive memory describes how individuals in groups take on responsibility for particular information, relieving other group members from the task. In this way, information loads on memory can be shared, giving group members access to more knowledge than any one individual can hold. This unshared knowledge, or expertise, is considered the dormant power and competitiveness of an organization (Brauner, 2002). In a
review of effective teamwork, transactive knowledge systems were identified as an emergent cognitive structure central to team effectiveness (DeChurch & Mesmer-Magnus, 2010).

Understanding transactive knowledge systems is important because they provide a dynamic and sophisticated model of information flow in teams and organizations.

As Groysberg and Slind (2012) observe, leadership is another organizational structure that is in flux in that a traditional top-down style of leadership is no longer the most effective approach for many organizations. Pearce, Manz, and Sims (2009) have identified three drivers of change shifting the locus of leadership in organizations. First, competition is driving firms toward organizing around teams. This increased reliance on teamwork has changed leadership from a role that a person fills to a social process that requires leadership from team members as well as the team leader. Second, increased work complexity makes it difficult for the senior-most leaders to possess sufficient expertise to make decisions independently. Often individuals in lower hierarchical positions are better informed about important aspects of the work than are individuals in positions above them (Pearce et al., 2009). Therefore, leadership decisions must come from across organizations. Finally, today’s markets require much faster responses to environmental pressures than in the past. Organizations cannot wait for issues to be pushed up the ladder to senior leaders for response. Additionally, once identified, teams are more effective in responding to environmental changes, creating complex business plans faster than individual senior leaders. The construct of shared leadership is one approach that can be used to model these changes. A better understanding of shifts in leadership and their influence on teams and organizations is important to improve team effectiveness and organizational competitiveness.

Business leaders and group researchers alike have recognized a fundamental change in modern work teams and organizations (Kozlowski et al., 2015). It is important to recognize that
traditional approaches to information flow and leadership within teams and organizations are changing and to create models that better fit current organizational structures. This knowledge will allow organizations to effectively react to the ever increasing time pressures and complexity of the current marketplace.
Chapter 2: Transactive Memory and Transactive Knowledge Systems

Transactive Memory, Origins

Wegner, Giuliano, and Hertel (1985) first proposed the theory of transactive memory as an alternative to theories of the ‘group mind’ (e.g., McDougall, 1920). At that time, social psychology used the idea of the group mind to explain observations about within-group similarities (i.e., attitudes, understandings of the world, language), social agency (i.e., behaving as a unit, interacting with outside agents), and configurable properties of groups (i.e., actions of groups were not reducible to those of particular individuals). One obvious problem was that the group mind did not have a ‘group body’ (Wegner et al., 1985). Methodologically, this created disagreement and confusion about how to conduct research and the theory fell out of favor.

Wegner et al. (1985) offered a new approach, transactive memory, and put communication processes at the center of their theory: “communication processes operate to produce the distinction between the group mind and the minds of individual members.” (Wegner et al., 1985, p. 256). Wegner et al. (1985) defined transactive memory in terms of two components: an organized store of knowledge that is contained in the individual memory of each group member and a set of knowledge-relevant transactive processes that occur among group members. Knowledge contained in an individual’s memory has always been accessible to researchers by asking the right questions. However, the insight that communication connects individuals’ cognition in groups, provided a means to observe and test previously hidden processes in groups. The combination of communication and cognition in a group creates the dynamic environment from which transactive knowledge systems emerge.

Scholars often use the terms transactive memory and transactive memory systems interchangeably, although the concepts are distinct (Ren & Argote, 2011). A transactive memory
Transactive memory, leadership, effectiveness

exists in the mind of an individual. A transactive memory system describes the collective use of
transactive memory by a group of individuals to store, retrieve, and communicate information
(Ren & Argote, 2011). The terms transactive memory system and transactive knowledge system
describe the same construct and may be used interchangeably. I predominantly use the term
transactive knowledge systems because in cognitive psychology memory is considered the place
where knowledge is stored. Using the term ‘knowledge’ places focus on the content of memory
that is important for teams.

Structure of Transactive Memory

Wegner and colleagues’ original definition of transactive memory was: “(1) an organized
store of knowledge that is contained entirely in the individual memory systems of the group
members and (2) a set of knowledge-relevant transactive processes that occur among group
members” (Wegner et al., 1985, p. 256). This definition continues to be relevant to current
descriptions of the structure of transactive memory. However, expansion of the original structure
as well as additional structures within the original definition have since been identified.

Wegner’s structure. Wegner (1986, 1995) used the theory of transactive memory to
describe the “thinking” processes of dyads in close relationships that led to cognitive
interdependence and was interested in how people use other people as memory storage devices.
As an analogy, he created a computer network model to describe the structure linking one
individual memory to another individual memory. In this model, boxes represent two computers.
Each computer has a processor that receives and organizes information. The processor organizes
information into two directories; one directory for information contained in its own memory
storage and another directory for information contained in the other computers’ memory storage.
These directories are created and maintained by sending information across a physical
connection within or between the computers, represented by lines in Wegner’s model. Processor
1 and Processor 2 can represent Person 1 and Person 2. In this case, a directory of information
contained in ones’ own memory is created and maintained by each person using internal
cognitive processes. A directory about another persons’ memory is created and maintained using
communication processes. In this case, lines connecting Person 1 and Person 2 represent
knowledge-relevant processes that allow Person 1 to gain knowledge about the memory of
Person 2 and vice versa (see Figure 1). Although this network model becomes more complicated
when expanded from dyads to teams, it can easily be applied to include many individuals
working in a team.

Figure 1. Illustration of transactive memory systems as computer network models.
Slightly modified from “A Computer Network Model of Transactive Memory,” by D. M. Wegner, 1995, Social

Wegner et al. (1985) identified two processes that provide structure to facilitate
communication in transactive memory systems. **Differentiated structure** reflects the degree to
which individual members of a group have specialized, unshared knowledge. Individuals learn
about what others’ know, but do not learn all the details of what they know. Differentiation of
knowledge creates efficiency in transactive knowledge systems because responsibility for
knowledge can be dispersed throughout the group. **Integrated structure** reflects the degree of
shared knowledge between or among individual group members. Shared knowledge allows
members of a group to communicate and coordinate effectively. Useful integration of knowledge
may be as simple as using a common language or as complex as shared understanding of an
organization’s policies and goals. Wegner et al. (1985) stressed that knowledge is never fully
differentiated or integrated in a dyad or group, nor would that be productive. The most efficient
knowledge structure has the right balance to best accomplish the tasks at hand.

**Moreland and colleagues’ structure.** Moreland and colleagues (Liang, Moreland, &
Argote, 1995; Moreland, 1999; Moreland, Argote, & Krishnan, 1996, 1998) were the first to
apply Wegner’s model to work groups, conducting laboratory experiments on groups of typically
three people. Trained observers coded behaviors that were presumed to reveal underlying
processes of transactive memory. From these studies, Moreland and colleagues identified three
dimensions to indirectly measure the operation of transactive memory systems in work
groups: memory differentiation, task credibility, and task coordination. *Memory differentiation* is similar
to Wegner et al.’s (1985) differentiation structure and describes the tendency for group members
to specialize in recalling distinct information about a group’s tasks. *Task credibility* describes the
level of confidence individuals have about other group members’ knowledge and abilities to
successfully accomplish tasks. *Task coordination* describes the ability of the group to coordinate
individual expertise to efficiently and effectively complete group tasks. It is possible for a group
to contain the necessary expertise to complete a task, yet fail because they were unable to
coordinate their expertise. The first two of these structures, memory differentiation and task
credibility, are cognitive in nature. The third, task coordination, is procedural. One drawback of
this model is that the second structure, task credibility, actually measures the affective construct
of trust (Jochmann & Sommer, 2002). Although trust may have an important influence on
transactive memory development, Jochmann and Sommer (2002) argue it is a distinct and separate construct from transactive memory.

**Brauner's structure.** Jochmann, Sommer and Brauner (2002; Jochmann & Sommer, 2002; Brauner & Robertson, 2009; Robertson, Gockel, & Brauner, 2013) identified five dimensions of transactive memory that are theoretically derived from Wegner’s original model (Wegner, 1986, 1995; Wegner et al., 1985): differentiation, integration, cognitive interdependence, metaknowledge, and transactivity (see Figure 2). This model of the structure of transactive memory has been validated in a laboratory setting as well as in the field. (Robertson, 2009; see also Brauner & Robertson, 2009; Robertson et al., 2013).

The first dimension, *differentiation*, is similar to that of Wegner et al. (1985) and Moreland (1999). Differentiation describes the degree to which individual members of a group have specialized, unshared knowledge. This is important because one of the benefits of forming a transactive knowledge system is that group members can share information loads on memory, thereby expanding the total expert knowledge available to the group as a whole. Again from Wegner et al. (1985), the second dimension, *integration*, describes the degree of shared knowledge between individual group members. Integration is important for task coordination and efficiency in groups. In some situations it is beneficial to have highly integrated knowledge among group members. For instance, it would be ideal for members of a technical support team to have equal experience and knowledge about the technology. In contrast, differentiation of knowledge is especially crucial in groups where members have diverse expert knowledge. A team of professionals brought together to create a new product might have expertise in areas of marketing, technology, design, and production. In this case, it is beneficial to have a high level of differentiation and just enough integration to allow effective communication. The degree of
unshared knowledge, or differentiation, creates the power and competitiveness of an organization (Brauner, Becker, & Jordan, 2005).

The third dimension, metaknowledge, is what Wegner (1995) describes as the ‘feeling of knowing’ (Hart, 1967) in the process of retrieval coordination. Wegner suggests that ‘knowing’ judgements will lead an individual to either trust their own knowledge or ask another person for information. Further, Wegner proposes that individuals may generate ‘knowing’ judgements for other group members’ knowledge. Metaknowledge has been defined as knowledge about knowledge, both one’s own (Nelson, 1999) and that of others (Wegner, 1995). As differentiation increases, metaknowledge becomes increasingly important because individuals need more frequent access to external knowledge sources. Metaknowledge about another person’s knowledge generates mainly through social interaction (Brauner & Becker, 2006). Therefore, transactive processes are integral in developing metaknowledge. However, metaknowledge is only as useful as it is accurate. In a review of the social metacognitive literature, Jost, Kruglanski, and Nelson (1998), concluded that “under some circumstances, at least, metacognitive assessments of other persons’ knowledge appears to be just as accurate as metacognitive assessments of self-knowledge.” (p. 146). Thus, people seem to be relatively good at assessing others’ knowledge. This may seem surprising because the processes for gathering information about one’s own knowledge are different from that for others’ knowledge. One cannot observe the internal thought processes of others, therefore, one must rely on transactive strategies to gather information about their knowledge. Processes that have shown to result in development of metaknowledge about others include written evaluations (Moreland & Myaskovsky, 2000), observation (Vesonder & Voss, 1985), verbal communication (Hollingshead, 1998b), and non-verbal cues (Hollingshead, 1998a).
The fourth dimension, *transactivity*, assesses information exchange between members of a group by measuring communicative processes in the group. Communication processes involved in the development of transactive memory may take many forms including verbal, non-verbal, and written. The more information exchanged between members of a group, the more each member will know about other members’ knowledge. “Each fact about the self that is revealed to the other lends the other a sense of one’s expertise and experience” (Wegner et al., 1985, p. 265). This exchange of information is an important factor in building strong metaknowledge and accurate transactive knowledge systems. Levels of transactivity (information exchange) correlate highly with levels of cooperation, coordination, and efficiency in groups (Robertson & Brauner, 2009).

*Figure 2.* Representation of five dimensions of transactive knowledge systems (Robertson & Brauner, 2008).

The fifth and final dimension, *cognitive interdependence*, describes the degree to which group members rely on each other to access information. Cognitive interdependence is a natural result of the social nature of transactive knowledge systems. A significant advantage of a transactive knowledge system is that it allows individuals in groups to develop specific expertise...
Transactive memory, leadership, effectiveness

(Wegner, 1986). However, as group members develop expertise, they grow to depend on each other for specialized knowledge outside their own domain. The result is that individuals in the group become cognitively interdependent (Brauner, 2002).

**Processes of Transactive Memory Systems**

Transactive processes are integral to the formation of transactive memory systems and have been a focus of research. “Each fact about the self that is revealed to the other lends the other a sense of one’s expertise and experience” (Wegner et al., 1985, p. 265). Communication may take many forms including verbal, non-verbal, and behavioral. Theories have been proposed to describe the underlying processes involved.

**Wegner’s transactive processes.** Wegner (1995) described three processes necessary for the formation and successful operation of a transactive memory system as: directory updating, information allocation, and retrieval coordination.

*Directory updating.* Directory updating references the process that enables individuals in a group to learn about expertise knowledge that other group members hold in their memory. Wegner identified four channels for directory updating: default entries, negotiated entries, expertise entries, and access entries. *Default entries* are based on observation of surface characteristics of individuals and rely on stereotypes. These entries are not reliable and occur more often when members in a group are not yet familiar with each other. A key purpose of communication in a group is to move beyond default entries. *Negotiated entries* are created when a group member is assigned responsibility for particular information. As long as other members of the group know of the assignment, they will know who has this information. As group members become familiar with special knowledge and interests of the others, they form *expertise entries.* Once a member is designated as the ‘expert’ in a domain, information coming into the
group will be routed to them for storage and retrieval. *Access entries* reference a default assignment of information to the group member who is the first to access the information. For example, if a group member is the first to receive training in new software, they will become the person to whom others go for questions about the software. Directory updating must be a continuous process or information becomes old and unreliable.

*Information allocation.* Information allocation describes the process of determining who will be responsible for what information. The most efficient information allocation occurs when only high-level information transfers from one person to another. For example, if the access entry person is not the designated expert for the information, it will be most efficient if they do not use cognitive resources to learn this information before passing it on to the expert. Groups are also more efficient when information is not allocated to too many people and therefore becomes overly repetitive in the group.

*Retrieval coordination.* Retrieval coordination involves group member’s identification of where information is held in the group, and how to access it. Two important aspects of retrieval coordination are speed and accuracy. The first step in this process is to assess if one needs to search outside of ones’ own memory. One can apply feelings of knowing or not knowing to oneself or others (Wegner et al., 1985; Wegner, 1995). Having accurate feelings of knowing is important for speed of retrieval coordination. One benefit of group retrieval is that information that has been lost to the group may be found by working together. For example, interactive cueing is a retrieval strategy where two people, who share an experience, collaborate to recall more information than either can recall individually (Wegner et al., 1985). Thus, interaction between individuals is used to retrieve memory items available to the group as a whole but not to every single individual.
**Rulke and Rau’s transactive processes.** Rulke and Rau (2000) examined the development of transactive memory by observing encoding processes in teams that were trained together. In a study of three-person teams trained in a task, examination of group communication revealed transactive encoding cycles that “began with either questions about the task or statements indicating no expertise, continue with declarations of expertise and evaluations of members’ competence and expertise, and end with efforts at coordinating who does what in the group.” (Rulke & Rau, 2000, p. 391). Rulke and Rau (2000) presented these encoding cycles as representing the dynamic relationship between four elements or stages of transactive encoding: questioning/no expertise, expertise, evaluating, and coordinating. This cyclical process allowed the group to reliably identify who knew what. In addition, variations of frequency were found for elements over time (Rulke and Rau, 2000). The frequency of expertise statements decreased, whereas evaluating sentences increased over time, suggesting that individuals claim task expertise they are confident about first, leaving needed expertise domains to be decided later through extended group evaluation. Furthermore, groups with higher transactive memory scores spent more time in the first stage of the cycle, finding out who had expertise in what domains. This study presented the first example of temporal transactive patterns in groups.

**Brauner’s transactive processes.** Brauner and Becker (2006) modified Wegner’s processes and proposed an updated model that identified four transactive processes supporting transactive memory development and functioning: knowledge disclosure, knowledge acquisition, knowledge requisition, and knowledge allocation. *Knowledge disclosure* describes an individual’s disclosure about the expert knowledge they possess. *Knowledge acquisition* describes the incorporation of new knowledge into one’s memory along with the ability to easily access it at a later time. Both these processes are theoretically implied in Wegner’s process of
directory updating. Distinguishing between disclosure and acquisition, however, allows for a better operationalization of behaviors, specifically for interaction coding (Brauner & Becker, 2006). *Knowledge requisition* describes requesting information from external sources such as individuals known to have the information or to be known experts of the type of information needed. This process is analogous to Wegner’s process of retrieval coordination while making it easier to operationalize and identify behaviors in team interaction that engage in this process. The last process, *knowledge allocation*, describes distribution of knowledge to individuals in the group, for storage and future retrieval. This process is analogous to information allocation albeit with the focus on knowledge rather than information. Together these four processes create an organized flow of knowledge in the transactive knowledge system (Brauner & Becker, 2006).

Transactive knowledge systems research has grown exponentially over the 30 years since the concept was first proposed by Wegner et al. (1985; Peltokorpi, 2008). Theoretical development of the underlying structure and transactive processes provided guidance to researchers who then examined the relationship of transactive knowledge systems with many variables.

**Transactive Memory: Research Past and Present**

In this section, I provide an overview of transactive memory and transactive knowledge systems research. Research has progressed from studies on dyads in a laboratory setting to the current focus of work groups in organizations. Each research method has contributed to our understanding of the theory.

**Dyads.** Wegner, Erber, and Raymond (1991) conducted research on dyads in laboratory settings using memory recall tasks. These studies were among the first to provide support for the existence of transactive memory. Dyads were either dating couples or strangers and were tested
Transactive memory, leadership, effectiveness

on a memory recall task. Dyads were given cards with sentences describing a target word that
subjects were asked to recall later. Word cards were organized by topics. Dating couples were
given a forced choice assessment asking if they or their partner had more expertise on a range of
topics. These dating couples had significantly high agreement on assessment of expertise. When
preforming the recall task, both types of dyads were divided into two conditions. They were
either given randomly assigned areas of expertise or they were given no assignment of expertise.
Under the assigned expertise condition, dating couples recalled significantly fewer words than
strangers. However, dating couples recalled significantly more words than strangers when areas
of expertise were not assigned. These findings suggest that couples have existing transactive
memory for who will take responsibility for particular topics. Furthermore, the assignment of
random areas of expertise to the dating couples interfered with these naturally existing
transactive memory schemes.

Building on Wegner et al.’s (1985) research, Hollingshead manipulated the use of
communication by natural and impromptu dyads who were asked to complete recall or
knowledge-pooling tasks. In one study, natural dyads outperformed impromptu dyads when they
worked face-to-face and performed significantly better when they had nonverbal cues than when
they did not (Hollingshead, 1998a). In another study, Hollingshead (1998b) found that natural
dyads underperformed impromptu dyads when allowed to communicate prior to the task but
outperformed them when not allowed to communicate prior to the task. One possible explanation
for these results is that natural dyads were pressured to create an artificial transactive knowledge
system, which interfered with their existing natural system. Hollingshead suggested that
“communication at learning will lead to effective memory performance when the discussion
about who will learn what corresponds to members’ relative expertise.” (p. 439). Together, these
Transactive memory, leadership, effectiveness

studies supported the position that both verbal and nonverbal communication are important to the development and use of transactive knowledge systems.

**Groups in laboratory settings.** The focus of transactive memory research later extended to groups in laboratory settings using group assembly tasks (Lewis, 2004; Liang et al., 1995; Moreland & Myaskovsky, 2000; Moreland et al., 1996, 1998; Rulke & Rau, 2000). In a series of studies, researchers trained groups of three people, either together or apart, to construct transistor radios (Liang et al., 1995). Although groups took approximately the same amount of time to construct the radios, groups that trained together had significantly fewer errors and remembered significantly more about how to assemble the radio. In follow up studies (Moreland et al., 1996, 1998) the increase in accuracy and procedure recall for groups trained together was due to the development of a transactive memory system. These results suggested that communication between group members during the training session created opportunity for members to gain knowledge about others’ knowledge, thereby benefiting groups in the assembly phase of the study. These findings were important because the development of transactive memory among group members resulted in higher performance (Liang et al., 1995).

In another study examining groups of three people and using a transistor radio assembly task, Moreland and Myaskovsky (2000) examined the use of written rather than face-to-face communication. They found that groups that were trained together performed equally to groups that were trained apart but given written evaluations of each member. This supported the idea that performance benefits link more directly to transactive knowledge systems than to face-to-face communication. These studies also raised questions about how communication aids the development and maintenance of transactive knowledge systems. The groups in this study were temporary laboratory groups and members did not necessarily know each other prior to the
study. Perhaps the effects of communication on transactive knowledge systems take time to develop, or different environments may require different levels of communication.

Some evidence emerged showing that groups with heterogeneous expertise may have more difficulty developing transactive knowledge systems than groups with homogeneous expertise. Brauner (2002) explored the effects of perspective-taking and expertise diversity on the generation of transactive knowledge systems in groups. Brauner (2002) assembled groups of three participants into problem-solving teams and asked them to reconstruct a series of events related to an aircraft incident. The researcher trained participants in perspective-taking (focus on another’s cognition) or introspection (focus on their own cognition) prior to the task. In addition, group members received information such that they would have homogenous or heterogeneous expertise. Brauner found that the development of transactive knowledge was enhanced in homogeneous groups by training in perspective-taking but not by training in introspection. This indicates that focusing on the cognition of others may aid in development of transactive knowledge (Brauner, 2002). In addition, an interaction effect was found where individuals in heterogeneous expertise groups learned more in their own knowledge domain and less in other group members’ domains, when compared to individuals in homogeneous groups. Brauner suggested that heterogeneous members felt more responsible for their area of expertise and therefore committed more of the information to memory. This research addressed situational factors of group composition and personal characteristics of group members on transactive knowledge systems development.

One strength of transactive knowledge systems theory is that it can easily be applied to work teams and organizations (e.g., Moreland, 1999). The influence of transactive knowledge systems on performance for teams in laboratory settings had been established. Practical
implications for work groups were recognized and researchers began to conduct studies in organizations to determine if the same influence could be found for work teams in a field setting.

**Work teams in organizations.** In one of the first field studies of work groups, Austin (2003) studied employees of an apparel and sporting goods store over a five-month period. Austin calculated scores for 27 groups organized around product lines using a self-report questionnaire and responses to scenarios scored by senior managers. Transactive memory highly correlated with measures of group goal attainment, external group evaluation, and internal group evaluation. In addition, of variables tested in the study, transactive memory accuracy was shown to be the strongest predictor of group performance. In another field study of Masters of Business Administration student teams working on a consulting project, communication and initially distributed expertise positively related to measures of transactive knowledge systems (Lewis, 2004). These studies provided evidence for the validity of using self-report measures for transactive knowledge systems. They also contributed to the body of evidence for external validity of transactive knowledge systems theory.

At this point, the theory of transactive knowledge systems was well established and accepted for application in dyads, groups, and work teams. In addition, scales had been developed and validated to measure various aspects of transactive knowledge systems. The field of transactive knowledge systems research experienced exponential growth. Additional research pertaining to this dissertation will be addressed in Chapter 4 in support of the proposed input-mediator-output-input (IMOI) model and research questions. Beyond work groups, transactive memory and the applied theory of transactive knowledge systems have been used to describe knowledge management and organizational learning (Anand, Manz, & Glick, 1998; Brauner et al., 2005).
Chapter 3: Leadership and Shared Leadership

Leadership

**Definition.** The study of leadership has a long history. Still, many questions remain about what leadership is, exactly. Even the most influential researchers in the field have difficulty defining leadership. Vroom and Jago (2007) stated simply that “the term leadership, despite its popularity, is not a scientific term with a formal, standardized definition” (p. 17). The difficulty does not lie in disagreement of the use of the term so much as in the multitude of angles from which it has been studied. It has been viewed as a consequence of structure; an effect of interaction; a result of behavior or personality; a form of influence, persuasion, or power; an instrument to achieve goals; as group processes; or any combination of the above. The view of Bass and Avolio (1990) has merit, concluding that “the definition of leadership should depend on the purposes to be served by the definition” (p. 20). For this paper, leadership will be defined as the use of interpersonal processes to influence, motivate, and guide others to promote the attainment of group and individual goals.

**History.** The importance of leadership is well established. It influences individual and collective learning (Nystrom & Starbuck, 1984), job satisfaction, group potency, group effectiveness (Sosik, Avolio, Kahai, & Jung, 1998), and group productivity and satisfaction (Kahai, Sosik, & Avolio, 1997). Historically, theories of leadership have focused on the individual. Prior to any organized study of leadership, the general belief was that “great leaders are born, not made.” Individual leaders were thought to be personally responsible for changing the course of history. The Great Man/Woman Theory helps explain why leaders have historically been succeeded by their closest living relative (Riggio, 2003).
**Trait theory.** The next theories of leadership developed from the idea that these Great Men and Women have certain traits in common and these traits should be identifiable to the observer. Trait Theory focused on a leader’s physical traits such as height and appearance and personality traits such as extroversion and dominance (Cowley, 1928). Although some traits were common among leaders, there was no single trait or combination of specific traits that were found in all leaders. Based on these findings, scholars generally agreed that certain traits may help a member of a group rise to leadership, but they do not make a leader. Instead, the leader must earn the esteem of members of the group through participation and demonstration of their abilities. Trait theories recently regained popularity in research, predicting leader emergence. Traits such as intelligence, need for dominance, and self-monitoring of social perception are predictive of future leadership roles (Jex, 2002).

**Behavior theory.** Conclusions drawn from findings by trait theorists led researchers to examine the behaviors of leaders as the basis for success. Behavior theorists at Ohio State University found that leader behaviors could be classified onto two factors (Fleishman, 1953; Halpin & Winer, 1957). The *initiating structure* factor included behaviors relating to organization and structure of work and the work situation (i.e., task completion, deadlines, and group roles). The *consideration* factor included behaviors showing concern, mutual respect, and trust for subordinates (i.e., communicating with and encouraging subordinates, asking for opinions, and showing concern for their feelings). At about the same time, behavior theorists at the University of Michigan identified two general categories for successful leader behavior that were similar to those of the Ohio State studies. *Task-oriented* behaviors included supervision, meeting production goals, and setting work standards. *Relationship-oriented* behaviors included showing concern for employees and including them in the decision making process (Kahn &
Katz, 1953/1960). Unexpectedly, both behavior types could link to successful leadership. This confluence was a problem because one style was not superior to the other. How could two very different styles of leadership both be effective? Perhaps the appropriate style would depend on other contingent factors such as the particular task at hand or the culture of the group.

**Contingency theory.** At this point, theories of leadership broadened in scope, considering both personal attributes of the leader as well as the situation. The most well-known contingency theory of leadership was developed by Fiedler (1967). Fiedler’s model states that leaders are inherently either task-oriented or relationship-oriented. Furthermore, task-oriented leaders will be more successful in highly favorable or highly unfavorable situations, whereas relationship-oriented leaders will be more effective in moderate situations. Fiedler identified three factors that determine situation favorability. Leader-member relations describe how well a leader gets along with their subordinates. Generally, positive relationships are considered to be favorable to the leader. Task structure concerns the level of ambiguity in the work task environment. A high degree of structure is considered to be favorable to the leader. The final situational factor is the position power of the leader. More power is thought to be favorable to the leader because subordinates are more likely to follow their direction without question or complaint. The ability of Fiedler’s model to consider aspects of the leader and situational conditions brought about a new way of thinking about leadership and spurred much research in the area. One concern with Fiedler’s model is that leaders are seen as inflexible in regard to their task or relationship orientation. More recent contingency theories view leaders as more flexible in their approach.

Path-Goal Theory (House, 1971, 1996; House & Mitchell, 1974) is a contingency theory that focuses on both leadership and employee motivation. Here, the role of a leader is to help
subordinates become successful. By recognizing differences among subordinates and adjusting their style of leadership to fit the subordinate, leaders guide them down the “path to the goal.” House identified four leadership styles: directive leadership, supportive leadership, achievement-oriented leadership, and participative leadership. Path-goal theory states that a successful leader will be flexible enough to identify and use the appropriate form of leadership based on the characteristics of subordinates and the characteristics of the work environment. Although much research has been conducted using the theory, the ability of the theory to predict outcomes has been mixed. A meta-analysis of 120 studies indicated that a number of potential moderators exist for the relationship between leader behavior and various outcomes (Wofford & Liska, 1993). This result suggests that the theory may be too broad in scope.

Another approach to understanding the leader-follower relationship, The Leader-Member Exchange Model (originally termed Vertical Dyad Linkage; Dansereau, Graen, & Haga, 1975; Graen & Uhl-Bien, 1995) argued that leaders have unique relationships with each subordinate. This relationship develops over time depending on exchanges that occur between them. Liden and Maslyn (1998) identified and developed a scale of four distinct dimensions of the exchange including affect, loyalty, contribution, and professional respect. The Leader-Member Exchange Model is related to a number of organizational variables including performance, turnover, job satisfaction, career progress, and organizational commitment (see Graen & Uhl-Bien, 1995 for a review).

**Recent theory.** Other recent work on leadership has expanded the original Trait Theory approach. New types of leadership have been identified as Charismatic or Transformational Leadership (Bass 1985, 1999; Bass & Avolio, 1990; House, 1996). These leaders not only influence subordinates, but inspire them to perform beyond their capabilities. In addition, they
are seen as the force behind meaningful change in organizations. These theories focus on traits such as captivating tone of voice, facial expressions, and powerful, confident, and dynamic communication style, which these leaders use to communicate their vision and facilitate change. It has been shown that these leaders are able to affect subordinates’ performance and job satisfaction. Also, transformational leadership increases group potency and effectiveness (Sosik et al., 1998). Applying modern research and statistical techniques to the historical Trait Theory approach has provided empirical evidence for these theories. However, questions as to whether this type of leadership can be taught or if it is necessary and effective in all situations remain.

Overall, scholars have not identified any specific group of traits or behaviors that predetermine successful leadership. Instead, it appears that different styles of leadership are effective in different situations and in different group cultures. Also, the ability to communicate clearly and effectively and to inspire motivation in others may characterize outstanding leadership. Perhaps the most effective leaders have the flexibility to change their leadership style to fit the situation, group, or individual.

**Leadership styles.** Despite theoretical benefits to flexible leadership styles, support for leadership types has been strong. Individual differences in overall leadership style have been well documented (Dansereau, Alutto, & Yammarino, 1984; Graen & Uhl-Bien, 1995; Vroom & Jago, 1995) and are found across organizations, hierarchical levels, management function, gender, and culture (Vroom & Jago, 1995). Sims and colleagues (Cox & Sims, 1996; Manz & Sims, 1991; Pearce, Perry, & Sims, 2001; Pearce & Sims, 2002; Sims & Manz, 1996) have identified five leadership behavior styles: aversive, directive, transactional, transformational, and empowering.
Aversive leadership describes behaviors that rely on coercive power (French & Raven, 1959) rooted in punishment research (Arvey & Ivancevitch, 1980). Coercive power occurs when one person has the ability to punish another and when the other expects they will be punished if they fail to conform to the influence of the person with the power to punish (French & Raven, 1959). Punishment behaviors have not yielded effective results in leadership literature. Noncontingent reprimand (punishment for no reason) aligns with negative subordinate satisfaction and with little effect on performance. Similar effects were found for contingent reprimand (punishment with reason), producing little effect on performance (Cox, 1994). Behaviors that characterize this leadership style include engaging in intimidation, dispensing reprimands, and coercive use of power. Directive leadership describes leadership that primarily relies on official organizational position and legitimate power. Legitimate power (French & Raven, 1959) comes from cultural values and internalized norms in the subordinate. These values and norms dictate a leader’s legitimate right to influence the subordinate such that the subordinate feels an obligation to accept the influence. The Ohio State (Fleishman, 1953; Halpin & Winer, 1957) and University of Michigan (Kahn & Katz, 1953/1960) studies defined leadership behaviors that involved planning and organizing subordinates’ roles and responsibilities and were instrumental in developing the construct. Behaviors characteristic of directive leadership include issuing instructions and commands and assigning goals. Transactional leadership focuses on clarifying the effort-reward relationship and includes behaviors such as providing personal and material rewards. Transformational leadership, first described by Burns (1978), was later operationalized and empirically tested by Bass and colleagues (Avolio & Bass, 1988; Bass & Avolio, 1990; House, 1977). Bass described these leaders as possessing charismatic leadership, inspirational motivation, intellectual stimulation,
and individualized consideration. These leaders also display the behaviors of providing vision, expressing idealism, using inspirational communication, having high performance expectations, challenging the status quo, and providing intellectual stimulation. The last leadership behavior type, *empowering leadership*, focuses on encouraging others to lead themselves and is sometimes referred to as Super Leadership. Manz and Sims (1980) expanded clinical applications of behavioral self-management to organizations by defining self-management as a substitute for leadership. This key contribution of social cognitive theory provides a framework to understand how modeling influences individual behavior. Empowering leadership behavior ideally includes modeling appropriate self-leadership behavior, which is then adopted by the subordinate. Empowering leadership behavior also includes encouraging independent action, opportunity thinking, team-work, self-development and self-reward, and using participative goal setting. Researchers have used each style of leadership behavior to successfully to explore vertical and shared leadership (Pearce & Sims, 2002).

**Shared leadership.** Traditional theories of leadership have assumed hierarchical organizational structures identifying a single designated leader (vertical leadership). However, increased use of team structures in organizations has encouraged researchers to broaden the concept of leadership to include peer influence. Yukl (1998) identified this form of distributed leadership as “shared leadership” (p. 368). Shared leadership references an emergent team property of mutual influence and shared responsibility among team members whereby they lead each other toward goal achievement (Carson, Tesluk, & Marrone, 2007; Hoch & Kozlowski, 2014; Pearce & Conger, 2003).

Shared leadership and vertical leadership are not mutually exclusive, rather, one can study them together. In a vertical leadership environment, informal leadership provided by other
organizational members may contribute significantly to team or unit-level effectiveness (Pearce & Sims, 2002). Therefore, shared leadership is an important compliment to traditional vertical forms of leadership. Additionally, shared leadership has unique effects on team outcomes beyond vertical leadership (Wang, Waldman, & Zhen, 2014). In one study comparing vertical and shared leadership in change management teams, shared leadership was a more useful predictor of team effectiveness than vertical leadership (Pearce & Sims, 2002). One important distinction between them is that although shared leadership is a “simultaneous, ongoing, mutual influential process” (Pearce, 2004, p. 48) that involves “peer-lateral, upward or downward influences of team members” (Pearce & Conger, 2003, p. 286), vertical leadership is typically a downward influence on subordinates by an appointed or elected leader (Pearce & Conger, 2003).

Leader styles identified over past decades continue to be relevant in shared leadership research. Pearce and Sims (2002) used five traditional and well established styles of leadership behavior to measure vertical and shared leadership. The researchers adapted questions on the scale to measure vertical leadership by using the wording ‘My leader…’ and to measure shared leadership by using the wording “My team members…” In a study using this scale, Pearce and Sims found that vertical and shared leadership were important predictors of team effectiveness but that shared leadership was a stronger predictor. Furthermore, four of the five leadership styles had a relationship with team effectiveness for vertical and shared leadership conditions. Aversive and directive leadership had negative relationships with measures of team effectiveness whereas transformational and empowering leadership had positive relationships with measures of team effectiveness. Shared leadership behaviors influence team self-ratings, internal customer ratings, and manager ratings of effectiveness (Pearce & Sims, 2002). Shared leadership also
strongly relates to attitudinal outcomes, behavioral processes, emergent states, and team effectiveness (Wang et al., 2014).

In summary, researchers have well documented the relationship between leadership behavior and group outcomes. Also, scholars generally accepted the concept that some styles of leadership are more effective than others. Only recently has leadership been conceptualized as an emergent shared characteristic of groups. Researchers have used traditional styles of leadership successfully to study the construct of shared leadership and some evidence emerged that shared leadership and vertical leadership have similar influences on group outcomes. However, very little is known about which variables moderate or mediate the relationship between leadership style and team effectiveness.
Chapter 4: Input-Mediator-Output-Input Model and Research Questions

In prior chapters, I reviewed the constructs of transactive knowledge systems and shared leadership style. The discussion included their definitions, history, and a review of theory and research. In this chapter, I define and propose an Input-Mediator-Output-Input (IMOI) model, provide support for relationships proposed in the model, and identify research questions to test the proposed model.

Input-Mediator-Output-Input (IMOI) Model

Ilgen, Hollenbeck, Johnson, and Jundt (2005) first described the IMOI model in response to the advancement of team research from studying questions of what predicts team effectiveness to more complex questions of why some teams are more effective than others. In addition, Ilgen et al. acknowledged a shift in team research to an understanding of teams as complex, dynamic systems existing in larger systemic contexts. This shift required adjustment from the classic but unidirectional Input-Process-Output (IPO) model (McGrath, 1984) to one that would recognize emergent states as inherent in teams. Emergent states refer to dynamic conditions that enable and underlie effective teamwork. An alternative, the Input-Moderator-Output-Input model was proposed. As with McGrath’s (1984) IPO model, input describes antecedent factors at the individual level (i.e., team member characteristics such as competencies and personalities), team-level (i.e., task structure and leader influences), and contextual level (i.e., environmental complexity and organizational features). The process in IPO describes team members’ interactions, directed toward task accomplishment, that evolve into outcomes. In the IMOI model, the ‘P’ (processes) was changed to ‘M’ (mediation) to reflect a broader range of variables important for explaining variability in team performance (i.e., cognitive, behavioral, and affective). Outcomes in both models represent by-products of team activity and may include
performance (i.e., quality and quantity) and affective reactions (i.e., satisfaction, commitment, and growth). *Input* (I) was added at the end of the IMOI model to address the important concept of feedback loops that are critical to understanding how teams evolve over time. The hyphen was eliminated to signify that causal linkages may not be linear or additive, but may be nonlinear or conditional (Ilgen et al., 2005). This format reflects that team states are likely to be influenced over time and as a function of outcomes. It is important to understand that the emergent and cyclical nature of the IMOI model does not make it untestable. Although change is inherent in the model, patterns develop and may even become ingrained. It is also important to note that team effectiveness criteria (outcomes) have evolved to include many different forms and combinations; thus, what constitutes effectiveness has become increasingly more complex (Mathieu, Maynard, Rapp, & Gilson, 2008).

The construct of shared leadership, in the context of the IMOI model, reflects an emerging view of team-level leadership as an output that serves also as an input in the next stage of development (Day, Gronn, & Salas, 2004). In this model, input from individual team leaders (whether appointed or emergent) create, foster, and promote a shared understanding necessary to enable effective teamwork. In this way, leaders provide valuable input for team processes and structures. If leaders are successful, they will aid in development of team-level (shared) leadership that is available to the team in future performance cycles (Day et al., 2004). The result is that leadership becomes embedded in the input-output-input cycle of the IMOI loop.

In a meta-analytic review of cognitive underpinnings of effective teamwork (DeChurch & Mesmer-Magnus, 2010), cognitive emergent states were an important mediator of team functioning. In the same study, emergent collective cognitive processes were recognized as central to team effectiveness. Collective cognition describes the organization, representation, and
Transactive memory, leadership, effectiveness

distribution of knowledge within the team that is important to team functioning (DeChurch & Mesmer-Magnus, 2010). Transactive knowledge systems represent one theory of emergent collective cognition that occurs in teams. Therefore, transactive knowledge systems assumes the position of mediator in the IMOI model, helping predict outputs of team effectiveness (see Figure 3).

Figure 3. Proposed IMOI model.

Based on the theory explained above, I propose an IMOI model representing shared leadership style as an ‘input’ in the input-output-input cycle, and with transactive memory and the team construct of transactive knowledge systems as emergent cognitive structures that mediate the relationship between shared leadership and measures of team effectiveness (output). I also include two moderators (perspective-taking and motivation) which act as antecedent factors at the individual level, influencing the relationship between shared leadership and
Transactive memory, leadership, effectiveness

Transactive knowledge systems in the IMOI model (see Figure 3). I developed the research questions and hypotheses in the following section based on the proposed IMOI model.

Research Questions and Hypotheses

Shared leadership style, transactive memory, and transactive knowledge systems.

Evidence has accrued that situational variables such as leadership style may affect the development of transactive memory and transactive knowledge systems. In a study of groups with and without leaders, groups with leaders had significantly more differentiation of knowledge, less integration of knowledge, and a higher degree of cognitive interdependence when compared to groups with no leader (Robertson & Brauner, 2009). Similar differences emerged for groups when controlling for leadership style. In an exploratory study, a relationship-oriented style of leadership correlated positively with differentiation, cognitive independence, and transactivity (Kusari, 2004). Other researchers suggested that a leadership style that promotes interaction, sharing of information, and cooperative goals will result in increased transactive knowledge systems development (Zhang, Hempel, Han, & Tjosvold, 2007). This notion makes good sense when considering the role that transactive processes play in the emergence of transactive knowledge systems. A better understanding of the effect of leadership style on the development of transactive memory and transactive knowledge systems is important because situational effects on transactive knowledge systems are not well understood.

I propose that shared leadership style will predict transactive knowledge systems development for individuals and teams. In Chapter 3, I introduced leader behaviors characterizing aversive, directive, transactional, transformational, and empowering leadership styles. Aversive leadership relies primarily on coercive power and is characterized by behaviors such as intimidation and dispensing reprimands. I expect that an aversive shared leadership style
will result in decreased transactivity and metacognition, yielding weak transactive knowledge systems. Directive leadership relies on position power and is characterized by behaviors such as issuing instructions and assigning goals. A directive leadership style may lead to greater differentiation of knowledge, however, I expect it will inhibit transactivity, integration, and metaknowledge, ultimately resulting in weak transactive knowledge systems. In Chapter 3, I cited research supporting the position that aversive and directive leadership styles are generally negative or restricting (Pearce & Sims, 2002). Therefore, for this study, I combine aversive and directive leadership styles into one construct named ‘restrictive shared leadership style’ (SLS restrictive).

Transactional leadership focuses on clarifying effort-reward relationships and includes behaviors such as providing personal and material rewards, and stepping in before a problem arises (management by exception-active). Although these behaviors may influence some aspects of teams, I do not expect them to encourage or discourage development of dimensions of transactive knowledge systems. Therefore, I did not include transactional leadership in my study.

Transformational leadership incorporates charismatic affect to inspire employees and includes behaviors such as providing intellectual stimulation and having high performance expectations. Transformational leadership behaviors should increase transactivity, differentiation, metacognition, and cognitive interdependence, resulting in stronger transactive knowledge systems. Empowering leadership is characterized by leading others to lead themselves by modeling self-leadership behavior and encourages teamwork and opportunity thinking. Empowering leadership behaviors should encourage transactivity, integration, differentiation, metacognition, and cognitive interdependence, resulting in stronger transactive knowledge systems. Researchers support the position that transformational and empowering
leadership behaviors are generally positive or constructive (Pearce & Sims, 2002). Therefore, for this study, I combine transformational and empowering leadership styles into one construct named ‘construcive shared leadership style’ (SLS constructive). It is expected that restrictive shared leadership style will negatively influence transactive knowledge systems and constructive shared leadership style will positively influence transactive knowledge systems.

**H1a and b:** Restrictive shared leadership style will predict transactive knowledge systems such that increased restrictive shared leadership style will significantly predict lower transactive knowledge systems for individuals (H1a) and teams (H1b).

**H1c and d:** Constructive shared leadership style will predict transactive knowledge systems such that increased constructive shared leadership style will significantly predict higher transactive knowledge systems for individuals (H1c) and teams (H1d).

**Shared leadership style, transactive knowledge systems, and effectiveness.** As noted in Chapter 3, leadership influences many types of outcomes including individual and collective learning (Nystrom & Starbuck, 1984), job satisfaction, group potency, group effectiveness (Sosik et al., 1998), and group productivity and satisfaction (Kahai et al., 1997). Research also supports the effect of shared leadership style on performance outcomes for teams. In a meta-analysis of shared leadership and team effectiveness, Wang et al. (2014) found a positive and moderately strong relationship between shared leadership and team effectiveness. Furthermore, the relationship between traditional leadership types (transactional, directive, aversive, and participative) and team effectiveness was weaker than that between more recently identified leadership types (visionary, transformational, charismatic, empowering, and authentic) and team
effectiveness. Therefore, I expect that restrictive shared leadership style will negatively influence measures of effectiveness and constructive shared leadership style will positively influence measures of effectiveness.

\textit{H2a and b}: Restrictive shared leadership style will predict measures of effectiveness such that increased restrictive shared leadership style will significantly predict lower effectiveness for individuals (H2a) and teams (H2b).

\textit{H2c and d}: Constructive shared leadership style will predict measures of effectiveness such that increased constructive shared leadership style will significantly predict higher effectiveness for individuals (H2c) and teams (H2d).

Transactive memory and transactive knowledge systems have consistently predicted outcomes in laboratory and applied settings (Austin, 2003; Liang, et al., 1995; Moreland & Myaskovsky, 2000; Zhang et al., 2007), including measures of performance (Liang et al., 1995; Moreland & Myaskovsky, 2000); job satisfaction and positive relationships with colleagues and superiors (Brauner, 2002); cooperation, coordination, and efficiency (Robertson & Brauner, 2009). Therefore, I expect that transactive knowledge systems will positively influence measures of effectiveness.

\textit{H2e and f}: Transactive knowledge systems will predict measures of effectiveness such that increased transactive knowledge systems will significantly predict higher effectiveness for individuals (H2e) and teams (H2f).
To my knowledge, no published studies have explored whether transactive knowledge systems mediate the relationship between leadership style and measures of effectiveness. Based on the theory that shared leadership style influences development of transactive knowledge systems, and past research that supports the relationship between transactive knowledge systems and effectiveness measures, I believe transactive knowledge systems are one reason for the relationship between shared leadership styles and outcomes. Therefore, I expect that a shared leadership style that restricts transactive knowledge systems development will result in lower measures of effectiveness. I expect the converse to also be true; a shared leadership style that promotes transactive knowledge systems development will result in higher measures of effectiveness. Therefore, I expected that transactive knowledge systems mediate the relationship between shared leadership style and measures of effectiveness in the following way:

\[ H2g \text{ and } h: \text{Transactive knowledge systems mediate the relationship between restrictive shared leadership style and measures of effectiveness such that restrictive shared leadership style leads to lower transactive knowledge systems which leads to depressed measures of effectiveness for individuals (H2g) and teams (H2h).} \]

\[ H2i \text{ and } j: \text{Transactive knowledge systems mediate the relationship between constructive shared leadership style and measures of effectiveness such that constructive shared leadership style leads to higher transactive knowledge systems, which leads to heightened measures of effectiveness for individuals (H2i) and teams (H2j).} \]

**Perspective-taking.** Perspective-taking increases transactive memory accuracy and agreement (Gockel & Brauner, 2013). “As team members move their attention from themselves
to other team members …they gain more knowledge about one another” (Gockel & Brauner, 2013, p. 229). This tendency to spontaneously adopt the psychological view of others correlates with self-esteem and extraversion (Davis, 1983). Perspective-taking also facilitates smoother and more rewarding interpersonal relationships and better social functioning (Davis, 1983). It is difficult to predict perspective-taking by leadership style. Constructive shared leadership behaviors, such as providing intellectual stimulation, should be more successful if one understands what is interesting to the other. Similarly, encouraging opportunity thinking may require that one recognize what is seen as an opportunity by the other. Individuals using restrictive shared leadership behaviors may also score high in perspective-taking. Intimidation may require an understanding of what behaviors will be intimidating to the other. I expect teams whose members are high in perspective-taking will have greater transactivity and metaknowledge for both restrictive and constructive shared leadership styles. They may also have increased cognitive interdependence and well balanced levels of knowledge integration and differentiation. Therefore, I expect that perspective-taking moderates the relationship between shared leadership style and transactive memory in the following way:

H3a and b: Perspective-taking will moderate the relationship between restrictive shared leadership style and transactive knowledge systems in a positive direction, such that when perspective-taking is high the relationship between restrictive shared leadership style and transactive knowledge systems is stronger for individuals (H3a) and teams (H3b).

H3c and d: Perspective-taking will moderate the relationship between constructive shared leadership style and transactive knowledge systems in a positive direction, such that the relationship between constructive shared
leadership style and transactive knowledge systems is stronger for individuals

(H3c) and teams (H3b).

**Motivation.** In a review of transactive memory research from 1985–2010, Ren and Argote (2011) identified areas of research that would most benefit the field. A team member’s motivation to develop transactive memory was an important area for further exploration. Guay, Vallerand, and Blanchard (2000), found that motivation relates to behavioral intentions of willingness to partake in discussion, which provides evidence that motivation may influence levels of transactive processes in individuals and teams. Furthermore, it is my position that creating transactive memory requires cognitive effort. Specifically, creating metacognition requires paying attention to communication about others’ and storing information in one’s memory about others’ knowledge. In general, self-determined motivation types (intrinsic motivation and identified regulation) align with positive outcomes, whereas motivation types that are not self-determined (external regulation and amotivation) align with negative outcomes (Deci & Ryan, 1985; Vallerand, 1997). For this research, I reduced four motivation scales into two scales named, intrinsic motivation (intrinsic motivation and identified regulation) and extrinsic motivation (external regulation and amotivation). I propose that individuals and teams with higher levels of internal motivation will have increased transactivity and metacognition, thereby building stronger transactive knowledge systems. Also, individuals and teams with higher levels of external motivation will have reduced levels of transactivity and metacognition, resulting in less strong transactive knowledge systems. Therefore, I expect that motivation moderates the relationship between shared leadership style and transactive knowledge systems in the following way:
Transactive memory, leadership, effectiveness

H4a, b, c, and d: Intrinsic sources of motivation will moderate the relationship between shared leadership style (restrictive and constructive) and transactive knowledge systems in a positive direction, such that when intrinsic motivation is high, the relationship between shared leadership style and transactive knowledge systems is stronger for individuals (H4a,c) and teams (H4b,d).

H4e, f, g, and h: Extrinsic sources of motivation will moderate the relationship between shared leadership style (restrictive and constructive) and transactive knowledge systems in a negative direction, such that when extrinsic motivation is high, the relationship between shared leadership style and transactive knowledge systems is weaker for individuals (H4e, g) and teams (H4f, h).

**Transactive knowledge systems development**\(^1\). Temporal aspects of transactive knowledge systems development have, to my knowledge, not been studied. However, transactive knowledge is an emergent property of teams that develops through interaction and learning about others’ knowledge. Therefore, I predict that transactive knowledge systems will increase over time for individuals and teams.

Little is known about how situational factors influence development of transactive knowledge systems. For the reasons outlined in Hypotheses 1a-d, I expect shared leadership style will influence the rate of development of transactive knowledge systems over time. Therefore, I expect that transactive knowledge systems will increase over time and will do so at different rates for shared leadership styles in the following way:

\(^1\) These hypotheses apply to Study 1 only because longitudinal data were not collected in Study 2.
H5a: Transactive knowledge systems significantly increase over time.

H5b: Transactive knowledge systems will increase at lower rates for teams with restrictive shared leadership style.

H5c: Transactive knowledge systems will increase at higher rates for teams with constructive shared leadership style.

In Chapter 5, I will report on tests of the proposed IMOI model in a longitudinal field study. In Chapter 5, I will also report on tests of temporal theories of transactive knowledge systems. In Chapter 6, I will report on tests of the proposed IMOI model in a cross-sectional study. These designs test the IMOI model in two distinctly different populations.
Chapter 5: Field Study of Real Teams in a Team Based Learning Environment (Study 1)

The purpose of Study 1 is to test the proposed theoretical IMOI model in a longitudinal field study. I also tested temporal theories of transactive memory and transactive knowledge systems. This method allowed examination and prediction of relationships between theoretical constructs in an applied setting.

Method

Participants. Participants were students from a major university on the East Coast of the United States. Participants were at least 18 years of age and enrolled in courses using the Team Based Learning (TBL) pedagogy. Participants were asked to complete three surveys over one semester. Data was collected in two semesters, Fall 2013 and Spring 2014. Participation was voluntary. A total of 245 participants completed at least one survey.

Hypotheses 1–4, testing the IMOI model. For analysis of hypotheses 1–4, participants were excluded if they did not complete Survey 2 and Survey 3 because models for these hypotheses tested predictors at time 2 and outcomes at time 3. This resulted in the exclusion of 100 participants. Therefore, the analysis included 145 participants (101 women, 44 men) averaging 21.47 years of age ($SD = 5.18$, range: 18–44). The university provided grade-point-average (GPA) and course grade data. The mean cumulative GPA for participants was 3.34 (grade ‘A-’) ($SD = 0.60$). The mean individual grade students received in the TBL course they were enrolled in was 3.21 (grade ‘B+’) ($SD = 0.89$). Education and ethnicity information is provided in Table 1.

Hypothesis 5, testing transactive knowledge systems over time. All 245 participants were included in analysis of hypothesis 5 because longitudinal analysis enables inclusion of participants that completed Survey 1, Survey 2, Survey 3, or any combination of surveys.
Therefore, the analysis is based on 245 participants (166 women, 79 men) averaging 21.52 years of age ($SD = 5.99$, range: 18–51). The mean cumulative GPA for participants was 3.23 (grade ‘B+’) ($SD = 0.65$). The mean individual grade students received in the team based learning course they were enrolled in was 2.87 (grade ‘B’) ($SD = 1.20$). Education and ethnicity information is provided in Table 1.

**Teams.** TBL instructors created teams within their classrooms using TBL guidelines. TBL guidelines focus on four aspects of group formation: minimizing barriers to group cohesiveness, distributing member resources, groups should be fairly large and diverse, and groups should be permanent (Michaelsen, Knight, & Fink, 2004). These teams existed for one semester and worked together on team based assignments throughout the semester. Analysis for hypotheses 1–4 included participants from 68 teams across 17 classrooms. Teams had an average of between six and seven members ($M = 6.17$, $SD = 1.25$, range: 4–10) with an average of between three and four women ($M = 3.87$, $SD = 1.28$, range: 0–7) and between two and three men ($M = 2.38$, $SD = 1.33$, range: 0–6) on each team. Analysis for hypothesis 5 included participants from 83 teams across 18 classrooms. Teams had an average of between five and six members ($M = 6.14$, $SD = 1.80$, range: 2–10) with an average of between three and four women ($M = 3.80$, $SD = 1.55$, range: 0–9) and between two and three men ($M = 2.35$, $SD = 1.41$, range: 0–6) on each team. The TBL method includes team assignments such as ‘readiness assessments’ that are graded and compared in the classroom. Teams are also required to work together to provide graded solutions to problems, cases, or applications (Michaelsen et al., 2004). These team grades comprise part of each individual team member’s course grade.
Table 1. *Participant’s Demographics, Study 1*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hypotheses 1–4</th>
<th>Hypothesis 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>101 (69.7)</td>
<td>166 (67.8)</td>
</tr>
<tr>
<td>Male</td>
<td>44 (30.3)</td>
<td>79 (32.2)</td>
</tr>
<tr>
<td>Highest level of college completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshmen</td>
<td>65 (44.8)</td>
<td>105 (42.9)</td>
</tr>
<tr>
<td>Sophomore</td>
<td>28 (19.3)</td>
<td>47 (19.2)</td>
</tr>
<tr>
<td>Junior</td>
<td>20 (13.8)</td>
<td>31 (12.7)</td>
</tr>
<tr>
<td>Senior</td>
<td>11 (7.6)</td>
<td>28 (11.4)</td>
</tr>
<tr>
<td>Some graduate school</td>
<td>16 (11)</td>
<td>29 (11.8)</td>
</tr>
<tr>
<td>M.A. or M.S.</td>
<td>5 (3.4)</td>
<td>5 (2.0)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>61 (42.1)</td>
<td>93 (38)</td>
</tr>
<tr>
<td>Black</td>
<td>13 (9.0)</td>
<td>24 (9.8)</td>
</tr>
<tr>
<td>Asian</td>
<td>38 (26.2)</td>
<td>49 (20)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>17 (11.7)</td>
<td>38 (15.5)</td>
</tr>
<tr>
<td>Italian-American</td>
<td>1 (0.7)</td>
<td>4 (1.6)</td>
</tr>
<tr>
<td>Two or more races</td>
<td>4 (2.8)</td>
<td>7 (2.9)</td>
</tr>
<tr>
<td>Other or None of the above</td>
<td>11 (7.6)</td>
<td>30 (12.2)</td>
</tr>
</tbody>
</table>

**Measures.** Nine scales assessed respondents in Study 1: The Questionnaire for Transactive Knowledge Systems (Q-Tracks) (Bohnenkamp, 2016; Brauner & Robertson, 2009; Robertson et al., 2013), The Vertical and Shared Leadership Scale (VSLS) (Pearce & Sims, 2002), the Perspective-taking Scale (PT) from the Interpersonal Reactivity Index (IRI) (Davis, 1980, 1983), The Situational Motivation Scale (SIMS) (Guay et al., 2000), and five self-report measures of productive output from The Team Diagnostic Scale (TDS) (Wageman, Hackman, & Lehman, 2005). All scales were answered using a 6-point Likert-type scale (*1* = strongly disagree, *6* = strongly agree) to indicate the extent of agreement with each item. The university provided objective measures of performance (GPA and course grade). Demographic questions about individuals and teams were asked. Three surveys were administered over each semester.
Scales varied across surveys based on hypotheses being tested. For example, I included Q-Tracks in all three surveys to allow for longitudinal analysis, whereas I only included team effectiveness measures in survey 3. Scales used in survey 1, 2, and 3 appear in Appendix O. I provide means, standard deviations, interscale correlations, and consistency reliability estimates (Cronbach’s Alpha) for all scales in Tables 2 and 3. I describe all constructs and scales measuring them below. I provide a complete list of questions for Study 1 in Appendices A, C, E, F, H, J, L, and O.

**Transactive memory and transactive knowledge systems.** The Questionnaire for Transactive Knowledge Systems (Q-Tracks) (Bohnenkamp, 2016; Brauner & Robertson, 2009; Robertson et al., 2013) measured five dimensions of transactive knowledge systems: integration, differentiation, metaknowledge, transactivity, and cognitive interdependence. Integration (five items) measured the degree of shared knowledge between individual group members. For example “All team members have the same amount of basic knowledge relevant to our work.” Differentiation (five items) measured the degree to which individual members of a group have specialized unshared knowledge. For example “Our team has been put together so that we can complement each other’s specific knowledge.” Metaknowledge (five items) measured how much individuals in a group know about other group members’ knowledge. For example “If I don’t know something, I know whom in the team to ask.” Transactivity (five items) measured the level of information exchange in a group. For example “Knowledge is regularly exchanged among team members.” Cognitive interdependence (five items) measured the degree to which group members rely on each other to access information. For example “To do my job successfully, I have to integrate other team members’ knowledge.” An overall measure of transactive knowledge systems was created by averaging across the five subscales. Internal consistency
estimates were strong for a combined scale of transactive knowledge systems (H1–4: time 2: $\alpha = .83$; time 3: $\alpha = .87$ and H5: time 1: $\alpha = .82$; time 2: $\alpha = .83$ time 3: $\alpha = .87$) and are presented in Tables 2 and 3. The scale consists of 25 items that can be found in Appendix A.

*Shared leadership style.* The Vertical and Shared Leadership Scale (Pearce & Sims, 2002) measured five types of leadership behavior: aversive, directive, transactional, transformational, and empowering. Aversive leadership (seven items) relies primarily on coercive power and is characterized by behaviors such as intimidation and dispensing reprimands. For example, “My team members can be quite intimidating.” Directive Leadership (nine items) relies on legitimate power and is characterized by behaviors such as issuing instructions and commands and assigning goals. For example, “My team members give me instructions about how to do my work.” Transformational leadership (16 items) incorporates charismatic effect to inspire employees and includes behaviors such as providing intellectual stimulation and having high performance expectations. For example, “My team members provide a clear vision of where our team is going.” Empowering leadership (six items) is characterized by leading others to lead themselves by modeling self-leadership behavior and encouraging team work and opportunity thinking. For example “My team members encourage me to learn by extending myself.” As proposed in the IMOI model, four shared leadership subscales were combined into two subscales: I created *SLS restrictive* by averaging scores across the subscales aversive leadership and directive leadership. Similarly, I created *SLS constructive* by averaging scores across the subscales of transformational leadership and empowering leadership. Internal consistency estimates were good for measured of SLS restrictive (H1–4: $\alpha = .74$ and H5: $\alpha = .73$) and SLS constructive (H1–4: $\alpha = .83$ and H5: $\alpha = .83$) and are presented in Tables 2 and 3. The scale contains 45 items, listed in Appendix C.
Perspective-taking. The Perspective-taking scale from the Interpersonal Reactivity Index (IRI) (Davis, 1980, 1983) measured perspective-taking. Perspective-taking refers to the tendency of individuals to adopt the psychological point of view of others. For example, “I try to look at everybody’s side of a disagreement before I make a decision.” To keep the questionnaire to a manageable length, I selected four of seven questions using factor analysis loading reported in Davis (1980, p. 9). Reliability estimates (Cronbach’s alpha) were good (H1–4: \( \alpha = .76 \)) and are reported in Table 2. Scale items appear in Appendix E.

Motivation. The Situational Motivation Scale (SIMS) (Guay et al., 2000) measured four types of motivation: intrinsic motivation, identified regulation, external regulation, and amotivation. These types of motivation differ in inherent levels of self-determination which is a sense of freedom in doing what one has chosen to do. SIMS asks participants to answer items based on the question “Why are you currently engaged in these work activities?” Intrinsic motivation occurs when one engages in behaviors for the sole pleasure and satisfaction derived from them. For example, “I think that these activities are interesting.” Identified regulation occurs when one values behaviors and perceives those behaviors as being chosen by oneself. For example, “I think that these activities are good for me.” External regulation occurs when one engages in behavior because of rewards offered or to avoid negative consequences. For example, “It is something that I have to do.” Amotivation occurs when individuals experience a lack of contingency between their behaviors and outcomes. For example, “There may be good reasons to do these activities, but personally I don’t see any.” In order to keep the survey to a manageable length, I included two questions from each subscale, for a total of eight questions. I chose questions with the highest factor analysis loadings, as reported in Guay et al. (2000, p. 189). Items appear in Appendix F.
In the original development of the IMOI model (Chapter 4), I proposed to reduce four motivation scales into two scales, intrinsic motivation (intrinsic motivation and identified regulation) and extrinsic motivation (external regulation and amotivation). This decision was based on the validation study of SIMS (Guay et al., 2000; p. 185) which reported a high positive correlation between intrinsic motivation and identified regulation ($r = .36, p < .01$) and also between external regulation and amotivation ($r = .26, p < .01$). However, analysis of the data did not support combination of the subscales external regulation and amotivation because of low correlation and Cronbach’s alpha ($r = .12, \alpha = .20$). Instead, three measures of motivation were examined, each with good estimates of internal consistency: intrinsic/identified regulation ($\alpha = .91$), external regulation ($\alpha = .75$), and amotivation ($\alpha = .78$) (Table 2). Intrinsic/identified regulation motivation (IIR motivation) measured self-determined motivation. External regulation measured non-self-determined motivation. Amotivation measured a lack of contingency between behavior and motivation.

**Objective measures of effectiveness.** The university provided GPA and course grades as objective measures of effectiveness. GPA is the individual students’ overall grade point average including the semester in which they took part in this study. Course grade is the grade the individual student earned in the Team Based Learning course in which they were enrolled while participating in this study.

**Self-report measures of effectiveness.** Criteria of Team Effectiveness measures taken from The Team Diagnostic Survey (TDS) (Wageman et al., 2005) measured aspects of team effectiveness. Criteria of team effectiveness provide an indirect measure of a team’s ability to generate satisfactory products, services, and decisions (Wageman et al., 2005). The first of the criteria, *productive output*, measured the ability of a team to produce output that will meet or
Transactive memory, leadership, effectiveness

exceed expectations. Three productive output (PO) criteria of team effectiveness are: effort related, strategy related, and knowledge and skill related (Hackman, 2002; Wageman et al., 2005). PO-effort related (three items) measured the level of effort members collectively expended on tasks. For example, “Members demonstrate their commitment to our team by putting in extra time and effort to help it succeed.” PO-strategy related (three items) measured the quality of team task performance strategies. For example, “Our team has a great deal of difficulty actually carrying out the plans we make for how we will proceed with the task.” (reverse coded). PO-knowledge and skill related (three items) measured the degree to which the team used the full complement of member knowledge and skill. For example, “Our team is quite skilled at capturing the lessons that can be learned from our work experiences.” The scale contains nine items, listed in Appendix H.

The second criteria of team effectiveness, social processes, assesses whether the social processes the team uses in carrying out the work enhance members’ capability to work together interdependently in the future (Hackman, 1990, 2002; Hackman & Wageman, 2005, Wageman et al., 2005). I used the subscale satisfaction with team relationships (three items) from social processes in this study. This scale measured team members’ satisfaction with within-team relationships. For example, “I very much enjoy talking and working with my teammates.” The scale contains three items, listed in Appendix H.

The third criteria of team effectiveness, individual learning and well-being, assess whether the group experience contributes positively to the learning and well-being of individual team members rather than frustrating, alienating, or deskilling them (Wageman, et al., 2005). Three subscales measured Individual learning and well-being, each of which measured an individual affective reaction to the team and its work. The three affective reactions are: internal
work motivation (four items), satisfaction with growth opportunities (three items), and general satisfaction (three items). One question assessing internal work motivation is “I feel a real sense of personal satisfaction when our team does well.” One question assessing satisfaction with growth opportunities is “I learn a great deal from my work on this team.” One question assessing general satisfaction is “I enjoy the kind of work we do in this team.” The scale contains ten items, listed in Appendix H.

*Internal consistency.* In order to improve the internal consistency of the productive output measures, I removed four items due to low Cronbach’s alpha. I removed one question from each of the productive output scales of the Team Diagnostic Survey. The item removed from the PO-effort related scale was “Some members of our team do not carry their fair share of the overall workload.” (reverse coded) \( (\alpha = .04, \text{before removal of item}) \). After removal of this item, internal consistency of the measure was acceptable \( (\alpha = .75) \). The item removed from the PO-strategy related scale was “Our team often comes up with innovative ways of proceeding with the work that turn out to be just what is needed.” \( (\alpha = .39, \text{before removal of item}) \). After removal of this item, internal consistency of the scale was much improved \( (\alpha = .69) \). The item removed from the PO-knowledge and skill related scale was “How seriously a member’s ideas are taken by others on our team often depends more on who the person is than on how much he or she actually knows.” (reverse coded) \( (\alpha = .22, \text{before removal of item}) \). After removal of this item, internal consistency of the measure was acceptable \( (\alpha = .76) \). After removal of these items, analysis included two items for each of the productive output scales. In addition, one item was removed from the satisfaction with growth opportunities subscale of individual learning and well-being due to a low Cronbach’s alpha. The item was “My own creativity and initiative are
suppressed by this team.” (reverse coded) \( (a = -0.30, \text{ before removal of item}). \) After removal of this item, internal consistency was good \( (a = 0.74) \) (see Table 2).

*Demographic information.* Individual and team demographic questions included items about age, gender, ethnicity, education, gender of team members, number of team members, and if the participant is the informal leader of the team. In addition, a text box invited participants’ comments. (see Appendices J and L).

**Procedure**

I informed instructors of Team Based Learning (TBL) courses in the 2013 Fall and 2014 Spring semesters of this study. I requested class time to present my research to their students. If they agreed, a researcher presented an overview of the study to each class. Over two semesters, the study was presented to eighteen classes. The university provided email addresses for students in these classes and surveys were sent via email. Surveys were created and responses collected using SurveyMonkey. Survey links were sent to participants’ email address at the beginning, middle, and end of each semester, directly from the researcher. The first page of each survey included a consent form. If the student consented to participate, they would then continue on to the survey. Surveys varied in length, taking approximately twenty to forty minutes to complete. At the end of the survey, participants were thanked for their time and provided contact information for the Principal Investigator. Personal identifiers were requested from students participating in this research. Specifically, the survey asked for first and last names, course information, and team based learning team number/name. Instructors were also asked to provide students name and group name/number information for teams in their classrooms. This information was necessary to gather course grade, GPA, group membership identification, and to link participants’ longitudinal data. Data were downloaded from SurveyMonkey into SPSS and
SAS. Course grade and grade point average data were provided by the university and entered manually into the database by the researcher. When group identification was provided by instructors, it was manually added to the database by the researcher. Identifying information was stored and deleted as directed by the Institutional Review Board of the City University of New York. All personal identifying information was deleted prior to conducting analysis.

**Incentives.** A raffle was offered to students to increase participation in the study. Students were informed about the raffle in a presentation to their class. Information was also provided in the consent form, which participants read prior to participating in each of the three surveys. Students were informed that, in order to qualify for the raffle, they must complete all three surveys over the semester. At the end of each semester, winners were chosen using a participant ID number created by researchers and a random number sequence website (https://www.random.org/sequences/). First prize was a $100 Visa gift card, second prize was a $75 Amazon.com gift card, and third prize was a $50 Starbucks gift card. Winners were contacted by email and prizes distributed electronically or via mail. Participation in this study also filled a research participation requirement for students in some courses. Credits were granted through the SONA-System.

**Multilevel linear models.** Multilevel Linear Models (MLM) are a group of statistical models that allow parameters, (means) and slopes (independent/dependent variable relationships), to vary at more than one level. This approach is important for this research because it allows analysis at the individual and team level. Specifically, individuals are evaluated in comparison to other team members and teams in comparison to other teams. In general, these models provide many advantages for group research (Tabachnick & Fidell, 2013). For example, MLM do not require independence of errors. In this study, I recognized that students in groups
from the same classroom may be more similar than groups of students from other classrooms. MLM allow covariance between these groups, not requiring one to assume they are the same. Another advantage of MLM for this study was that they allow for separate analyses of each case over time. This enables evaluation of individual growth curves in transactive memory while also evaluating variables (such as shared leadership style) that may predict these differences. Additionally, MLM allow one to include predictors at every level of analysis. In this study, I use shared leadership style and transactive memory at time 2 to predict group outcomes at time 3. If using ANCOVA, group differences in slope between a predictor and the dependent variable would violate the assumption of homogeneity of regression. MLM expect these differences and researchers can glean valuable information about group outcomes.

These models are appropriate and necessary for research designs where data are organized at more than one level or include repeated measurements. Analyzing hierarchical data as if they are on the same level may result in errors of ecological fallacy or atomistic fallacy (Hox, 2002). Ecological fallacy occurs when individual level data is aggregated to examine a group level effect, but interpretation of the findings is applied at the individual level. Aggregation of individual scores to the group level also results in decreased power and loss of information. Power is lost when the error term (as in ANOVA) becomes the group, when \( n \) equals the number of groups, not the number of participants. MLM do not require aggregation of individual data into group data. Instead, effects in both individuals and in groups are evaluated, thereby retaining more information. Atomistic fallacy occurs when individual level analyses are applied to the group level. This approach results in Type I error, failing to detect an effect, because analyses rest on too many degrees of freedom that are not truly independent. MLM provide a powerful and appropriate tool for nested and longitudinal research designs as presented in this research.
Overview of statistical analysis, hypotheses 1 through 4. To evaluate hypotheses one through four, based on the proposed IMOI model (Figure 3), three-level MLM were fitted with students (level-1) nested within groups (level-2) nested within classrooms (level-3). This model was fitted with restricted maximum likelihood estimation using SAS’s PROC MIXED. The models included fixed slopes and random group intercepts (level-2) and random classroom intercepts (level-3) effects. Random effects allow the focal outcomes to vary across both groups and classrooms. Measures at time 2 were used to predict outcomes at time 3. These analyses included 145 subjects within 68 groups and 17 classrooms.

Overview of statistical analysis, hypothesis 5. To evaluate hypothesis 5, which addressed change in transactive knowledge systems over time, three-level MLM were fitted with repeated measures (level-1) nested within students (level-2) nested within groups (level-3). Models were fitted with restricted maximum likelihood estimation using SAS’s PROC MIXED. Models also controlled for classroom effect using fixed effects. The models included correlated random intercepts and slopes at level-two (student-level) and fixed slopes and random intercepts at level-three (group-level). Random effects allow students to vary in starting point and rate of change in transactive knowledge systems over time. The analyses included three time-points nested within 245 subjects within 83 groups.

Results

Descriptive statistics. Means, standard deviations, and consistency reliability coefficients (Cronbach’s alpha) for all variables for hypotheses 1–4 are presented in Table 2. For all variables for hypothesis 5 respective data are presented in Table 3.
Table 2. Hypotheses 1–4: Means, Standard Deviations, Interscale Correlations, and Consistency
Reliability Estimates (Cronbach’s Alpha)

<table>
<thead>
<tr>
<th>Construct</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 PT (T1)</td>
<td>(.76)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 M IIR (T1)</td>
<td>.13</td>
<td>(.91)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 M Ext (T1)</td>
<td>.14</td>
<td>−.02</td>
<td>(.75)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Amot (T1)</td>
<td>−.05</td>
<td>−.71</td>
<td>(.78)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 SLS (T2)</td>
<td>−.18</td>
<td>.22</td>
<td>(.74)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 SLS (T2)</td>
<td>−.09</td>
<td>.35</td>
<td>(.83)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 TM (T2)</td>
<td>.01</td>
<td>.48</td>
<td>(.83)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 TM (T3)</td>
<td>−.04</td>
<td>.34</td>
<td>(.87)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Course grade</td>
<td>.00</td>
<td>−.08</td>
<td>−.03</td>
<td>.07</td>
<td>−.24</td>
<td>−.20</td>
<td>−.20</td>
<td>−.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 GPA</td>
<td>−.07</td>
<td>−.01</td>
<td>−.08</td>
<td>.04</td>
<td>−.24</td>
<td>−.24</td>
<td>−.21</td>
<td>−.19</td>
<td>.79</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 PO (T3)</td>
<td>.02</td>
<td>.33</td>
<td>(.75)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 PO (T3)</td>
<td>.23</td>
<td>.09</td>
<td>(.69)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 PO (T3)</td>
<td>.00</td>
<td>.34</td>
<td>(.76)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 SocPr (T3)</td>
<td>.04</td>
<td>.30</td>
<td>(.71)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 ILWB (T3)</td>
<td>.03</td>
<td>.31</td>
<td>(.77)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mean 4.88 4.37 5.13 3.31 3.18 3.73 4.34 4.14 3.21 3.34 3.97 3.95 4.21 4.50 4.37
SD 0.79 1.06 0.96 1.34 0.78 0.69 0.76 0.85 0.89 0.60 1.20 1.02 1.02 0.87

Note. *p < .05, **p < .01, and ***p < .001. The analyses included a total of n = 145 subjects falling within n = 68 groups among 17 classes. Internal consistency reliability estimates (Cronbach’s alpha) are displayed in bold on the main diagonal. α T1 = time one; T2 = time two; T3 = time three; PT = Perspective-Taking; M IIR = Intrinsic/Identified Regulation Motivation; M Ext = External Regulation Motivation; Amot = Amotivation; SLS = Restrictive Shared Leadership Style; SLS = Constructive Shared Leadership Style; TMem = Transactive Memory; Grade = Course Grade; PO = Productive Output-Related; PO = Productive Output-Strategy Related; POKn = Productive Output-Knowledge and Skill Related; SocPr = Social Processes; ILWB = Individual Learning and Well-being.

Table 3. Hypothesis 5: Means, Standard Deviations, Interscale Correlations, and Consistency
Reliability Estimates (Cronbach’s Alpha)

<table>
<thead>
<tr>
<th>Construct</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 SLS restrictive</td>
<td>(.73)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 SLS constructive</td>
<td>.72***</td>
<td>(.83)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Transactive memory (T1)</td>
<td>.47***</td>
<td>.54***</td>
<td>(.82)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Transactive memory (T2)</td>
<td>.53***</td>
<td>.61***</td>
<td>.66***</td>
<td>(.83)</td>
<td></td>
</tr>
<tr>
<td>5 Transactive memory (T3)</td>
<td>.46***</td>
<td>.64***</td>
<td>.48***</td>
<td>.70***</td>
<td>(.87)</td>
</tr>
</tbody>
</table>

Mean 3.14 3.75 4.21 4.34 4.15
SD 0.77 0.69 0.78 0.77 0.84

Note. *p < .05, **p < .01, and ***p < .001. The analyses included a total of n = 145 subjects falling within n = 68 groups among 17 classes. Internal consistency reliability estimates (Cronbach’s alpha) are displayed in bold on the main diagonal. SLS Cronbach’s alphas are based on time 2. SLS = shared leadership style; T1 = time one; T2 = time two; T3 = time three.
Hypotheses 1a–d: Time 2 shared leadership style (restrictive and constructive)

predicting time 3 transactive knowledge systems. The results of the multilevel model testing the impact of shared leadership style (SLS) on transactive knowledge systems are presented in Table 4. Specifically, this model tested the hypotheses that increased SLS restrictive will predict decreased transactive knowledge systems for students and teams and increased SLS constructive will predict increased transactive knowledge systems for students and teams. Examination of the random effects variances showed no significant between-group within class or between-class variance, Group: $z = 0.25, p = .40$; Class: $z = 0.49, p = .31$. The fixed effects results demonstrated that there were significant within-group ($\beta = 0.55, t(124) = 2.44, p < .05$) and between-group ($\beta = 0.83, t(124) = 4.23, p < .0001$) effects of SLS constructive on transactive knowledge systems, but not for SLS restrictive (within: $\beta = 0.07, t(124) = 0.36, p > .05$; between: $\beta = -0.29, t(124) = -1.59, p > .05$). The results suggest that students with increased constructive shared leadership style relative to their team average and teams with higher levels of constructive shared leadership style had higher expected levels of transactive knowledge systems (see Figure 4). However, no effects of restrictive shared leadership style on transactive knowledge systems were found for students or teams.

Table 4. Time 2 Shared Leadership Style Predicting Time 3 Transactive Knowledge Systems

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Est. (SE)</th>
<th>df</th>
<th>t/z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.02 (0.48)</td>
<td>16</td>
<td>4.25</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Within-group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLSr</td>
<td>0.07 (0.20)</td>
<td>124</td>
<td>0.36</td>
<td>.720</td>
</tr>
<tr>
<td>SLSc</td>
<td>0.55 (0.22)</td>
<td>124</td>
<td>2.44</td>
<td>.016</td>
</tr>
<tr>
<td>Between-group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLSr</td>
<td>-0.29 (0.18)</td>
<td>124</td>
<td>-1.59</td>
<td>.114</td>
</tr>
<tr>
<td>SLSc</td>
<td>0.83 (0.20)</td>
<td>124</td>
<td>4.23</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Level 3</td>
<td>Class var.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.02 (0.05)</td>
<td>—</td>
<td>0.49</td>
<td>.311</td>
</tr>
<tr>
<td>Level 2</td>
<td>Group var.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.01 (0.06)</td>
<td>—</td>
<td>0.25</td>
<td>.403</td>
</tr>
<tr>
<td>Level 1</td>
<td>Residual var.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.53 (0.08)</td>
<td>—</td>
<td>6.30</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Note: The test statistics for the fixed effects are $t$-values and the test statistics for the random effects are $z$-values. SLSc = Constructive Shared Leadership Style; SLSr = Restrictive Shared Leadership Style; Class = Classroom.
Figure 4. Hypothesis 1: Time 2 Shared Leadership Style predicting Time 3 Transactive Knowledge Systems.

Hypotheses 2a–f: Time 2 shared leadership style (restrictive and constructive) and transactive knowledge systems predicting time 3 effectiveness.

GPA. The results of the multilevel model testing the impact of time 2 SLS and transactive knowledge systems on time 3 effectiveness for GPA are presented in Table 5. Specifically, this model tested the hypotheses that increased SLS restrictive will predict lower GPA and increased SLS constructive will predict higher GPA for students and teams. Also, that increased transactive knowledge systems will predict higher GPA for students and teams. The variability components for the level-two group random intercepts and level-two classroom random intercepts were very close to zero, which caused difficulty in estimating the model. Thus, the model was simplified by dropping random effects, and it reached proper convergence. Fixed effects demonstrated no significant effects for SLS constructive (within: \( \beta = -0.15, t(138) = -0.82, p > .05 \); between: \( \beta = -0.08, t(138) = -0.42, p > .05 \)) or SLS restrictive (within: \( \beta = -0.02, t(138) = -0.10, p > .05 \); between: \( \beta = -0.09, t(138) = -0.63, p > .05 \)). Similar results emerged for transactive knowledge systems, with no significant within-group (\( \beta = -0.19, t(138) = -1.73, p > .05 \)) or between-group
(β = 0.03, t(138) = 0.21, p > .05) effects. Therefore, hypotheses were not supported for the effectiveness measure GPA.

Table 5. *Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for GPA*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Est. (SE)</th>
<th>df</th>
<th>Test Stat</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercepts</td>
<td></td>
<td>138</td>
<td>8.86</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>SLSr</td>
<td>-0.20 (0.16)</td>
<td>138</td>
<td>-0.10</td>
<td>.922</td>
</tr>
<tr>
<td>Within-group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLSc</td>
<td>-0.15 (0.19)</td>
<td>138</td>
<td>-0.82</td>
<td>.416</td>
</tr>
<tr>
<td>TM</td>
<td>-0.19 (0.11)</td>
<td>138</td>
<td>-1.73</td>
<td>.086</td>
</tr>
<tr>
<td>SLSr</td>
<td>-0.09 (0.14)</td>
<td>138</td>
<td>-0.63</td>
<td>.531</td>
</tr>
<tr>
<td>Between-group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLSc</td>
<td>-0.08 (0.19)</td>
<td>138</td>
<td>-0.42</td>
<td>.674</td>
</tr>
<tr>
<td>TM</td>
<td>-0.03 (0.13)</td>
<td>138</td>
<td>0.21</td>
<td>.838</td>
</tr>
<tr>
<td>Level 3 Class var.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 2 Group var.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1 Residual var.</td>
<td>0.35 (0.04)</td>
<td></td>
<td>8.31</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

*Note:* The test statistics for the fixed effects are *-values, and the test statistics for the random effects are *z*-values. Random effects were dropped from the GPA model due to lack of variability in the Level-2 Group random intercepts and Level-3 Classroom intercepts. The different model specifications result in different degrees of freedom for the GPA model. TM = Transactive Memory/Transactive Knowledge Systems; SLSc = Constructive Shared Leadership Style; SLSr = Restrictive Shared Leadership Style; Class = Classroom.

*Course grade.* The results of the multilevel model testing the impact of time 2 SLS and transactive knowledge systems on time 3 effectiveness for course grades are presented in Table 6. This model tested the hypotheses that increased SLS restrictive will predict lower course grade and increased SLS constructive will predict higher course grade for students and teams. Also, that increased transactive knowledge systems will predict higher course grade for students and teams. Examination of the random effects variances showed no significant between-group within class or between-class variance, Group: *z = 0.49, p = .31; Class: *z = 1.39, p = .08. No significant fixed effects emerged for SLS constructive (within: \( \beta = 0.22, t(122) = 0.87, p > .05 \); between: \( \beta = 0.02, t(122) = 0.07, p > .05 \)) or SLS restrictive (within: \( \beta = -0.39, t(122) = -1.78, p > .05 \); between: \( \beta = -0.20, t(122) = -0.91, p > .05 \)). Similar results were found for transactive knowledge systems with no significant within-group (\( \beta = -0.26, t(122) = -1.76, p > .05 \)) or
between-group ($\beta = 0.01, t(122) = -0.06, p > .05$) fixed effects. Therefore, no support was found for the effectiveness measure course grade.

Table 6. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for Course Grade

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Est. (SE)</th>
<th>df</th>
<th>Test Stat</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>4.08 (.65)</td>
<td>16</td>
<td>6.28</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>SLSr</td>
<td>-0.39 (.23)</td>
<td>122</td>
<td>-1.78</td>
<td>.077</td>
</tr>
<tr>
<td>SLSc</td>
<td>0.22 (.25)</td>
<td>122</td>
<td>0.87</td>
<td>.385</td>
</tr>
<tr>
<td>TM</td>
<td>-0.26 (.15)</td>
<td>122</td>
<td>-1.76</td>
<td>.082</td>
</tr>
<tr>
<td>SLSr</td>
<td>-0.20 (.22)</td>
<td>122</td>
<td>-0.91</td>
<td>.367</td>
</tr>
<tr>
<td>SLSc</td>
<td>-0.02 (.30)</td>
<td>122</td>
<td>-0.07</td>
<td>.948</td>
</tr>
<tr>
<td>TM</td>
<td>-0.01 (.19)</td>
<td>122</td>
<td>-0.06</td>
<td>.952</td>
</tr>
<tr>
<td>Level 3 Class var.</td>
<td>0.12 (.09)</td>
<td>—</td>
<td>1.39</td>
<td>.313</td>
</tr>
<tr>
<td>Level 2 Group var.</td>
<td>0.03 (.06)</td>
<td>—</td>
<td>0.49</td>
<td>.082</td>
</tr>
<tr>
<td>Level 1 Residual var.</td>
<td>0.64 (.09)</td>
<td>—</td>
<td>6.72</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Note: The test statistics for the fixed effects are t-values, and the test statistics for the random effects are z-values. The different model specifications result in different degrees of freedom for the Course Grade model. TM = Transactive Memory/Transactive Knowledge Systems; SLSc = Constructive Shared Leadership Style; SLSr = Restrictive Shared Leadership Style; Class = Classroom.

**Productive output (PO)-effort related.** The results of the multilevel model testing the impact of time 2 SLS and transactive knowledge systems on time 3 productive output (PO) – effort related (the level of effort members collectively expend on tasks) are presented in Table 7. This model tested the hypotheses that increased SLS restrictive will predict lower PO-effort related and increased SLS constructive will predict higher PO-effort related for students and teams. Also, that increased transactive knowledge systems will predict higher PO-effort related for students and teams. Examination of the random effects variances showed no significant between-group within class or between-class variance, Group: $z = 0.87, p = .19$; Class: $z = 0.40, p = .34$. The fixed effects results for SLS constructive demonstrated significant within-group ($\beta = 0.72, t(122) = 2.42, p < .05$) but not between-group ($\beta = 0.11, t(122) = 0.32, p > .05$) effects of SLS constructive on PO-effort related. No significant fixed effects emerged for SLS restrictive
Transactive memory, leadership, effectiveness

(within: $\beta = -0.36, t(122) = -1.39, p > .05$; between: $\beta = -0.14, t(122) = -0.53, p > .05$).

Significant effects did emerge for transactive knowledge systems for both within-group ($\beta = 0.65, t(122) = 3.76, p < .001$) and between-group ($\beta = 0.79, t(122) = 3.41, p < .001$) effects. This outcome suggests that students with increased constructive shared leadership style relative to their team average had higher expected levels of effort related productive output.

**Table 7. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for PO-Effort Related**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Est. (SE)</th>
<th>df</th>
<th>t/z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.68 (0.80)</td>
<td>16</td>
<td>0.86</td>
<td>.402</td>
</tr>
<tr>
<td>SLSr</td>
<td>-0.36 (0.26)</td>
<td>122</td>
<td>-1.39</td>
<td>.168</td>
</tr>
<tr>
<td>Within-group SLSc</td>
<td>0.73 (0.30)</td>
<td>122</td>
<td>2.42</td>
<td>.017</td>
</tr>
<tr>
<td>TM</td>
<td>0.65 (0.17)</td>
<td>122</td>
<td>3.76</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>SLSr</td>
<td>-0.14 (0.26)</td>
<td>122</td>
<td>-0.53</td>
<td>.597</td>
</tr>
<tr>
<td>Between-group SLSc</td>
<td>0.11 (0.35)</td>
<td>122</td>
<td>0.32</td>
<td>.752</td>
</tr>
<tr>
<td>TM</td>
<td>0.78 (0.23)</td>
<td>122</td>
<td>3.41</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Level 3 Class var.</td>
<td>0.06 (0.15)</td>
<td>---</td>
<td>0.40</td>
<td>.343</td>
</tr>
<tr>
<td>Level 2 Group var.</td>
<td>0.09 (0.11)</td>
<td>---</td>
<td>0.87</td>
<td>.193</td>
</tr>
<tr>
<td>Level 1 Residual var.</td>
<td>0.89 (0.14)</td>
<td>---</td>
<td>6.46</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

*Note: Test statistics for the fixed effects are t-values, and the test statistics for the random effects are z-values. TM = Transactive Memory/Transactive Knowledge Systems; SLSc = Constructive Shared Leadership Style; SLSr = Restrictive Shared Leadership Style; Class = Classroom.*

However, teams with increased constructive shared leadership style relative to other teams did not have higher expected effort related productive output. Furthermore, results suggest that students who had increased levels of transactive knowledge systems relative to their team average and teams that had increased levels of transactive knowledge systems, had greater expected effort related productive output. No effects of restrictive shared leadership style on effort related productive output were found for students or teams.

**Productive output (PO)-strategy related.** The results of the multilevel model testing the impact of time 2 SLS and time 2 transactive knowledge systems on time 3 PO–strategy related
(the quality of team task strategies) are presented in Table 8. This model tested the hypotheses that increased SLS restrictive will predict lower PO-strategy related and increased SLS constructive will predict higher PO-strategy related for students and teams. Also, that increased transactive knowledge systems will predict higher PO-strategy related for students and teams.

Table 8. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for PO-Strategy Related

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Est. (SE)</th>
<th>df</th>
<th>t/z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.71 (0.79)</td>
<td>16</td>
<td>4.68</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>SLSc</td>
<td>−0.44 (0.25)</td>
<td>122</td>
<td>−1.77</td>
<td>.079</td>
</tr>
<tr>
<td>Within-group SLSc</td>
<td>0.30 (0.29)</td>
<td>122</td>
<td>1.03</td>
<td>.303</td>
</tr>
<tr>
<td>TM</td>
<td>−0.03 (0.17)</td>
<td>122</td>
<td>−0.19</td>
<td>.850</td>
</tr>
<tr>
<td>SLSr</td>
<td>−0.34 (0.27)</td>
<td>122</td>
<td>−1.31</td>
<td>.194</td>
</tr>
<tr>
<td>Between-group SLSc</td>
<td>0.06 (0.35)</td>
<td>122</td>
<td>0.16</td>
<td>.873</td>
</tr>
<tr>
<td>TM</td>
<td>0.26 (0.23)</td>
<td>122</td>
<td>1.13</td>
<td>.262</td>
</tr>
<tr>
<td>Level 3</td>
<td>0.13 (0.21)</td>
<td></td>
<td>0.60</td>
<td>.274</td>
</tr>
<tr>
<td>Level 2</td>
<td>0.11 (0.13)</td>
<td></td>
<td>0.88</td>
<td>.189</td>
</tr>
<tr>
<td>Level 1</td>
<td>0.83 (0.13)</td>
<td></td>
<td>6.25</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Note: Test statistics for the fixed effects are t-values, and the test statistics for the random effects are z-values. TM = Transactive Memory/Transactive Knowledge Systems; SLSc = Constructive Shared Leadership Style; SLSr = Restrictive Shared Leadership Style; Class = Classroom.

Examination of the random effects variances showed no significant between-group within class or between-class variance (Group: z = 0.88, p = .19; Class: z = 0.60, p = .27). The fixed effects results demonstrated that there were no significant effects for SLS constructive (within: β = 0.30, t(122) = 1.03, p > .05; between: β = −0.06, t(122) = 0.16, p > .05) or SLS restrictive (within: β = −0.44, t(122) = −1.77, p > .05; between: β = −0.35, t(122) = −1.31, p > .05) and no effects for transactive knowledge systems (within: β = −0.31, t(122) = −0.19, p > .05; between: β = 0.26, t(122) = 1.13, p > .05) on PO-strategy related. Thus, no effect of shared leadership style or transactive knowledge systems was found on the team effectiveness measure strategy related productive output.
Productive output (PO)-knowledge and skill related. The results of the multilevel model testing the impact of time 2 SLS and transactive knowledge systems on time 3 PO–knowledge and skill related (the degree to which a team uses the full complement of member’s knowledge and skill) are presented in Table 9. This model tested the hypotheses that increased SLS restrictive will predict lower PO-knowledge and skill related and increased SLS constructive will predict higher PO-knowledge and skill related for students and teams. Also, that increased transactive knowledge systems will predict higher PO-knowledge and skill related for students and teams. The variability components for level-2 group random intercepts and level-2 class random intercepts were close to zero, which caused difficulty in estimating the model. As a result, the model was simplified by dropping random effects and consequently it reached proper convergence. The fixed effects results demonstrated that there were no significant within-group or between-group effects of SLS constructive (within: $\beta = 0.23, t(138) = 0.92, p > .05$; between: $\beta = 0.31, t(138) = 1.21, p > .05$) on PO – knowledge and skill related. No significant results were found for SLS restrictive within-group ($\beta = 0.12, t(138) = 0.54, p > .05$); however, significance was found for SLS restrictive for between-group effects ($\beta = -0.42, t(122) = -2.17, p < .05$).

Furthermore, transactive knowledge systems yielded significant results for within-group ($\beta = 0.40, t(138) = 2.70, p < .01$) and between-group ($\beta = 0.96, t(138) = 5.61, p < .0001$) effects. This outcome suggests that teams with increased levels of restrictive shared leadership style had significantly lower knowledge and skill productive output. Also, students with increased transactive knowledge systems relative to their team average and teams with increased transactive knowledge systems had greater expected knowledge and skill productive output.
Table 9. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for PO-Knowledge and Skill Related

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Est. (SE)</th>
<th>df</th>
<th>t/z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.24 (0.59)</td>
<td>138</td>
<td>0.40</td>
<td>.687</td>
</tr>
<tr>
<td>SLSr</td>
<td>0.12 (0.22)</td>
<td>138</td>
<td>0.54</td>
<td>.593</td>
</tr>
<tr>
<td>Within-group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLSc</td>
<td>0.23 (0.25)</td>
<td>138</td>
<td>0.92</td>
<td>.357</td>
</tr>
<tr>
<td>TM</td>
<td>0.40 (0.15)</td>
<td>138</td>
<td>2.69</td>
<td>.008</td>
</tr>
<tr>
<td>SLSr</td>
<td>−0.42 (0.20)</td>
<td>138</td>
<td>−2.17</td>
<td>.032</td>
</tr>
<tr>
<td>Between-group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLSc</td>
<td>0.31 (0.26)</td>
<td>138</td>
<td>1.21</td>
<td>.229</td>
</tr>
<tr>
<td>TM</td>
<td>0.96 (0.17)</td>
<td>138</td>
<td>5.61</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Level 3</td>
<td>Class var.</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Level 2</td>
<td>Group var.</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Level 1</td>
<td>Residual var.</td>
<td>0.64 (0.07)</td>
<td>8.31</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Note: Random effects were dropped from the PO-knowledge and skills model due to lack of variability in the level-2 Group random intercepts or level-2 Classroom intercepts. TM = Transactive Memory/Knowledge Systems; SLSc = Constructive Shared Leadership Style; SLSr = Restrictive Shared Leadership Style; Class = Classroom.

Social processes, satisfaction with team relationships. The results of the multilevel model testing the impact of time 2 SLS and transactive knowledge systems on time 3 social processes, satisfaction with team relationships (satisfaction with within-team relationships) are presented in Table 10. This model tested the hypotheses that increased SLS restrictive will predict lower satisfaction with team relationships and increased SLS constructive will predict higher satisfaction with team relationships for students and teams. Also, that increased transactive knowledge systems will predict higher satisfaction with team relationships for students and teams. Again, the lack of variability in the level-2 group random intercepts and level-2 class random intercepts caused difficulty in estimating the 3-level model. As a result, the random effects were dropped, and the model was re-estimated. Fixed effects results demonstrated significant within-group and between-group results for SLS constructive (within: β = 0.57, t(138) = 2.09, p < .05; between: β = 0.62, t(138) = 2.20, p < .05) and SLS restrictive (within: β = −0.68, t(138) = −2.85, p < .01; between: β = −0.85, t(138) = 3.98, p < .0001). Significant within-group and between-group results also emerged for transactive knowledge systems (within: β = 0.35,
Transactive memory, leadership, effectiveness

$t(138) = 2.17, p < .05$; between: $\beta = 0.88, t(138) = 4.78, p < .0001$ suggesting that students with increased constructive shared leadership style relative to their team average and teams with an increased constructive shared leadership style had higher expected levels of satisfaction with team relationships. Additionally, students with increased restrictive shared leadership style relative to their team average and teams with increased restrictive shared leadership style had lower expected levels of satisfaction with team relationships. Lastly, students with increased transactive knowledge systems relative to their team average and teams with increased transactive knowledge systems had greater expected levels of satisfaction with team relationships.

**Table 10. Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for Social Processes, Satisfaction with Team Relationships**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Est. (SE)</th>
<th>df</th>
<th>t/z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.04 (0.63)</td>
<td>138</td>
<td>1.64</td>
<td>.104</td>
</tr>
<tr>
<td>SLSr</td>
<td>0.68 (0.24)</td>
<td>138</td>
<td>2.85</td>
<td>.005</td>
</tr>
<tr>
<td>SLSc</td>
<td>0.57 (0.28)</td>
<td>138</td>
<td>2.09</td>
<td>.039</td>
</tr>
<tr>
<td>TM</td>
<td>0.35 (0.16)</td>
<td>138</td>
<td>2.17</td>
<td>.032</td>
</tr>
<tr>
<td>SLSr</td>
<td>−0.84 (0.21)</td>
<td>138</td>
<td>−3.98</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>SLSc</td>
<td>0.62 (0.28)</td>
<td>138</td>
<td>2.20</td>
<td>.029</td>
</tr>
<tr>
<td>TM</td>
<td>0.88 (0.18)</td>
<td>138</td>
<td>4.78</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Level 3</td>
<td>Class var.</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Level 2</td>
<td>Group var.</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Level 1</td>
<td>Residual var.</td>
<td>0.75 (0.09)</td>
<td>—</td>
<td>8.31</td>
</tr>
</tbody>
</table>

*Note:* Random effects were dropped from the PO-social processes model due to lack of variability in the level-2 Group random intercepts or level-2 Classroom intercepts. TM = Transactive Memory/Knowledge Systems; SLSc = Constructive Shared Leadership Style; SLSr = Restrictive Shared Leadership Style; Class = Classroom.

**Individual learning and well-being.** The results of the multilevel model testing the impact of time 2 SLS and transactive knowledge systems on time 3 individual learning and well-being (whether the group experience contributes positively to the learning and well-being of individual team members) are presented in Table 11. This model tested the hypotheses that increased SLS restrictive will predict lower individual learning and well-being and increased SLS constructive will predict higher individual learning and well-being for students and teams. Also, that
increased transactive knowledge systems will predict higher individual learning and well-being for students and teams. The lack of variability in the level-2 group random intercepts and level-2 class random intercepts caused difficulty in estimating the 3-level model. As a result, the random effects were dropped and the model was re-estimated. The fixed effects results demonstrated significant within-group and between-group effects of SLS constructive (within: $\beta = 0.55$, $t(138) = 2.41, p < .05$; between: $\beta = 0.47$, $t(138) = 2.05, p < .05$) and SLS restrictive (within: $\beta = -0.46$, $t(138) = -2.38, p < .05$; between: $\beta = -0.64$, $t(138) = -3.68, p < .001$) on individual learning and well-being. Significant within-group and between-group results also emerged for transactive knowledge systems (within: $\beta = 0.35$, $t(138) = 2.69, p < .01$; between: $\beta = 0.71$, $t(138) = 4.68, p < .0001$). This suggests that students with increased constructive shared leadership style relative to their team average and teams with increased constructive shared leadership style had higher expected levels of individual learning and well-being. Also, students with increased restrictive shared leadership style relative to their team average and teams with increased restrictive shared leadership style had lower expected levels of individual learning and well-being. Lastly, students with increased transactive knowledge systems relative to their team average and teams with increased transactive knowledge systems had higher expected levels of individual learning and well-being. As a reminder, individual learning and well-being measures affective outcomes of internal work motivation, satisfaction with growth opportunities, and general satisfaction with the individual experience of being a member of the team. The variable does not measure learning specific to student’s classroom material. Earlier analysis revealed that course grade was not significantly influenced by shared leadership style (restrictive or constructive) or transactive memory.
Table 11. *Time 2 Shared Leadership Style and Transactive Knowledge Systems Predicting Time 3 Effectiveness for Individual Learning and Well-being*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Est. (SE)</th>
<th>df</th>
<th>t/z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.56 (0.52)</td>
<td>138</td>
<td>3.00</td>
<td>.003</td>
</tr>
<tr>
<td>SLSr</td>
<td>-0.46 (0.19)</td>
<td>138</td>
<td>-2.38</td>
<td>.019</td>
</tr>
<tr>
<td><strong>Within-group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLSc</td>
<td>0.54 (0.23)</td>
<td>138</td>
<td>2.41</td>
<td>.017</td>
</tr>
<tr>
<td>TM</td>
<td>0.35 (0.13)</td>
<td>138</td>
<td>2.69</td>
<td>.008</td>
</tr>
<tr>
<td>SLSr</td>
<td>-0.64 (0.17)</td>
<td>138</td>
<td>-3.68</td>
<td>&lt; .001</td>
</tr>
<tr>
<td><strong>Between-group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLSc</td>
<td>0.47 (0.23)</td>
<td>138</td>
<td>2.05</td>
<td>.042</td>
</tr>
<tr>
<td>TM</td>
<td>0.71 (0.15)</td>
<td>138</td>
<td>4.68</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Level 3</td>
<td>Class var.</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Level 2</td>
<td>Group var.</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Level 1</td>
<td>Residual var.</td>
<td>0.51 (0.06)</td>
<td>8.31</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

*Note:* Random effects were dropped from the PO-individual learning and well-being model due to lack of variability in the level-2 Group random intercepts or level-2 Classroom intercepts. The test statistics for the fixed effects are *t*-values. TM = Transactive Memory/Knowledge Systems; SLSr = Restrictive Shared Leadership Style; SLSc = Constructive Shared Leadership Style; Class = Classroom.

Figure 5. Hypothesis 2a-d: Summary of results for Time 2 Shared Leadership Style Predicting Time 3 Effectiveness.

Note. SLS = shared leadership style; PO = Productive Output, ILWB = individual learning and well-being. Social Processes = social processes as satisfaction with team relationships, Knowledge = knowledge and skill related.
Figure 6. Hypothesis 2e and f: Summary of results for Time 2 Transactive Knowledge Systems Predicting Time 3 Effectiveness.
Note. PO = Productive Output, ILWB = individual learning and well-being, Social Processes = social processes as satisfaction with team relationships, Knowledge = knowledge and skill related.

**Hypothesis 2g–j: Transactive knowledge systems mediate the relationship between shared leadership style (restrictive and constructive) and effectiveness.** The hypotheses that transactive knowledge systems mediate the relationship between shared leadership style and effectiveness cannot be tested directly for Study 1 due to the combined multilevel and longitudinal design (Preacher, 2015). However, results lend empirical support to the hypothesis for constructive shared leadership style for students and teams. First, constructive shared leadership style was shown to be a strong predictor of transactive knowledge systems for students and teams. Second, constructive shared leadership style was shown to be a strong predictor of effectiveness for students and teams. Third, transactive knowledge systems emerged as a strong predictor of effectiveness for students and teams. Together, these relationships provide empirical support for the mediational hypothesis that transactive knowledge systems mediate the effect of shared leadership style on effectiveness for students and teams, for most
measures of effectiveness tested in this study (see Figures 5 and 6). No support was found for restrictive shared leadership style. This study is the first attempt at establishing a mediating effect of transactive knowledge systems. As such, the model requires further investigation and replication.

**Hypothesis 3a–d:** Time 1 perspective-taking moderating the relationship of time 2 shared leadership style (restrictive and constructive) on time 3 transactive knowledge systems. Results of the multilevel model testing time 1 perspective-taking as a moderator between time 2 SLS and time 3 transactive knowledge systems are presented in Table 12. This model tested the hypothesis that perspective-taking moderates the relationship between shared leadership style and transactive knowledge systems. Interaction terms were created and the model was tested. Examination of the random effects variances shows no significant between-group within class or between-class variance, Group: $z = 0.50, p = .31$; Class: $z = 0.47, p = .32$.

**Table 12. Time 1 Perspective-taking as Moderator of the relationship between Time 2 Shared Leadership Style on Time 3 Transactive Knowledge Systems**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Est. (SE)</th>
<th>df</th>
<th>t/z</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.60 (4.35)</td>
<td>16</td>
<td>0.60</td>
<td>.559</td>
</tr>
<tr>
<td>SLSr</td>
<td>0.07 (0.19)</td>
<td>118</td>
<td>0.37</td>
<td>.712</td>
</tr>
<tr>
<td>SLSc</td>
<td>0.56 (0.23)</td>
<td>118</td>
<td>2.46</td>
<td>.015</td>
</tr>
<tr>
<td>Within-group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT</td>
<td>−0.14 (0.11)</td>
<td>118</td>
<td>−1.32</td>
<td>.190</td>
</tr>
<tr>
<td>SLSr/PT</td>
<td>0.08 (0.41)</td>
<td>118</td>
<td>0.20</td>
<td>.842</td>
</tr>
<tr>
<td>SLSc/PT</td>
<td>0.35 (0.48)</td>
<td>118</td>
<td>0.73</td>
<td>.470</td>
</tr>
<tr>
<td>Between-group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLSr</td>
<td>−1.09 (1.42)</td>
<td>118</td>
<td>−0.77</td>
<td>.443</td>
</tr>
<tr>
<td>SLSc</td>
<td>1.33 (1.36)</td>
<td>118</td>
<td>0.98</td>
<td>.330</td>
</tr>
<tr>
<td>PT</td>
<td>−0.10 (0.84)</td>
<td>118</td>
<td>−0.12</td>
<td>.907</td>
</tr>
<tr>
<td>SLSr/PT</td>
<td>0.17 (0.28)</td>
<td>118</td>
<td>0.61</td>
<td>.546</td>
</tr>
<tr>
<td>SLSc/PT</td>
<td>−0.11 (0.27)</td>
<td>118</td>
<td>−0.42</td>
<td>.673</td>
</tr>
<tr>
<td>Level 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class</td>
<td>0.02 (0.04)</td>
<td>—</td>
<td>0.47</td>
<td>.320</td>
</tr>
<tr>
<td>Level 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>0.03 (0.06)</td>
<td>—</td>
<td>0.50</td>
<td>.310</td>
</tr>
<tr>
<td>Level 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual var.</td>
<td>0.52 (0.08)</td>
<td>—</td>
<td>6.33</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

*Note:* The test statistics for the interaction effects are $t$-values, and test statistics for the random effects are $z$-values. SLSc = Constructive Shared Leadership Style; SLSr = Restrictive Shared Leadership Style; PT = Perspective-Taking.
No significant within-group or between-group interaction effects emerged for perspective-taking as a moderator between SLS constructive and transactive knowledge systems (within: $\beta = 0.35, t(118) = 0.73, p > .05$; between: $\beta = -0.11, t(118) = -0.42, p > .05$). Also, no significant within-group or between-group interaction effects were found for perspective-taking as a moderator between SLS restrictive and transactive knowledge systems (within: $\beta = 0.83, t(118) = 0.20, p > .05$; between: $\beta = 0.17, t(118) = 0.55, p > .05$). Thus, there was no support for perspective-taking as a moderator of the relationship between shared leadership style and transactive knowledge systems.

**Hypothesis 3a–h: Time 1 motivation moderating the relationship of time 2 shared leadership style (restrictive and constructive) on time 3 transactive knowledge systems.** The results of the multilevel model testing time 1 motivation as a moderator between time 2 shared leadership style and time 3 transactive knowledge systems are presented in Table 13 and 14. This model tested the hypothesis that motivation moderates the relationship between shared leadership style and transactive knowledge systems. Interaction terms were created and the model was tested. The class-level random effect was dropped because it was close to zero and none of the models had significant between-class variability ($p > .05$ for all). No significant within-group or between-group interaction effects emerged for motivation (intrinsic/identified regulation, external regulation, or amotivation) as a moderator between shared leadership style (constructive or restrictive) and transactive knowledge systems ($p > .05$ for all). Thus, no support arose for motivation as a moderator on the relationship between shared leadership style and transactive knowledge systems.
Table 13. *Time 1 Intrinsic/Identified Regulation Motivation as Moderator of the relationship between Time 2 Shared Leadership Style and Time 3 Transactive Knowledge Systems*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Intrinsic/Identified Regulation Motivation</th>
<th>Intercept</th>
<th>Est. (SE)</th>
<th>df</th>
<th>t/z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.46 (2.20)</td>
<td>60</td>
<td>1.12</td>
<td>.268</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSr</td>
<td>0.08 (0.18)</td>
<td>70</td>
<td>0.45</td>
<td>.651</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSc</td>
<td>0.45 (0.21)</td>
<td>70</td>
<td>2.14</td>
<td>.036</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mot.IIR</td>
<td>-0.01 (0.10)</td>
<td>70</td>
<td>-0.12</td>
<td>.905</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mot.Ext.</td>
<td>0.02 (0.08)</td>
<td>70</td>
<td>0.25</td>
<td>.801</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amot.</td>
<td>-0.32 (0.08)</td>
<td>70</td>
<td>-3.84</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSr/MotIIR</td>
<td>0.49 (0.33)</td>
<td>70</td>
<td>1.49</td>
<td>.140</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSc/MotIIR</td>
<td>0.002 (0.32)</td>
<td>70</td>
<td>0.01</td>
<td>.995</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSr</td>
<td>-1.17 (1.04)</td>
<td>60</td>
<td>-1.12</td>
<td>.265</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSc</td>
<td>1.57 (0.90)</td>
<td>60</td>
<td>1.74</td>
<td>.086</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mot.IIR</td>
<td>0.18 (0.50)</td>
<td>60</td>
<td>0.36</td>
<td>.718</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mot.Ext.</td>
<td>-0.04 (0.10)</td>
<td>60</td>
<td>-0.42</td>
<td>.686</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amot.</td>
<td>-0.16 (0.10)</td>
<td>60</td>
<td>-1.62</td>
<td>.110</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSr/MotIIR</td>
<td>0.19 (0.22)</td>
<td>60</td>
<td>0.89</td>
<td>.379</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSc/MotIIR</td>
<td>-0.20 (0.20)</td>
<td>60</td>
<td>-0.99</td>
<td>.326</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Group var.</td>
<td>0.04 (0.06)</td>
<td>—</td>
<td>0.72</td>
<td>.236</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Residual var.</td>
<td>0.44 (0.07)</td>
<td>—</td>
<td>5.99</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

*Note:* The test statistics for the fixed effects are t-values and the test statistics for the random effects variances components are z-values. SLSc = Constructive Shared Leadership Style; SLSr = Restrictive Shared Leadership Style; MotIIR = Intrinsic/Identified Regulation Motivation; Mot.ext = External Regulation Motivation; Amot = Amotivation.

Table 14. *External Regulation Motivation and Amotivation as Moderator of the relationship between Time 2 Shared Leadership Style and Time 3 Transactive Knowledge Systems*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>External Motivation</th>
<th>Amotivation</th>
<th>Intercept</th>
<th>Est. (SE)</th>
<th>df</th>
<th>t/z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.42 (5.21)</td>
<td>60</td>
<td>1.62</td>
<td>0.1115</td>
<td>4.22 (1.94)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSr</td>
<td>0.14 (0.18)</td>
<td>70</td>
<td>0.76</td>
<td>0.4506</td>
<td>0.09 (0.18)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSc</td>
<td>0.37 (0.23)</td>
<td>70</td>
<td>1.63</td>
<td>0.1086</td>
<td>0.48 (0.21)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MotIIR</td>
<td>-0.05 (0.11)</td>
<td>70</td>
<td>-0.47</td>
<td>0.6400</td>
<td>-0.02 (0.11)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mot.Ext.</td>
<td>0.05 (0.08)</td>
<td>70</td>
<td>0.57</td>
<td>0.5676</td>
<td>0.03 (0.08)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amot.</td>
<td>-0.31 (0.09)</td>
<td>70</td>
<td>-3.55</td>
<td>0.0007</td>
<td>-0.29 (0.09)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSr/MotExt</td>
<td>-0.02 (0.27)</td>
<td>70</td>
<td>-0.10</td>
<td>0.9192</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSc/MotExt</td>
<td>0.33 (0.28)</td>
<td>70</td>
<td>1.17</td>
<td>0.2442</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSr/Amot.</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>-0.21 (0.25)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSc/Amot.</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.02 (0.24)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSr</td>
<td>-1.27 (1.53)</td>
<td>60</td>
<td>-0.83</td>
<td>0.4076</td>
<td>-0.58 (0.68)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSc</td>
<td>0.20 (2.11)</td>
<td>60</td>
<td>0.09</td>
<td>0.9263</td>
<td>0.71 (0.70)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MotIIR</td>
<td>0.01 (0.12)</td>
<td>60</td>
<td>0.08</td>
<td>0.9354</td>
<td>0.03 (0.14)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mot.Ext.</td>
<td>-1.06 (0.99)</td>
<td>60</td>
<td>-1.07</td>
<td>0.2894</td>
<td>-0.10 (0.10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amot.</td>
<td>-0.13 (0.10)</td>
<td>60</td>
<td>-1.40</td>
<td>0.1670</td>
<td>-0.43 (0.46)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSr/MotExt</td>
<td>0.20 (0.29)</td>
<td>60</td>
<td>0.68</td>
<td>0.5013</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSc/MotExt</td>
<td>0.09 (0.41)</td>
<td>60</td>
<td>0.22</td>
<td>0.8269</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSr/Amot.</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.10 (0.21)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLSc/Amot.</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>-0.01 (0.20)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Group var.</td>
<td>0.02 (0.06)</td>
<td>—</td>
<td>0.38</td>
<td>0.3520</td>
<td>0.06 (0.06)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Residual var.</td>
<td>0.47 (0.08)</td>
<td>—</td>
<td>5.86</td>
<td>&lt; .0001</td>
<td>0.45 (0.07)</td>
</tr>
</tbody>
</table>

*Note:* The test statistics for the fixed effects are t-values and the test statistics for the random effects variances components are z-values. SLSc = Constructive Shared Leadership Style; SLSr = Restrictive Shared Leadership Style; mot.int = Intrinsic Motivation; mot.id = Identified Regulation Motivation; Mot.ext = External Motivation; Amot = Amotivation.
Hypothesis 5a: Change in transactive knowledge systems over time. The results of the unconditional multilevel model testing change in transactive knowledge systems, as measured at time 1, time 2, and time 3 are presented in Table 15. This model tested the hypothesis that transactive knowledge systems increase over time. Examination of the random effects variances showed significant random intercept and slope variance at the student-level ($z = 6.34, p < .001$), indicating there was substantial between-student variability in the starting point and rate-of-change over time ($z = 3.91, p < .0001$). There was also a significant negative intercept-time covariance ($z = -2.30, p < .05$), which indicates that students with higher initial levels of transactive memory tended to have greater decreases in transactive memory over time. On the group-level (level-three), random effects show that there was no significant between-group variability in transactive knowledge systems ($z = 1.35, p = .08$). Lastly, fixed effects of time indicate that transactive knowledge systems did not, on average, change over the three assessments ($\beta = -0.007, t(498) = -0.22, p > .05$). This result is consistent with the mean plot presented in Figure 7. Therefore, no support was found for the hypothesis that transactive knowledge systems increase over time.

Table 15. Unconditional Model: Change in Transactive Knowledge Systems over Time

<table>
<thead>
<tr>
<th></th>
<th>Transactive memory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Est. (SE)</td>
</tr>
<tr>
<td>Intercept</td>
<td>4.27 (0.05)</td>
</tr>
<tr>
<td>Time</td>
<td>-0.007 (0.03)</td>
</tr>
<tr>
<td>Level 3 Group int.</td>
<td>0.51 (0.04)</td>
</tr>
<tr>
<td>Level 2 Ind. intercept</td>
<td>0.39 (0.06)</td>
</tr>
<tr>
<td>Level 2 Ind. int./time cov.</td>
<td>-0.06 (0.02)</td>
</tr>
<tr>
<td>Level 2 Ind. time</td>
<td>0.09 (0.02)</td>
</tr>
<tr>
<td>Level 1 Residual var.</td>
<td>0.17 (0.02)</td>
</tr>
</tbody>
</table>

*Note:* The test statistics for the interaction effects are *t*-values, and the test statistics for the random effects are *z*-values. Supplementary analyses indicated no significant class effect ($p > .05$). Ind = Individual; Int = Intercept; Cov = Covariance; Var = Variance.
Hypothesis 5b and 5c: Shared leadership style (restrictive and constructive) as predictors of change in transactive knowledge systems over time. The results of the multilevel model testing change in transactive knowledge systems over time as a function of group-level SLS types are presented in Table 16. This model tested the hypothesis that transactive knowledge systems increase over time at a faster rate for constructive shared leadership style when compared to restrictive shared leadership style. Results showed that the rate of change in transactive knowledge systems over time did not differ as a function of SLS types (SLS constructive: $\beta = 0.09$, $t(334) = 1.01, p > .05$; SLS restrictive: $\beta = -0.006$, $t(334) = -0.07, p > .05$). However, after dropping the non-significant SLS-by-time interactions, there was a significant main effect of SLS constructive on transactive knowledge systems ($\beta = 0.61$, $t(235) = 5.89, p < .0001$) but no main effect for SLS restrictive ($\beta = 0.08$, $t(235) = 0.75, p > .05$). This
outcome indicates that groups with higher constructive shared leadership style had greater expected transactive knowledge systems across all three time-points. Although this result does not support the hypotheses that transactive knowledge systems increase as a function of shared leadership style, it does provide additional support for Hypothesis 1a, that constructive shared leadership style predicts higher transactive knowledge systems for groups.

Table 16. Conditional Model: Group-Level Shared Leadership Style Restrictive and Constructive as Predictors of Change in Transactive Knowledge Systems over Time

<table>
<thead>
<tr>
<th></th>
<th>Full Model</th>
<th>Reduced Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Est. (SE)</td>
<td>df</td>
</tr>
<tr>
<td>Intercept</td>
<td>1.94 (0.38)</td>
<td>235</td>
</tr>
<tr>
<td>Time</td>
<td>-0.31 (0.26)</td>
<td>334</td>
</tr>
<tr>
<td>SLSr</td>
<td>0.08 (0.12)</td>
<td>235</td>
</tr>
<tr>
<td>SLSc</td>
<td>0.55 (0.12)</td>
<td>235</td>
</tr>
<tr>
<td>Time/SLSr</td>
<td>-0.006 (0.08)</td>
<td>334</td>
</tr>
<tr>
<td>Time/SLSc</td>
<td>0.08 (0.08)</td>
<td>334</td>
</tr>
<tr>
<td>Level 2: Ind. int.</td>
<td>0.36 (0.05)</td>
<td>—</td>
</tr>
<tr>
<td>Level 2: Ind./int./time</td>
<td>-0.07 (0.03)</td>
<td>—</td>
</tr>
<tr>
<td>Level 2: Ind. time</td>
<td>0.09 (0.02)</td>
<td>—</td>
</tr>
<tr>
<td>Level 1: Residual</td>
<td>0.18 (0.02)</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: Level 3 group random effect was dropped because the variance was close to zero and caused difficulties in model estimation. N = 7 subjects were dropped from these models because they were missing SLS data at both time 2 and time 3. Supplementary analyses indicated no significant class effect (p > .05). SLSc = Constructive Shared Leadership Style; SLSr = Restrictive Shared Leadership Style; Ind. Int. = Individual Intercept.

Summary of Results, Study 1

The purpose of study one was to examine the relationships among transactive knowledge systems, shared leadership style, perspective-taking, motivation, and team effectiveness in an applied setting. Temporal development of transactive knowledge systems was also tested. In this section, I present a summary of results for Study 1. In Chapter 7, I provide a detailed discussion of all findings, including strengths and weaknesses, possible explanations or insights about results, and contributions to current literature.
The hypotheses that shared leadership style predicts transactive knowledge systems was supported for constructive shared leadership style, but not for restrictive shared leadership style. As predicted, students and teams with higher constructive shared leadership style at time 2 had higher than expected transactive knowledge systems at time 3. However, students and teams with increased restrictive shared leadership style at time 2 did not have lower transactive knowledge systems at time 3 (see Figure 4).

Support for shared leadership style and transactive knowledge systems as predictors of effectiveness was mixed. Hypotheses that shared leadership style and transactive knowledge systems predict objective measures of effectiveness (GPA and course grade) were not supported for students or teams. However, strong support emerged for shared leadership style and transactive knowledge systems as predictors of self-report measures of effectiveness for students and teams (see Figures 5 and 6).

Specifically, increased constructive shared leadership style was shown to predict higher expected levels of effort related productive output, social processes for satisfaction with team relationships, and individual learning and well-being for students and teams, and knowledge and skill related productive output for teams (but not for students). Furthermore, all significant results were in a positive direction. Constructive shared leadership style was not a significant predictor of strategy related productive output. The Cronbach’s alpha for this scale is generally considered just under the acceptable value (α = .69). It’s possible this scale is not a strong measurement tool and one should not place emphasis on these findings as an evaluation of the hypothesis. Overall, these results indicate that constructive shared leadership style is a strong positive predictor of effectiveness for students and teams (see Figure 5).
Support emerged for restrictive shared leadership style as a negative predictor of self-report measures of effectiveness. Increased restrictive shared leadership style was shown to predict decreased levels of social processes for satisfaction with team relationships and for individual learning and well-being for students and teams. The same result was found for knowledge and skill related productive output for teams (but not students). Again, strategy related productive output was not supported for students or teams. Overall, these results indicate that restrictive shared leadership style is a good negative predictor of effectiveness at both the student and team levels (see Figure 5).

As expected, strong support emerged for transactive knowledge systems as a predictor of self-report measures of effectiveness. Increased transactive knowledge systems predicted significantly increased levels of effort related productive output, knowledge and skill related productive output, social processes for satisfaction with team relationships, and individual learning and well-being for students and teams. Productive output strategy related was the only measure of effectiveness that was not partially or fully supported. Overall, these findings indicate that development of stronger transactive memory systems results in higher effectiveness, which was in the predicted direction (see Figure 6).

The hypotheses testing moderators of the relationship between shared leadership style and transactive knowledge systems were not supported. No support emerged for perspective-taking as a moderator in the relationship between shared leadership style and transactive knowledge systems on the student or team levels. Also, no support was found for motivation as a moderator in the relationship between shared leadership style and transactive knowledge systems on the student or team levels.
Relationships between the variables in this study provide empirical support for my hypothesis that transactive knowledge systems mediate the relationship between shared leadership style and team effectiveness. Although I cannot directly test the theory of mediation due to the combined nested and longitudinal nature of the study (Preacher, 2015), empirical support was found for possible mediation for constructive shared leadership style for students and teams, but not restrictive shared leadership style. Increased constructive shared leadership style was shown to predict increased transactive knowledge systems for students and teams. Constructive shared leadership style was also shown to be a strong predictor of effectiveness for students and teams. Transactive knowledge systems was shown to be a strong predictor of effectiveness for students and teams (see Figures 5 and 6). Together, these relationships suggest that transactive knowledge systems may have a mediating effect on the relationship between constructive shared leadership style and effectiveness for students and teams, for most measures of effectiveness tested in this study. This study is the first attempt at establishing a mediating effect of transactive memory and transactive knowledge systems. As such, the model requires further investigation and replication.

My hypothesis that transactive knowledge systems increase over time was not supported. Also, there was no significant difference in change in transactive knowledge systems over time for shared leadership style. However, a main effect of constructive shared leadership style predicting stronger than expected transactive knowledge systems was found across three time points. This finding provides further support for the hypothesis that constructive shared leadership behaviors promote transactive memory and transactive knowledge systems development.
Overall, Study 1 provided strong support for relationships proposed in the IMOI model. Support was especially strong for the relationships of constructive shared leadership style, transactive knowledge systems, and team effectiveness in this population of student teams. In Chapter 6, I report on findings of Study 2 in which I tested the proposed IMOI model in a population of working adults in the United States using a cross-sectional design. The purpose of Study 2 is to test and compare relationships of variables in the proposed IMOI model in two distinctly different populations.
Chapter 6: Cross-sectional Study using Amazon Mechanical Turk (Study 2)

The purpose of Study 2 is to test the theoretical IMOI model created for this research using a sample closely resembling the general working population in the United States. This population enriches this dissertation by providing external validity and generalizability of relationships proposed in the IMOI model. A crowdsourcing platform, Amazon Mechanical Turk (MTurk), provides access to a diverse population of workers from various industries and regions within the United States (Woo, Keith, & Thornton, 2016).

Method

Participants. The sample in Study 2 consisted of 321 participants, recruited online through MTurk. Participants were required to be living in the USA, currently employed, and working on a team of at least three people. Participants were paid a fee of $1.75 through MTurk, upon completion of the questionnaire. After data collection, outlier screening and data quality analysis was completed that resulted in exclusion of 77 participants from the analysis (see Table 16). The final sample was comprised of 244 participants (114 women, 130 men) averaging 36 years of age ($SD = 11$, range: 21–68). Of participants, 90.6% (221) were employed full time and 9.4% (23) part time. Participants’ job titles and job duties ranged across many different skill sets and sectors of the economy. Participants had an average of six years and four months work experience in their current organization ($SD = 5$ years, 2 months) and five years and four months work experience in their current jobs ($SD = 4$ years, 3 months). In their current jobs, participants worked on an average of 2.8 teams ($SD = 1.36$, range: 1–8 or more) and had an average of three years and four months experience as members in the work team they considered for this study ($SD = 3$ years, 3 months). Of participants, 89% indicated that at least 50% of their job duties required teamwork and 94.2% of participants strongly agreed (64.3%) or moderately agreed
(29.9%) that the work they do on their team is important to their overall job performance. To assess hierarchical level of employment, participants identified the level at which they currently work from \(1 = \text{lowest level of hierarchy}\) to \(10 = \text{highest level}\). Participants placed themselves at a mean level of 5.41 (\(SD = 2.07\)). When asked if participants identified themselves as the formal leader of their team, 34% replied “yes” and 66% replied “no” (“yes” \(n = 82\), “no” \(n = 162\)).

Additional demographic information is provided in Table 17.

### Table 17. Participant’s Demographics, Study 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>(n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>114</td>
<td>46.7</td>
</tr>
<tr>
<td>Male</td>
<td>130</td>
<td>53.3</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>179</td>
<td>72.9</td>
</tr>
<tr>
<td>Black</td>
<td>18</td>
<td>7.4</td>
</tr>
<tr>
<td>Asian</td>
<td>26</td>
<td>10.7</td>
</tr>
<tr>
<td>Hispanic</td>
<td>12</td>
<td>4.9</td>
</tr>
<tr>
<td>American Indian or Alaskan</td>
<td>8</td>
<td>3.3</td>
</tr>
<tr>
<td>Two or more races</td>
<td>2</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Highest level of education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>31</td>
<td>12.7</td>
</tr>
<tr>
<td>Some college</td>
<td>45</td>
<td>18.4</td>
</tr>
<tr>
<td>College degree</td>
<td>113</td>
<td>46.3</td>
</tr>
<tr>
<td>Some graduate school</td>
<td>8</td>
<td>3.3</td>
</tr>
<tr>
<td>Graduate degree</td>
<td>47</td>
<td>19.3</td>
</tr>
<tr>
<td><strong>Region of US</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New England</td>
<td>6</td>
<td>2.5</td>
</tr>
<tr>
<td>Middle Atlantic</td>
<td>39</td>
<td>16</td>
</tr>
<tr>
<td>East North Central</td>
<td>35</td>
<td>14.3</td>
</tr>
<tr>
<td>West North Central</td>
<td>14</td>
<td>5.7</td>
</tr>
<tr>
<td>South Atlantic</td>
<td>55</td>
<td>22.5</td>
</tr>
<tr>
<td>East South Central</td>
<td>20</td>
<td>8.2</td>
</tr>
<tr>
<td>West South Central</td>
<td>27</td>
<td>11.1</td>
</tr>
<tr>
<td>Mountain</td>
<td>16</td>
<td>6.6</td>
</tr>
<tr>
<td>Pacific</td>
<td>32</td>
<td>13.1</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Time</td>
<td>221</td>
<td>90.6</td>
</tr>
<tr>
<td>Part Time</td>
<td>23</td>
<td>9.4</td>
</tr>
</tbody>
</table>

**Teams.** Teams that participants considered for this study had an average of between nine and ten members (\(M = 9.52, SD = 10.13; \text{range 3 - 100}\)) with an average of between four and five women (\(M = 4.03, SD = 3.81; \text{range 0 - 24}\)) and between five and six men (\(M = 5.29, SD = 6.66; \text{range 0 – 60}\)). Teams worked together over differing periods of time with 20.5% indicating less than one year, 11.9% less than three years, 3.3% less than five years, 29.1% more than five years, and 35.2% uncertain. Most participants reported that, on average, 80% of their work on
the team involved communication with team members, 80% of their work with their team involved being dependent on the team members, and 80% of the work with their team involved coordination with team members. To assess hierarchical diversity in teams, participants identified how many levels of organizational hierarchy were represented on their team. Participants indicated an average of 2.82 ($SD = 1.83$) different levels of hierarchy on their teams. Boundedness is an indicator of clarity of membership on a team and stability indicates a teams’ rate of membership change (Wageman et al., 2005). Participants rated their team’s boundedness and stability on a Likert-type scale from $1 = weak$ to $6 = strong$. The mean rating was $5.27$ ($SD = 0.84$) for boundedness and $4.79$ ($SD = 1.16$) for stability, indicating that team membership is generally known and turnover of members is typically low on these teams.

**Measures.** Eight scales assessed respondents in Study 2: The Questionnaire for Transactive Knowledge Systems (Q-Tracks) (Bohnenkamp, 2016; Brauner & Robertson, 2009; Robertson et al., 2013), The Vertical and Shared Leadership Scale (VSLS) (Pearce & Sims, 2002), the Perspective-taking Scale from the Interpersonal Reactivity Index (IRI) (Davis, 1980, 1983), The Situational Motivation Scale (SIMS) (Guay et al., 2000), three self-report measures of productive output from The Team Diagnostic Scale (TDS) (Wageman et al., 2005) and the Bounded and Stable scales of the Real Team scale from the Team Diagnostic Survey (Wageman et al., 2005). All scales were answered using a 6-point Likert-type scale ($1 = strongly disagree, 6 = strongly agree$) to indicate the extent of agreement with each item. Questionnaires included work unit and demographic questions about individuals and teams. Data quality questions included self-report indices of data quality and ‘hidden’ instructed items. Means, standard deviations, interscale correlations, and consistency reliability estimates (Cronbach’s Alpha) for all scales are provided in Table 19. All constructs and scales measuring them are described
below. A complete list of questions for Study 2 can be found in Appendices B, D, E, F, G, I, K, M, and N.

**Transactive memory.** The Questionnaire for Transactive Knowledge Systems (Q-Tracks) (Bohnenkamp, 2016; Brauner & Robertson, 2009; Robertson et al., 2013) measured five dimensions of transactive knowledge systems: integration, differentiation, metaknowledge, transactivity, and cognitive interdependence. I reviewed this scale in detail in Study 1. As a summary review: Integration (five items) measured the degree of shared knowledge between individual group members. Differentiation (five items) measured the degree to which individual members of a group have specialized unshared knowledge. Metaknowledge (five items) measured how much individuals in a group know about other group members’ knowledge. Transactivity (five items) measured the level of information exchange in a group. Cognitive interdependence (five items) measured the degree to which group members rely on each other to access information. I created an overall measure of transactive memory by averaging across the five subscales. Internal consistency estimates were good for a combined scale of transactive memory ($\alpha = .82$). The scale consists of 25 items, five items for each dimension.

Originally developed in German (Jochmann & Sommer, 2002; Jochmann et al., 2002), an English translation was validated (Robertson, 2009), and used in a number of studies (e.g., Brauner & Robertson, 2009; Jordan & Brauner, 2008; Robertson et al., 2013). Results of validity testing showed good internal consistency, reliability, and replication of factor loading on the five dimensions (Robertson, 2009). This version of Q-Tracks was used in Study 1 (see Appendix A). However, a comparison of a large number of samples over several years of data collection raised some concerns about conceptual consistency and psychometric soundness of several items, which resulted in a revision of the scale (Bohnenkamp, 2016). This revised version of the scale
had significantly improved psychometric properties and therefore was the instrument used in Study 2 of this research. The dimensions and underlying constructs did not change; however, wording of items were changed to improve internal validity (see Appendix B).

**Shared leadership style.** The Vertical and Shared Leadership Scale (Pearce & Sims, 2002) measured five types of leadership behavior: aversive, directive, transactional, transformational, and empowering. This scale was discussed in detail in Study 1. As a summary review: Aversive leadership (six items) relies primarily on coercive power and is characterized by behaviors such as intimidation and dispensing reprimands. Directive Leadership (seven items) relies on legitimate power and is characterized by behaviors such as issuing instructions and commands and assigning goals. Transformational leadership (eight items) incorporates charismatic effect to inspire employees and includes behaviors such as providing intellectual stimulation and having high performance expectations. Empowering leadership (five items) is characterized by leading others to lead themselves by modeling self-leadership behavior and encouraging team work and opportunity thinking. As proposed in the IMOI model, and reported in Study 1, four shared leadership subscales were combined into two subscales: *SLS restrictive* averaged across the subscales aversive leadership and directive leadership and *SLS constructive* averaged across the subscales of transformational leadership and empowering leadership.

To reduce repetitive items and shorten the survey for Study 2, I removed 14 questions from the Vertical and Shared Leadership Scale. Items with highly similar or identical meaning were identified and 11 questions with the lowest factor loadings reported in Pearce and Sims (2002) were removed. In addition, I removed three items from the transformational leadership subscale due to negative factor loadings in the sample for Study 1. In total, the scale reduced from 45 items to 31 items for Study 2 (see Appendix D). This reduction was an effort to improve
data quality based on concerns about survey length and participant fatigue in online research. Cronbach’s alpha was recalculated (using 13 items each for SLSc and SLSr) resulting in strong alphas for restrictive shared leadership style ($\alpha = .86$) and constructive shared leadership style ($\alpha = .84$).

**Perspective-taking.** The Perspective-taking scale from the Interpersonal Reactivity Index (IRI) (Davis, 1980, 1983) measured perspective-taking. This scale was the same as that used in Study 1. Perspective-taking refers to the tendency of individuals to adopt the psychological point of view of others. The same four items were used in Study 1 and Study 2 and are reported in Appendix E.

**Motivation.** The Situational Motivation Scale (SIMS) (Guay, et al., 2000) measured four types of motivation: intrinsic motivation, identified regulation, external regulation, and amotivation. I reviewed this scale in detail in Study 1. As a summary review: Intrinsic motivation (two items) occurs when one engages in behaviors for the sole pleasure and satisfaction derived from them. Identified regulation (two items) occurs when one engages in behaviors that are valued and perceived as being chosen by oneself. External regulation (two items) occurs when one engages in behavior because of rewards offered or in order to avoid negative consequences. Amotivation (two items) occurs when individuals experience a lack of contingency between their behaviors and outcomes. The same eight items were used in Study 1 and Study 2 and are reported in Appendix F.

Consistent with Study 1, I combined measures for intrinsic and identified regulation into a new measure intrinsic/identified regulation motivation (IIR Motivation). Measures for external regulation and amotivation were not combined because they did not correlate ($r = -.01$). Therefore, I examined three measures of motivation: Intrinsic/identified regulation motivation
Transactive memory, leadership, effectiveness

(IIR motivation) measured self-determined motivation, external regulation measured motivation that is not self-determined, and amotivation measured a lack of contingency between behavior and motivation. Estimates of internal consistency ranged from excellent to acceptable and are reported in Table 19.

**Self-report measures of effectiveness.** Criteria of Team Effectiveness measures taken from The Team Diagnostic Survey (TDS) (Wageman et al., 2005) measured aspects of effectiveness. Criteria of team effectiveness provide an indirect measure of a team’s ability to generate satisfactory products, services, and decisions (Wageman et al., 2005). I discussed the criteria and underlying scales in detail in Study 1. Study 2 included three scales from the first criteria, *productive output (PO)*, which measured the ability of a team to produce output that will meet or exceed expectations. As a summary review: The three PO scales are: effort related, strategy related, and knowledge and skill related (Hackman, 2002; Wageman et al., 2005). PO-effort related (three items) measured the level of effort members collectively expend on tasks ($\alpha = .67$). PO-strategy related (three items) measured the quality of team task performance strategies ($\alpha = .64$). PO-knowledge and skill related (three items) measured the degree to which the team uses the full complement of member knowledge and skill ($\alpha = .81$). The scale contains nine items (see Appendix I).

**Boundedness and stability.** I included measures of team boundedness and stability from the ‘Enabling Conditions’ of the Team Diagnostic Survey (TDS) (Wageman et al., 2005) to provide information about teams. Boundedness (three items) indicates clarity of membership on a team and stability (three items) indicates a team’s rate of membership change. While a good understanding of the characteristics of student teams existed for Study 1, these measures aided in
understanding teams described by participants in the online population in Study 2. Items can be found in Appendix G.

Work unit questions. I created questions to better understand work groups described by online participants. For example: What is your occupation or job title? What are your job duties and responsibilities? How much of your work involves other people? How much of your job duties and responsibilities require team work? What is the expected life span of your team? Participants answered questions using a format appropriate to the question (i.e., percentage scale from 10% to 100%, text answers, etc.; see Appendix K).

Demographic information. Individual and team demographic questions included questions about age, gender, ethnicity, education, length of service in the organization, length of service in the current position, employment status (full or part time), length of service on the current team, gender of team members, number of team members, and if the participant is the formal leader of the team. In addition, a text box invited participants’ comments as well as their MTurk ID number for reimbursement purposes (see Appendix M).

Hidden and self-report attention questions. The procedures section of this chapter addresses measures to ensure data quality for MTurk participants in Study 2 under “crowdsourcing, steps to ensure data quality” (see Appendix N for a complete list of items).

Procedures

I created a survey using SurveyMonkey, an online research service that provides survey creation software and data storage. I posted the survey created on SurveyMonkey on MTurk through TurkPrime. MTurk is an online crowdsourcing service. TurkPrime is an online service provider that interfaces directly with MTurk and provides additional controls to the researcher. Participants who were registered as workers on MTurk, and who met the criteria, voluntarily
completed the questionnaire from many offered on the secure website. Participants were asked to think of themselves and a specific work team when answering questions. Workers were paid $1.75 through MTurk upon completion of the questionnaire. Participant data loaded directly into SurveyMonkey and was then downloaded to SPSS statistical software for analysis. Participants were not identifiable in any way. Collecting data through MTurk provides an additional level of anonymity to participants because researchers have no direct interaction with participants.

Crowdsourcing: Steps to ensure data quality. Crowdsourcing has emerged as an attractive alternative to other sources of data collection, and is especially popular for self-report survey research (Gosling, Vazire, Srivastava, & John, 2004). Some practical benefits include efficiency, speed of collection, cost-effectiveness, flexibility, access to large subject pools, and elimination of time and errors associated with data entry (Behrend, Sharek, Meade, & Wiebe, 2011; Gosling et al., 2004). Crowdsourcing may be especially beneficial for Organizational Psychologists. Focusing on MTurk specifically, participants were older, more diverse in terms of education, employment status, and profession, and had longer tenure in their current jobs when compared to undergraduate samples (Behrend et al., 2011). Therefore, MTurk provides a unique benefit to researchers by enabling access to a diverse population of workers from various industries and regions within the United States. This may be a more appropriate population than college students or employees from a single organization when generalizing findings in organizational psychology. However, concerns about quality of data collected on crowdsourcing sites continue (Woo et al., 2015). Although no direct way exists to observe MTurk workers or to ensure the information they volunteer is true or accurate, researchers can use methods to identify dishonest, computer generated, or thoughtless responses (DeSimone, Harms, & DeSimone, 2015; Peer, Vosgerau, & Acquisti, 2014). I used a series of data quality checks for this study,
including: MTurk screening, response time analysis, instructed items, self-report indices of data quality, and Mahalanobis Distance (Bohnenkamp, 2016). Data quality checks resulted in removal of 77 of 321 participants (24% of the original sample), leaving 244 participants in the final sample (see Table 18).

Table 18. Summary of Data Quality Screening Methods and Participants Removed

<table>
<thead>
<tr>
<th>Index</th>
<th>Description</th>
<th>Cutoff</th>
<th>Excluded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Time</td>
<td>Statistical screening method. Total time to complete the survey as measured by MTurk.</td>
<td>Outlier labeling rule.</td>
<td>15</td>
</tr>
<tr>
<td>Instructed Items</td>
<td>Direct screening method. Participants asked to provide specific response to three questions.</td>
<td>Exclusion of cases who give one or more incorrect answers.</td>
<td>56</td>
</tr>
<tr>
<td>Self-report Yes or No</td>
<td>Direct screening method. One yes/no question asking participants if we should use their data.</td>
<td>Exclusion of participants who answered No.</td>
<td>1</td>
</tr>
<tr>
<td>Self-report Likert-scale</td>
<td>Direct screening method. Four questions asking about effort and attention.</td>
<td>Exclusion of participants with low self-reported scores on all four questions.</td>
<td>2</td>
</tr>
<tr>
<td>Mahalanobis distance</td>
<td>Statistical screening method. Multivariate outlier analysis.</td>
<td>Exclusion of cases with extreme Mahalanobis D values ($p &lt; .00$).</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Total participants excluded</td>
<td></td>
<td>77</td>
</tr>
</tbody>
</table>

**MTurk screening.** MTurk provides information about workers past performance in the form of approval ratings. Peer et al. (2014) found that using workers with approval ratings above 95% provided significantly higher quality data than did low-reputation workers. MTurk allows screening of workers by human-intelligence tasks (HIT), completion rate (fraction of tasks completed among those signed up for) and HIT approval rate (fraction of tasks accepted by requesters among those completed). Only workers with HIT completion rates of 10,000 and HIT approval rates of at least 99% were eligible to participate in this study.

**Response time.** Identified by DeSimone et al. (2015) as an important indicator of data quality, response time was analyzed using the outlier labeling rule (Hoaglin & Inglewicz, 1987; Hoaglin, Inglewicz, & Tukey, 1986; Tukey, 1977). Participants with response times falling
outside of the indicated range were removed from the study. This screening resulted in removal of 15 participants (4.7% of the original sample).

*Instructed items.* A type of direct screening, instructed items provide explicit instructions to respondents to identify those who are not paying attention or who are speeding through the survey (DeSimone et al., 2015; Peer et al., 2014). For example, “Please select moderately disagree as the answer.” Three instructed items were inserted at various points throughout the survey (see Appendix N). Participants who missed any of the three instructed items were removed from the study. This screening resulted in removal of 56 participants (17.4% of the original sample).

*Self-report indices of data quality.* Another direct approach to screen for data quality is simply to ask the participants about their level of effort (DeSimone et al., 2015). I included four questions asking about effort and attention (see Appendix M). For example, “I rushed through this survey.” Respondents answered questions using a 6-point Likert-type scale (1 = strongly disagree, 6 = strongly agree) to indicate the extent of agreement with each item. Participants who responded with the two most negative responses on all four questions were removed from the study. In addition, I directly asked the participant if I should use their data or not. If they answered ‘no’, I removed them from the study. This screening resulted in the removal of three participants (0.9% of the original sample). Items can be found in Appendix N.

*Mahalanobis distance.* A statistical screening method, Mahalanobis Distance is a multivariate version of outlier analysis that compares the distance between a respondent’s scores on survey items and the sample mean scores on survey items. I identified participants with extreme deviation from the normative response and removed them from the study. This screening resulted in removal of three participants (0.9% of the original sample).
Overview of Statistical Analyses

**Multiple linear regression.** A series of multiple linear regression analyses were fitted to test hypotheses for Study 2. Preliminary analyses were performed to ensure there was no violation of the assumption of normality, linearity, or multicollinearity. Multiple linear regression models were fitted to test each research hypothesis. To test moderation hypotheses, variables were centered prior to creating interaction terms used for testing. Regression analyses and the *Sobel t-test* were used to test the mediation hypothesis.

**Results**

**Descriptive statistics.** Means, standard deviations, and consistency reliability coefficients (Cronbach’s alpha) for all variables are presented in Table 19.

**Hypothesis 1a and c: Shared leadership style (restrictive and constructive) predicting transactive knowledge systems.** The results of the multiple linear regression model testing the impact of shared leadership style (SLS restrictive and SLS constructive) on transactive memory are presented in Table 20. Specifically, this model tested the hypotheses that increased SLS restrictive will predict decreased transactive knowledge systems and increased SLS constructive will predict increased transactive knowledge systems. Results indicated that shared leadership style explained 38% of the variability in transactive knowledge systems, which was statistically significant ($R^2 = 0.38; F (2, 241) = 73.32, p < .001$). Specifically, increased SLS constructive significantly predicted increased transactive memory ($\beta = 0.64, p < .001$), but SLS restrictive was not a significant predictor of transactive memory ($\beta = -0.08, p > .05$). The results suggest that individuals with increased constructive leadership style have higher expected levels of transactive knowledge systems. However, no effects of restrictive shared leadership style on transactive knowledge systems emerged.
Table 19. Means, Standard Deviations, Interscale Correlations, and Consistency Reliability Estimates (Cronbach’s Alpha)

<table>
<thead>
<tr>
<th>Construct</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perspective Taking</td>
<td>.90</td>
<td>.25***</td>
<td>.08</td>
<td>−.23</td>
<td>.27***</td>
<td>.08</td>
<td>.46***</td>
<td>.32***</td>
<td>.39***</td>
<td></td>
</tr>
<tr>
<td>Motivation IIR</td>
<td>.95</td>
<td>.25***</td>
<td>.02</td>
<td>−.38**</td>
<td>.29***</td>
<td>.27***</td>
<td>.37***</td>
<td>.20***</td>
<td>.34***</td>
<td></td>
</tr>
<tr>
<td>Motivation Ext</td>
<td>.73</td>
<td>.08***</td>
<td>.02</td>
<td>−.01</td>
<td>.13**</td>
<td>.16**</td>
<td>.22**</td>
<td>−.03**</td>
<td>.17**</td>
<td></td>
</tr>
<tr>
<td>Amotivation</td>
<td>.69</td>
<td>.23***</td>
<td>.02</td>
<td>−.14**</td>
<td>−.35**</td>
<td>−.37**</td>
<td>−.56**</td>
<td>−.57**</td>
<td>−.30**</td>
<td></td>
</tr>
<tr>
<td>SLS constructive</td>
<td>.84</td>
<td>.69</td>
<td>.08</td>
<td>−.23</td>
<td>.47***</td>
<td>.47***</td>
<td>.43***</td>
<td>.12**</td>
<td>.43***</td>
<td></td>
</tr>
<tr>
<td>SLS restrictive</td>
<td>.86</td>
<td>.73</td>
<td>.13</td>
<td>.16</td>
<td>.50**</td>
<td>.50**</td>
<td>.50**</td>
<td>.50**</td>
<td>.50**</td>
<td></td>
</tr>
<tr>
<td>Transact Memory</td>
<td>.82</td>
<td>.88</td>
<td>.17</td>
<td>.22</td>
<td>.17**</td>
<td>.17**</td>
<td>.17**</td>
<td>.17**</td>
<td>.17**</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.97</td>
<td>1.07</td>
<td>0.93</td>
<td>1.22</td>
<td>0.86</td>
<td>0.86</td>
<td>0.86</td>
<td>0.86</td>
<td>0.84</td>
<td>1.16</td>
</tr>
</tbody>
</table>

Note: N = 244. Internal consistency reliability estimates (Cronbach’s alpha) are displayed in bold on the main diagonal. PO = productive output; Know&SR = knowledge and skill related; IIR = intrinsic/identified regulation motivation; Ext = external regulation motivation. *p < .05, **p < .01, ***p < .001.

Table 20. Predicting the impact of Shared Leadership Style on Transactive Knowledge Systems

<table>
<thead>
<tr>
<th>Predictors</th>
<th>B</th>
<th>S.E.</th>
<th>Std. β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS restrictive</td>
<td>−0.05</td>
<td>0.04</td>
<td>−0.08</td>
<td>−1.45</td>
<td>.15</td>
</tr>
<tr>
<td>SLS constructive</td>
<td>0.56</td>
<td>0.05</td>
<td>0.64</td>
<td>11.61</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Note: R² = 0.38; Outcome = Transactive memory.

**Hypothesis 2a, c, and e:** Shared leadership style (restrictive and constructive) and transactive knowledge systems predicting team effectiveness.

**Productive output (PO)–effort related.** Results of the multiple linear regression model testing the impact of shared leadership style (SLS restrictive and SLS constructive) and transactive knowledge systems on the effectiveness measurement of PO-effort related (the level of effort members collectively expend on tasks) are presented in Table 21. This model tested the hypotheses that increased SLS restrictive will predict lower PO-effort related and increased SLS constructive will predict higher PO-effort related. Also, increased transactive knowledge systems will predict
higher PO-effort related. Results indicated that shared leadership style and transactive knowledge systems explained 33% of the variability in PO-effort related, which was statistically significant ($R^2 = 0.33; F (3, 239) = 40.03, p < .001$). Furthermore, increased SLS constructive and increased transactive memory both significantly predicted increased PO–effort related (SLS constructive: $\beta = 0.18, p < .05$; transactive memory: $\beta = 0.47, p < .001$). However, the effect of SLS restrictive on PO–effort related was not statistically significant ($\beta = -0.09, p > .05$). This result suggests that individuals with increased constructive shared leadership style will have higher expected levels of effort related productive output. Also, individuals with stronger transactive knowledge systems will have higher expected levels of effort related productive output. Support did not emerge for restrictive shared leadership style as a predictor of effort related productive output.

Table 21. Predicting the impact of Shared Leadership Style and Transactive Knowledge Systems on Effectiveness for Productive Output–Effort Related

<table>
<thead>
<tr>
<th>Predictors</th>
<th>$B$</th>
<th>S.E.</th>
<th>Std. $\beta$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS restrictive</td>
<td>-0.10</td>
<td>0.07</td>
<td>-0.09</td>
<td>-1.60</td>
<td>.11</td>
</tr>
<tr>
<td>SLS constructive</td>
<td>0.25</td>
<td>0.11</td>
<td>0.18</td>
<td>2.38</td>
<td>.02</td>
</tr>
<tr>
<td>Transactive memory</td>
<td>0.47</td>
<td>0.11</td>
<td>0.47</td>
<td>6.82</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

*Note: $R^2 = 0.33$; Outcome = Productive Output – Effort Related; SLS restrictive = restrictive shared leadership style; SLS constructive = constructive shared leadership style.*

**Productive output (PO)–strategy related.** Results of the multiple linear regression model testing the impact of shared leadership style (SLS restrictive and SLS constructive) and transactive knowledge systems on the effectiveness measure of PO-strategy related (the quality of team task performance strategies) are presented in Table 22. This model tested the hypotheses that increased SLS restrictive will predict lower PO-strategy related and increased SLS constructive will predict higher PO-strategy related. Also, that increased transactive knowledge systems will predict higher PO-strategy related. The results indicated that shared leadership style and transactive knowledge systems explained 32% of the variability in PO-strategy related,
which was statistically significant ($R^2 = 0.32; F (3, 239) = 37.56, p < .001$). Furthermore, increased SLS restrictive significantly predicted decreased PO-strategy related ($\beta = -0.33, p < .001$), whereas increased transactive memory predicted increased PO-strategy related ($\beta = 0.89, p < .001$). The effect of SLS constructive on PO-strategy related was not significant ($\beta = 0.11, p > .05$). This outcome suggests that individuals with increased restrictive shared leadership style will have lower expected levels of strategy related productive output. Also, individuals with stronger transactive knowledge systems will have higher expected levels of strategy related productive output. Support was not found for constructive shared leadership style as a predictor of strategy related productive output.

<table>
<thead>
<tr>
<th>Predictors</th>
<th>$B$</th>
<th>S.E.</th>
<th>Std. $\beta$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS restrictive</td>
<td>-0.33</td>
<td>0.07</td>
<td>-0.27</td>
<td>-4.62</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>SLS constructive</td>
<td>0.18</td>
<td>0.12</td>
<td>0.11</td>
<td>1.49</td>
<td>.14</td>
</tr>
<tr>
<td>Transactive Memory</td>
<td>0.89</td>
<td>0.13</td>
<td>0.49</td>
<td>6.99</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

*Note: $R^2 = 0.32$; Outcome = Productive Output – Strategy Related; SLS restrictive = restrictive shared leadership style; SLS constructive = constructive shared leadership style.*

**Productive output (PO)—knowledge and skill related.** The results of the multiple linear regression model testing the impact of shared leadership style (SLS restrictive and SLS constructive) and transactive knowledge systems on the effectiveness measure of PO-knowledge and skill related (the degree to which a team uses the full complement of member’s knowledge and skill) are presented in Table 23. This model tested the hypotheses that increased SLS restrictive will predict lower PO-knowledge and skill related and increased SLS constructive will predict higher PO-knowledge and skill related. Also, increased transactive knowledge systems will predict higher PO-knowledge and skill related. Results from the multiple linear regression model indicated that shared leadership style and transactive knowledge systems explained 41%
of the variability in PO-knowledge and skill related, which was statistically significant ($R^2 = 0.41; F (3, 239) = 54.24, p < .001$). Increased SLS constructive and increased transactive memory significantly predicted increased PO-knowledge and skill related (SLS constructive: $\beta = 0.16, p < .05$; transactive memory: $\beta = 0.72, p < .001$). Whereas increased SLS restrictive significantly predicted decreased PO-knowledge and skill related ($\beta = -0.15, p > .01$). This outcome suggests that individuals with increased restrictive shared leadership style will have lower expected levels of knowledge and skill related productive output. Also, individuals with increased constructive shared leadership style will have higher expected levels of knowledge and skill related productive output. Lastly, individuals with stronger transactive knowledge systems will have higher expected levels of knowledge and skill related productive output.

Table 23. Predicting the impact of Shared Leadership Style and Transactive Knowledge Systems on Effectiveness for Productive Output–Knowledge and Skill Related

<table>
<thead>
<tr>
<th>Predictors</th>
<th>B</th>
<th>S.E.</th>
<th>Std. $\beta$</th>
<th>t</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS restrictive</td>
<td>-0.15</td>
<td>0.05</td>
<td>-0.18</td>
<td>-3.19</td>
<td>.002</td>
</tr>
<tr>
<td>SLS constructive</td>
<td>0.16</td>
<td>0.08</td>
<td>0.14</td>
<td>2.06</td>
<td>.040</td>
</tr>
<tr>
<td>Transactive Memory</td>
<td>0.72</td>
<td>0.08</td>
<td>0.55</td>
<td>8.54</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Note: $R^2 = 0.41$; Outcome = Productive Output – Knowledge and Skill Related; SLS restrictive = restrictive shared leadership style; SLS constructive = constructive shared leadership style.

**Hypothesis 2g–j: Transactive knowledge systems mediate the relationship between shared leadership style (restrictive and constructive) and team effectiveness.** Empirical support for the hypothesis that transactive memory and transactive knowledge systems mediate the relationship between shared leadership style and team effectiveness emerged for constructive shared leadership style, but not restrictive shared leadership style. Constructive shared leadership style was shown to be a significant predictor of transactive knowledge systems. Constructive shared leadership style was also shown to be a significant predictor of team effectiveness for PO-effort related and PO-knowledge and skill related. Transactive knowledge systems were shown to be a
significant predictor of team effectiveness for PO-effort related and PO-knowledge and skill related.

Together, these results support the mediational hypothesis. Regression analysis was used to investigate the hypothesis. After controlling for transactive knowledge systems, constructive shared leadership style was no longer a significant predictor of PO-effort related ($\beta = 0.12, p > .05$) or PO-knowledge and skill related ($\beta = 0.08, p > .05$); consistent with full mediation. Furthermore, a Sobel $t$-test confirmed the change was highly significant for PO-effort related (Sobel $t = 6.28, p < .001$) and PO-knowledge and skill related (Sobel $t = 5.59, p < .001$). Therefore, transactive memory and transactive knowledge systems were found to fully mediate the relationship between constructive leadership style and team effectiveness for PO-effort related and PO-knowledge and skill related. These findings suggest that constructive shared leadership style acts on PO-effort related and PO-knowledge and skill related through transactive memory, such that transactive knowledge systems carry the influence of constructive shared leadership style to PO-effort related and PO-knowledge and skill related (see Tables 24 and 25; Figures 8 and 9).

Table 24. Transactive Memory and Transactive Knowledge Systems Mediate the Relationship between Constructive Shared Leadership Style and Productive Output-Effort Related

<table>
<thead>
<tr>
<th>Predictors</th>
<th>B</th>
<th>S.E.</th>
<th>Std. $\beta$</th>
<th>$T$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS constructive</td>
<td>0.17</td>
<td>0.09</td>
<td>0.12</td>
<td>1.83</td>
<td>.068</td>
</tr>
<tr>
<td>Transactive Memory</td>
<td>0.80</td>
<td>0.11</td>
<td>0.49</td>
<td>7.39</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Note: $R^2 = 0.32$; Outcome = Productive Output – Effort Related; SLS constructive = constructive shared leadership style.

Figure 8. Transactive memory and transactive knowledge systems mediate the relationship between constructive shared leadership style and productive output-effort related.

Note: Sobel $t = 6.28, p < .001$; $c$ = direct effect; $c'$ = indirect effect; Est(SE); *$p < .05$; **$p < .01$; ***$p < .001$. 
Table 25. *Transactive Memory and Transactive Knowledge Systems Mediate the Relationship between Constructive Shared Leadership Style and Productive Output-Knowledge and Skill Related*

<table>
<thead>
<tr>
<th>Predictors</th>
<th>B</th>
<th>S.E.</th>
<th>Std. β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS constructive</td>
<td>0.09</td>
<td>0.07</td>
<td>0.08</td>
<td>1.25</td>
<td>.211</td>
</tr>
<tr>
<td>Transactive Memory</td>
<td>0.72</td>
<td>0.08</td>
<td>0.56</td>
<td>8.70</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*Note: R² = 0.37; Outcome = Productive Output – Knowledge and Skill Related; SLS constructive = constructive shared leadership style.*

**Figure 9.** Transactive memory and transactive knowledge systems mediate the relationship between constructive shared leadership style and productive output-knowledge and skill related. *Note: Sobel t = 5.59, p < .001; c = direct effect; c’ = indirect effect; Est. (SE); *p < .05; *p < .01; ***p < .001.*

**Hypothesis 3a and c: Perspective-taking moderates the relationship between shared leadership style (restrictive and constructive) and transactive knowledge systems.** The results of the multiple linear regression model testing the moderation effect of perspective-taking on the relationship between shared leadership style and transactive knowledge systems are presented in Table 26. The SLS-by-perspective-taking interaction model showed no statistically significant interaction effects (*p > .05 for both the Perspective-taking Scale x SLS interaction terms*). Therefore, no support arose for perspective-taking as a moderator between shared leadership style and transactive knowledge systems. This outcome suggests that the relationship between constructive shared leadership and transactive knowledge systems is not moderated by perspective-taking. Also, that the relationship between restrictive shared leadership and transactive knowledge systems is not moderated by perspective-taking.
Hypothesis 4a, c, e, g, i, and k: Motivation (intrinsic/identified regulation, external, and amotivation) moderates the relationship between shared leadership style (restrictive and constructive) and transactive knowledge systems. The results of the multiple linear regression model testing the moderation effect of motivation (IIR motivation, external, and amotivation) on the relationship between shared leadership style (restrictive and constructive) and transactive knowledge systems are presented in Table 27. In the SLS-by-motivation interaction model, six interactions were tested (2 SLS variables x 3 motivation variables). Of the six interactions tested, only one interaction was significant (SLS restrictive x intrinsic/identified regulation motivation: $\beta = 0.12$, $p < .001$). A post-hoc analysis examined low, moderate, and high levels of intrinsic/identified regulation motivation (IIR motivation) across SLS restrictive and transactive knowledge systems. Analysis indicated a positive relationship between SLS restrictive and transactive memory for participants high in IIR motivation, but not for participants with moderate or low IIR motivation (see Figure 10).
Table 27. Predicting a moderating effect of Motivation (Intrinsic/Identified Regulation, External, Amotivation) on the relationship between Shared Leadership Style (restrictive and constructive) and Transactive Knowledge Systems

<table>
<thead>
<tr>
<th>Predictors</th>
<th>B</th>
<th>S.E.</th>
<th>Std. β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS restrictive</td>
<td>−0.001</td>
<td>0.04</td>
<td>−0.002</td>
<td>−0.04</td>
<td>.967</td>
</tr>
<tr>
<td>SLS constructive</td>
<td>0.40</td>
<td>0.05</td>
<td>0.45</td>
<td>8.79</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>IIR Motivation</td>
<td>0.08</td>
<td>0.03</td>
<td>0.12</td>
<td>2.38</td>
<td>.018</td>
</tr>
<tr>
<td>Extrinsic Motivation</td>
<td>0.10</td>
<td>0.03</td>
<td>0.15</td>
<td>3.40</td>
<td>.001</td>
</tr>
<tr>
<td>Amotivation</td>
<td>−0.13</td>
<td>0.03</td>
<td>−0.28</td>
<td>−5.22</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>SLS restrictive x IIR Motivation</td>
<td>0.12</td>
<td>0.03</td>
<td>0.18</td>
<td>3.68</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>SLS restrictive x Ext Motivation</td>
<td>0.02</td>
<td>0.04</td>
<td>0.03</td>
<td>0.68</td>
<td>.500</td>
</tr>
<tr>
<td>SLS restrictive x Amotivation</td>
<td>0.05</td>
<td>0.03</td>
<td>0.13</td>
<td>1.89</td>
<td>.060</td>
</tr>
<tr>
<td>SLS constructive x IIR Motivation</td>
<td>−0.06</td>
<td>0.04</td>
<td>−0.08</td>
<td>−1.60</td>
<td>.112</td>
</tr>
<tr>
<td>SLS constructive x Ext Motivation</td>
<td>−0.02</td>
<td>0.03</td>
<td>−0.03</td>
<td>−0.60</td>
<td>.550</td>
</tr>
<tr>
<td>SLS constructive x Amotivation</td>
<td>−0.03</td>
<td>0.04</td>
<td>−0.04</td>
<td>−0.65</td>
<td>.514</td>
</tr>
</tbody>
</table>

*Note: $R^2 = 0.50$; Outcome = Motivation as moderator. SLS restrictive = restrictive shared leadership style; SLS constructive = constructive shared leadership style; IIR = intrinsic/identified regulation; Ext = external.*

Figure 10. Post hoc analysis of low, moderate, and high levels of identified/intrinsic regulation motivation on the relationship between SLS restrictive and transactive knowledge systems.

Correlation effects of SLS restrictive and transactive memory were generally weak across all IIR motivation subgroups (Low, $r = .05$; Moderate, $r = .01$; High, $r = .28$). This outcome
suggests that intrinsic/identified regulation motivation moderates the relationship between restrictive shared leadership style and transactive memory in situations where an individual’s motivation is high. Other types of motivation did not moderate the relationship between constructive shared leadership style or restrictive shared leadership style and transactive memory.

**Summary of Results, Study 2**

The purpose of Study 2 was to examine relationships between transactive knowledge systems, shared leadership style, perspective-taking, motivation, and team effectiveness using a sample closely resembling the general working population in the United States. This study provided a test of the proposed IMOI model in a different population from the sample of college students used in Study 1. Overall, tests yielded similar results across Study 1 and Study 2. In this section, I present a summary of results for Study 2 (see Figure 11). In Chapter 7, I provide a detailed discussion of all findings, including strengths and weaknesses, possible explanations or insights about results, and contributions to current literature.

The hypothesis that shared leadership style predicts transactive knowledge systems was supported for constructive shared leadership style, but not restrictive shared leadership style. As predicted, individuals indicating higher levels of constructive shared leadership style also had significantly higher than expected transactive knowledge systems. However, individuals with higher levels of restrictive shared leadership style did not have significantly lower transactive knowledge systems. This result was also found in Study 1.

Support for shared leadership style as a predictor of team effectiveness was good, with support emerging for most measures of effectiveness. Increased constructive shared leadership style was found to be a significant predictor of increased effort related productive output and knowledge and skill related productive output, but not strategy related productive output. Increased restrictive
shared leadership style significantly predicted decreased strategy related productive output and knowledge and skill related productive output, but not effort related productive output. Overall, results for constructive shared leadership style were consistently in a positive direction while results for restrictive shared leadership style were consistently in a negative direction. The same directional relationship between shared leadership style and effectiveness measures was found in Study 1. However, relationships to some specific effectiveness measures were different in Study 1. For example, constructive shared leadership style did not predict increased knowledge and skill productive output. Also, restrictive shared leadership style did not predict decreased strategy related productive output (see Figure 5 for a review).

![Figure 11. Statistically significant paths, Study 2.](image-url)

*Note:* Only statistically significant paths are shown. The SLS constructive to transactive memory to productive output path is consistent with mediation. Unless otherwise indicated, relationship between constructs has a positive effect. The significant interaction effect of IIR Moderation on SLS restrictive and transactive memory is not shown because there was no significant main effect of SLS restrictive on transactive memory.

As expected, results fully supported the hypothesis that transactive memory and transactive knowledge systems predict effectiveness for the three self-report measures: effort related productive output, strategy related productive output, and knowledge and skill related
productive output. Individuals indicating high levels of transactive knowledge systems had significantly higher than expected levels of all three measures of team effectiveness. This result was also found in Study 1.

Support emerged for the hypothesis that transactive memory and transactive knowledge systems mediate the relationship between shared leadership style and effectiveness for constructive shared leadership style, but not for restrictive shared leadership style. Specifically, transactive knowledge systems were found to fully mediate the relationship between constructive shared leadership style and team effectiveness for measures of effort related and for knowledge and skill related productive output. These findings suggest that constructive shared leadership style acts on these measures of team effectiveness through transactive knowledge systems. Empirical evidence of relationships suggesting a mediating effect of transactive knowledge systems also emerged in Study 1. However, due to the combined multilevel and longitudinal design, mediation was not directly tested. A significant test of mediation in Study 2 provides further support for mediation in Study 1. This research is the first attempt at establishing a mediating effect of transactive memory and transactive knowledge systems for the relationship between shared leadership style and team effectiveness. Thus, the model requires further investigation and replication.

Support did not emerge for the hypotheses testing moderators of the relationship between shared leadership style (restrictive and constructive) and transactive knowledge systems. Support was not found for perspective-taking as a moderator in the relationship between shared leadership style and transactive knowledge systems. Very little support was found for motivation as a moderator in the relationship between shared leadership style and transactive knowledge systems. Of the six possible interactions (2 shared leadership style variables x 3 motivation
variables) only intrinsic/identified regulation motivation (IIR motivation) showed a significant moderating effect. Further analysis indicated a positive relationship between restrictive shared leadership style and transactive memory for participants high in IIR motivation, but not for participants with moderate or low IIR motivation. This result is further complicated because restrictive shared leadership style did not show a significant main effect on transactive knowledge systems. Similarly, no significant moderation effects were found for perspective-taking or motivation in Study 1.
Chapter 7: General Discussion

Business leaders and group researchers have identified a shift in organizational structure from being centered on individuals to being centered around teams. This change is in response to increasing environmental demand for work speed and complexity. Shared leadership and transactive knowledge systems are important emergent properties of teams in organizations. The aim of this research was to better understand situational influences on the development of transactive memory and transactive knowledge systems. Specifically, my goal was to better understand the relationships between shared leadership style, transactive knowledge systems, and team effectiveness. Another goal was to examine how individual team member characteristics of perspective-taking and motivation influence the relationship between shared leadership style and transactive knowledge systems. I created an IMOI model as a structural representation of the relationships of these constructs, as proposed in my hypotheses. A final goal was to find empirical support for theoretical models of temporal patterns in the development of transactive knowledge systems and to test for the influence of shared leadership style in those patterns.

Summary of Findings: IMOI Model

Shared leadership style predicts transactive knowledge systems. This research is the first to directly examine situational effects of leadership style on the development of transactive memory and transactive knowledge systems. Thus, the results contribute new information to the body of knowledge for both topics. Based on the results of this study and in agreement with my hypotheses, constructive shared leadership behaviors predict stronger transactive knowledge systems for team members and teams. Examples of constructive leadership behaviors include: creating a clear vision of who and what the team is and where it is going; dedication to higher purposes or ideals; members who are not afraid to move against the organizational system; an
enthusiastic approach to new work; team members who foster independence in each other and view unsuccessful performance as a chance to learn. One conclusion that can be drawn from these results is that constructive leadership behaviors create an environment that encourages information exchange among team members, which is essential to the development of transactive knowledge systems. Also, teams that foster a constructive shared leadership style will benefit from stronger transactive knowledge systems resulting in better understanding of where knowledge is contained in the group, more efficient assignment of, and access to, expertise among group members, and more effective balance of shared knowledge and unshared expertise. These results clarify and extend previous observations of researchers indicating that leadership may influence transactive memory and transactive knowledge systems development (Kusari, 2004; Robertson & Brauner, 2009; Zhang et al., 2007).

Contrary to my hypotheses, high levels of restrictive shared leadership style in individuals and teams did not predict weaker transactive knowledge systems. These findings seem to indicate that restrictive shared leadership behaviors do not influence the development of transactive knowledge systems negatively or positively. Although this is the first study testing this relationship, I was surprised by the results because they contradict prior research showing a generally negative or restricting effect (Pearce & Sims, 2002). It should be noted that, although results did not reach significance, statistics trended in the negative direction for Study 1 (between teams) and Study 2. Restrictive shared leadership style is a composite of directive and aversive leadership styles. An alternate explanation is that the creation of a composite variable dampened the effect of one leadership style or that specific behaviors that may have shown a restricting effect were lost.
Shared leadership style and transactive knowledge systems predict team effectiveness for objective measures (Study 1). No support was found for shared leadership style or transactive knowledge systems as predictors of GPA or course grade for individuals or teams. For GPA, this result is most likely because many factors are incorporated into the measure GPA. Shared leadership style and transactive knowledge systems develop when students work in teams. Team based learning is not established in every classroom and students’ GPA would be influenced by courses that do not incorporate team work. The results for course grade were more unexpected because part of students’ course grade was based on team assignments. Also, I expected team work, and the transactive processes inherent therein, to result in increased mastery of course material. On the other hand, team based learning classes generally include more individual assignments than group assignments, and midterm and final exams are not usually team based. Therefore, this result is likely due to the ratio of students’ grade attributed to individual work versus team work in team based learning classrooms, and should be evaluated cautiously. It would be interesting to test this hypothesis in classrooms where all or most assignments are team based.

Shared leadership style predicts team effectiveness for self-report measures. As hypothesized, results indicate that constructive shared leadership style is generally a strong positive predictor of effectiveness for individuals when compared to other team members and for teams when compared to other teams. In this study, results indicate that individuals and teams displaying constructive shared leadership behaviors are better able to generate satisfactory products, services, and decisions (Wageman et al., 2005). Results were especially strong for effectiveness measures of social processes (satisfaction with team relationships) and individual learning and well-being. Satisfaction with team relationships is one indicator that a team’s ability
to work together interdependently in the future is enhanced (Hackman & Wageman, 2005; Wageman et al., 2005). Individual learning and well-being indicates that the group experience contributes positively to the learning and well-being of individual team members rather than frustrating, alienating, or deskillling them (Wageman et al., 2005). Results of this research indicate that individuals in teams displaying constructive shared leadership behaviors had positive affective experiences around internal work motivation and growth opportunities, and were generally more satisfied than individuals in other teams. Constructive shared leadership behaviors also indicated increased collective effort by team members on tasks and greater ability of the team to use the full complement of member knowledge and skill. The results indicate that teams displaying constructive shared leadership behaviors are better able to produce output that will meet or exceed expectations. Together, these results complement and extend existing theoretical and empirical research linking constructive shared leadership behaviors to increased team effectiveness (Pearce & Sims, 2002; Wang et al., 2014).

Support also emerged for my hypothesis that restrictive shared leadership style is generally a negative predictor of effectiveness measures for individuals when compared to other team members and for teams when compared to other teams. Examples of restrictive shared leadership behaviors include: intimidating and reprimanding team members, pointing out and tracking mistakes, giving instructions and commands about how to carry out work, and collaborative establishment of individual team member goals (Pearce & Sims, 2002). Results of this research indicate that teams displaying restrictive shared leadership behaviors will be less able to generate satisfactory products, services, and decisions (Wageman et al., 2005). As with constructive shared leadership style, results were especially strong for effectiveness measures of social processes (satisfaction with team relationships) and individual learning and well-being.
Contrary to constructive shared leadership behaviors, results for teams displaying restrictive shared leadership behaviors were in a negative direction, indicating the teams’ inability to work together interdependently in the future. In addition, the experience of individuals in these teams contributed to frustrating, alienating, or deskilling group members rather than contributing positively to their learning and well-being (Wageman et al., 2005). These results indicate that individuals in teams displaying restrictive shared leadership behaviors had difficulty creating and carrying out strategies for team tasks. Specifically, they were less successful with devising innovative ways of proceeding with work, less able to carry out plans they made for proceeding with a task, and more apt to fall into mindless routines. Lastly, these teams were less likely to use the full complement of member knowledge and skill. For example, they were less likely to share their special knowledge and expertise with each other and less likely to learn and apply lessons from their work experiences. Together, results indicate that teams displaying restrictive shared leadership behaviors are less likely to produce output that will meet or exceed expectations. These results complement and extend existing research linking restrictive shared leadership behaviors to decreased team effectiveness (Pearce & Sims, 2002; Wang et al., 2014).

**Transactive knowledge systems predict team effectiveness for self-report measures.**

The results of this research concur with past research supporting transactive memory and transactive knowledge systems as very strong predictors of increased team effectiveness. Transactive knowledge systems significantly predicted all but one team effectiveness measure in a positive direction for individuals when compared to other members of their team and for teams when compared to other teams. Results of this research indicate that individuals and teams with strong transactive knowledge systems will expend more effort on tasks, are more likely to use the
full complement of member knowledge and skill, experience increased satisfaction with team relationships, have stronger internal work motivation, higher satisfaction with growth opportunities, and are generally more satisfied with their work experience. Additionally, in Study 2 but not Study 1, transactive knowledge systems were a significant and positive predictor of a teams’ ability to create and carry out strategies for team task performance. The difference in findings between studies in this case is most likely due to differences in the student and adult working populations. Students, being younger and having less experience working in teams, may have more difficulty with strategy related tasks in general. Together, these findings corroborate and extend extensive past research establishing transactive knowledge systems as an important emergent property in groups predicting team effectiveness (Austin, 2003; Brauner, 2002; Liang et al., 1995; Moreland & Myaskovsky, 2000; Robertson & Brauner, 2009; Zhang et al., 2007).

Transactive knowledge systems mediate the relationship between constructive shared leadership style and team effectiveness. This research is the first attempt to establish a mediating effect of transactive memory and transactive knowledge systems. Relationships tested in Study 1 provide empirical support for the hypothesis that transactive knowledge systems mediate the relationship between constructive shared leadership style and team effectiveness. Specifically, increased constructive shared leadership style was shown to predict increased transactive knowledge systems for individuals and teams. Constructive shared leadership style was also shown to be a strong positive predictor of team effectiveness for individuals and teams. Lastly, transactive knowledge systems emerged as a strong predictor of team effectiveness for individuals and teams. Together, these findings suggest that transactive knowledge systems mediate the relationship between constructive shared leadership style and team effectiveness for many measures examined in this study. Relationships supporting mediation emerged in Study 1
for effectiveness measures of effort related productive output, social processes, and individual learning and well-being for individuals compared to other team members and for social processes and individual learning and well-being for groups when compared to other groups. Unfortunately, the combined multilevel and longitudinal research design precluded statistical testing of this hypothesis in Study 1 (Preacher, 2015). Therefore, no final conclusions about this relationship can be drawn from Study 1.

Relationships tested in Study 2 also established empirical support for transactive knowledge systems mediating the relationship between constructive shared leadership style and team effectiveness. Testing of the mediation hypothesis was possible in Study 2 and analysis revealed that transactive knowledge systems fully mediate the relationship between constructive shared leadership style and team effectiveness measures for effort related productive output and knowledge and skill related productive output. These results indicate that transactive knowledge systems are one process through which constructive shared leadership behaviors act on measures of team effectiveness. One may think of transactive knowledge systems as amplifying the effect of constructive leadership behaviors, resulting in heightened influence on team effectiveness. This study is the first to show a mediating effect of transactive knowledge systems and thus sheds considerable light on processes underlying the examined relationships. Conversely, these results should be considered with caution until replicated.

One interpretation of this result is that constructive shared leadership behaviors create an environment that encourages transactivity, or, communication and information exchange among team members. Teams that experience increased transactivity are better able to create strong transactive knowledge systems. Specifically, they benefit from increased and more accurate metaknowledge (knowledge about own and others’ knowledge) and an effective balance of
integration (shared knowledge) and differentiation (unshared expertise). Transactive knowledge systems position individuals and teams to benefit from cognitive interdependence (reliance on team members for specialized knowledge), thereby enabling effective and efficient completion of tasks and goals. In this way, transactive knowledge systems are one important means by which constructive shared leadership behaviors result in increased team effectiveness, thereby offering an explanation for why some teams are more effective than others.

**Perspective-taking and motivation as moderators.** No evidence emerged to support my hypotheses that individual team member characteristics moderate the relationship between shared leadership style and transactive knowledge systems. Perspective-taking had been shown to increase transactive memory accuracy and agreement (Gockel & Brauner, 2013). Unfortunately, results of this study did not corroborate or clarify earlier results. This was possibly due to the method of measurement for perspective-taking. Gockel and Brauner (2013) used a behavioral measure whereas this study used a trait measure of perspective-taking. An alternative explanation could involve the aggregation of scores on the five dimensions of transactive knowledge systems in this study. It’s possible that perspective-taking may influence some but not all of the dimensions, and any effect was lost in the aggregation of scores. For these reasons, further research is needed on what influence perspective-taking may have on transactive knowledge systems.

Motivation was identified as an important area for further exploration in a review of transactive memory research (Ren & Argote, 2011). Additionally, motivation seemed a promising variable to study because it is related to willingness to partake in discussion, which would potentially increase transactivity and transactive knowledge systems development. However, very little support was found for motivation as a moderator in these studies. Of twelve
interactions tested, one significant relationship emerged. Intrinsic and identified regulation motivation (positive internal motivation types) had a positive moderating effect between restrictive shared leadership style and transactive knowledge systems. This finding is interesting because it indicates that internal types of motivation may have a buffering effect against restrictive leadership behaviors. Although these results are not strong, motivation continues to be a promising area for future research.

**Transactive Knowledge Systems over Time (Study 1)**

No support emerged for temporal development of transactive memory or transactive knowledge systems. Transactive knowledge systems did not increase over time for restrictive or constructive shared leadership style. This result is unexpected because of strong theoretical support that transactive memory and transactive knowledge systems develop over time and through communication, as team members learn about each other. Another important prerequisite for the development of transactive memory is group members’ perceived cognitive interdependence. This happens when each member perceives that outcomes are dependent on other members’ knowledge and expertise (Hollingshead, 2000). In the student teams used in this research, all team members had equal access to the information required to complete assignments. No explicit areas of expertise were assigned. However, it was expected that organic areas of expertise would emerge in these groups. It is possible that members quickly developed enough transactive memory to coordinate completion of group tasks, and development halted because this minimal transactive knowledge system was sufficient to accomplish student team goals.
Implications for Theory and Practice

This research provides further evidence for the validity of shared leadership and transactive memory as important variables for study by organizational psychologists. The finding that shared leadership style influences development of transactive knowledge systems is important for group researchers because it provides evidence of how environmental factors influence emergent cognitive structures in groups. This result should encourage research examining other environmental factors. The finding that transactive knowledge systems mediate the relationship between constructive shared leadership style and team effectiveness is important for the fields of team and leadership research because it sheds light on underlying processes in these relationships. Currently, there is no united theory about why some leadership styles are more effective than others. Identifying variables that mediate the relationship between leadership and outcomes would benefit leadership research. Together, these findings continue to move organizational psychology forward by providing yet another example of how organizational psychology has advanced from questions of what predicts team effectiveness to more complex questions of why some teams are more effective than others.

Strengths and Limitations

The support that emerged for IMOI relationships were similar for individuals when compared to other team members and for teams when compared to other teams. Findings were also similar across two populations, university students and the general working population in the United States. Replication of these findings across Study 1 and Study 2 provides strong support for the validity of these relationships. This research design also provides strong support for external validity of the findings and results can be generalized to both student groups and teams of working adults in the United States. Study 2 consisted of an on-line sample of
individuals registered as workers with Amazon Mechanical Turks resulting in slight concern about selection bias in this sample. Replication of the study using teams of working adults would improve external validity of these findings and further support generalizability to teams in organizations.

The vast majority of data collected in this study was collected through self-report survey questions and, therefore, common methods bias should be considered. Common methods may inflate correlations among variables resulting in some portion of the variance being attributed to the method used. Although common method variance is prevalent in organizational research, it is only important if it accounts for significant variance in scores (Meade, Watson, & Krustalis, 2007). In a meta-analysis of organizational research exclusively using self-report measures, Meade and colleagues (2007) conclude that common method bias is likely to be small to moderate in most cases. Additionally, many scales used in this study included negatively scored items and randomized order, which have been shown to reduce common method bias.

Composite scores were created for restrictive and constructive shared leadership styles for this study. Two leadership styles were combined for each composite variable. In addition, a number of behaviors are included within each leadership style. As reported, internal consistency was strong for both restrictive and constructive shared leadership styles in Study 1 and Study 2. However, creating composite scores may have hidden influences of specific leadership styles and behaviors.

Use of multilevel linear modeling was appropriate for the nested and longitudinal design of this research and provided many benefits over other methods of analysis. As discussed in Chapter 5, analysis of hierarchical data as if they are on the same level may result in errors of ecological fallacy or atomistic fallacy (Hox, 2002). In addition, multilevel linear modeling
included examination of variables at all levels of nesting and allowed for analysis of individual
growth curves and independent variables on growth curves. Using multilevel linear models
retained power and information that would have been lost if data had been aggregated to the
group level for analysis.

Future Research Directions

This research provides the first examination of the relationship between leadership style
and transactive knowledge systems. Therefore, this study should be replicated. Ideally, it would
be replicated using teams in organizations that work together on a regular basis. Replicating this
study would also provide further support for transactive knowledge systems as a mediator of the
relationship between shared leadership style and team effectiveness. Lastly, external validity of
these findings would be strengthened.

This research provided evidence that constructive shared leadership behaviors positively
influence transactive knowledge systems development. A next step would be to examine each
behavior separately to determine which are the most influential in the relationship. Furthermore,
examining restrictive shared leadership behaviors separately may identify behaviors that
significantly inhibit development of transactive knowledge systems. A closer look at which
behaviors are most influential, and in what direction, would be an interesting and important next
step in this research.

Temporal aspects of transactive memory and transactive knowledge systems are
important and require further examination. Replication of the longitudinal design in Study 1
using a different population would contribute important information to the current literature.
Ideally, one would conduct this study using new teams where diverse expertise is required to
complete team tasks. This type of team would be ideal because transactive memory would be
newly forming and because high levels of cognitive interdependence should result in increased transactivity between team members. Theoretical evidence for temporal development of transactive knowledge systems is strong. Providing empirical clarity for the theory would be a great push forward for transactive memory research.

Conclusion

Increasing use of, and reliance on, teams for competitive advantage in organizations has brought into focus the dynamic nature of teams and the existing larger context in which they exist. My aim in this dissertation was to contribute to the understanding of how and why teams are successful in organizations. Transactive knowledge systems provide one explanation of the competitive advantage of teams. The relatively recent construct of shared leadership is important to understand as teams become drivers of organizational work. My research attempted to contribute to knowledge about environmental influences on emergent cognitive structures of teams and resulting influences on team effectiveness. I examined theories of shared leadership and transactive knowledge systems and proposed an input-mediator-output-input model of predicted relationships. The results of my research provide insight to underlying processes that influence teams in organizations. This research also provides an empirical foundation for organizational leaders hoping to increase team effectiveness. Ultimately, I was able to contribute to the understanding of why some teams are more successful than other teams. Specifically, based on my findings, promoting constructive shared leadership behavior in teams will create an environment that promotes stronger transactive knowledge systems, resulting in teams that are better able to generate satisfactory products, services, and decisions.
Appendix A

Transactive Memory, Study 1:

Questionnaire for Transactive Knowledge Systems: (25)

Measurement: 6-point Scale: 1 (strongly disagree), 2 (moderately disagree), 3 (slightly disagree), 4 (slightly agree), 5 (moderately agree), 6 (strongly agree).

Integration:
1. All team members have the same level of basic knowledge relevant to our work.
2. It is important for the work that all team members have the same level of knowledge on relevant subject areas.
3. Team members have very similar knowledge relating to our work.
4. All team members bring the same amount of knowledge into the discussion of the group's tasks.
5. Team members understand a lot about what the other team members do.

Differentiation:
1. With regard to our work, all team members have their own special area of expertise.
2. Team members bring a wide spectrum of knowledge from different fields to our group.
3. Our team has been put together so that we can complement each other's specific knowledge.
4. We complement each other's specialized knowledge.
5. Expert knowledge from team members contributes to our work.

Cognitive Interdependence:
1. A successful result can only be achieved by combining our knowledge.
2. The knowledge of every member is needed in order to work on the task.
3. I would find it difficult to do my tasks without the suggestions of other group members.
4. Without the knowledge of the other group members, I wouldn't be able to work as effectively.
5. Other people’s knowledge helps me do my task.

Metaknowledge:
1. I usually know to whom to turn when problems occur.
2. When I think that a particular team member can answer my question, I am usually right.
3. I know very well who in the team can help me with a particular problem.
4. If I don't know something, I know whom to ask.
5. I know well which information should be passed on to whom.

Transactivity:
1. Team members exchange knowledge relevant to their work.
2. Knowledge is regularly exchanged between the team members.
3. We often talk with each other about newly gained knowledge (e.g., training, specialized readings).
4. We frequently talk to each other about how the work is going.
5. We learn from each other whilst working on the team.
Appendix B

**Transactive Memory, Study 2:**

**Questionnaire for Transactive Knowledge Systems:** (25)


*Measurement: 6-point Scale: 1 (strongly disagree), 2 (moderately disagree), 3 (slightly disagree), 4 (slightly agree), 5 (moderately agree), 6 (strongly agree).*

**Integration:**
1. All team members have the same amount of basic knowledge relevant to our work.
2. All team members bring the same amount of knowledge into the discussion of the group’s tasks.
3. Common expertise exists among out team members.*
4. We have a great deal of shared knowledge within our team.*
5. Over time, our team has developed a shared pool of knowledge through our work.*

**Differentiation:**
1. Team members have different expertise relating to our work.*
2. Team members bring a wide spectrum of knowledge from different fields to our group.
3. Our team has been put together so that we can complement each other’s specific knowledge.
4. Team members have different responsibilities based on their expertise.*
5. The fields of specialty on our team overlap only a little.*

**Cognitive Interdependence:**
1. I am able to work more effectively if other team members fulfill their responsibilities.*
2. My knowledge helps the other team members do their tasks.*
3. If I take care of my responsibilities, it facilitates other team members’ work.*
4. Other team members need my expertise in order to do their job well.*
5. To do my job successfully, I have to integrate other team members’ knowledge.*

**Metaknowledge:**
1. I usually know to whom to turn when problems occur.
2. Members on my team know who can help them with specific questions.*
3. I know very well who in the team can help me with a particular problem.
4. If I don’t know something, I know whom in the team to ask.
5. My team members know well which information needs to be shared with whom.*

**Transactivity:**
1. Team members share knowledge relevant to our work.*
2. Knowledge is regularly exchanged among team members.
3. We often talk with each other about newly gained knowledge (e.g., training, specialized readings).
4. We frequently talk to each other about how the work is going.
5. We learn from each other while working on the team.

Note: Asterisked items (*) were revised from Study 1 based on Bohnenkamp (2016).
Appendix C

Leadership Style, Study 1:

Shared Leadership Style: (45)

Measures: 5-point scale: 1 (definitely not true), 2 (not true), 3 (neither true nor untrue), 4 (true), 5 (definitely true).

Transformational Behavior:
1. My team members provide a clear vision of where our team is going.
2. My team members aren’t afraid to “break the mold” to find different ways of doing things.
3. My team members aren’t afraid to “buck the system” if they think it is necessary.
4. Because of my team members, I have a clear vision of our team’s purpose.*
5. My team members allow performance to fall below minimum standards before trying to make improvements.*
6. My team members delay taking action until problems become serious.*
7. My team members approach a new project or task in an enthusiastic way.
8. My team members provide a clear vision of who and what our team is.
9. My team members have a strong personal dedication to higher purposes or ideals.
10. My team members wait until things have gone wrong before taking action.*
11. My team members are non-traditional types that “shake up the system” when necessary.*
12. My team members strive towards higher purposes or ideals.
13. My team members stress the importance of our team to the larger organization.
14. My team members expect me to perform at my highest level.*
15. My team members are driven by higher purposes or ideals.*
16. My team members encourage me to go above and beyond what is normally expected of one (e.g., extra effort).*

Directive Behavior:
1. My team members work with me to develop my performance goals.
2. My team members establish the goals for my work.
3. My team members and I work together to decide what my performance goals should be.
4. When it comes to my work, my team members give me instructions on how to carry it out.
5. My team members give me instructions about how to do my work.
6. My team members set the goals for my performance.*
7. My team members and I sit down together and reach agreement on my performance goals.
8. My team members establish my performance goals.*
9. My team members provide commands in regard to my work.
Transactional Behavior:
1. If I perform well, my team members will recommend more compensation.
2. My team members will recommend that I am compensated more if I perform well.
3. My team members urge me to reward myself with something I like when I have successfully completed a major task.*
4. My team members will recommend that I am compensated well if I perform well.*
5. My team members encourage me to treat myself to something I enjoy when I do a task especially well.
6. My team members give me special recognition when my work performance is especially good.
7. My team members encourage me to give myself a pat on the back when I meet a new challenge.

Aversive Behavior:
1. My team members can be quite intimidating.
2. I feel intimidated by my team members’ behavior.
3. My team members focus attention on irregulars, mistakes, exceptions, and deviations from standard.
4. My team members reprimand me when my performance is not up to par.
5. When my work is not up to par, my team members point it out to me.
6. My team members track mistakes.
7. My team members let me know about it when I perform poorly.*

Empowering Behavior:
1. My team members encourage me to find solutions to my problems without their direct input.
2. My team members encourage me to search for solutions without supervision.
3. My team members urge me to assume responsibilities on my own.
4. My team members advise me to solve problems when they pop up without always getting a stamp of approval.*
5. My team members encourage me to view unsuccessful performance as a chance to learn.
6. My team members encourage me to learn by extending myself.

Note: Asterisked items (*) were removed from scale for Study 2 based on factor analysis provided in Pearce & Sims (2002) (see Appendix D).
Appendix D

Leadership Style, Study 2:

Shared Leadership Style: (31)

Measures: 5-point scale: 1 (definitely not true), 2 (not true), 3 (neither true nor untrue), 4 (true), 5 (definitely true).

Transformational Behavior:
1. My team members provide a clear vision of where our team is going.
2. My team members aren’t afraid to “break the mold” to find different ways of doing things.
3. My team members aren’t afraid to “buck the system” if they think it is necessary.
4. My team members approach a new project or task in an enthusiastic way.
5. My team members provide a clear vision of who and what our team is.
6. My team members have a strong personal dedication to higher purposes or ideals.
7. My team members strive towards higher purposes or ideals.
8. My team members stress the importance of our team to the larger organization.

Directive Behavior:
1. My team members work with me to develop my performance goals.
2. My team members establish the goals for my work.
3. My team members and I work together to decide what my performance goals should be.
4. When it comes to my work, my team members give me instructions on how to carry it out.
5. My team members give me instructions about how to do my work.
6. My team members and I discuss and reach agreement on my performance goals.
7. My team members provide commands in regard to my work.

Transactional Behavior:
1. If I perform well, my team members will recommend more compensation.
2. My team members will recommend that I am compensated more if I perform well.
3. My team members encourage me to treat myself to something I enjoy when I do a task especially well.
4. My team members give me special recognition when my work performance is especially good.
5. My team members encourage me to give myself a pat on the back when I meet a new challenge.

Aversive Behavior:
1. My team members can be quite intimidating.
2. I feel intimidated by my team members’ behavior.
3. My team members focus attention on irregulars, mistakes, exceptions, and deviations from standard.
4. My team members reprimand me when my performance is not up to par.
5. When my work is not up to par, my team members point it out to me.
6. My team members track mistakes.

Empowering Behavior:
1. My team members encourage me to find solutions to my problems without their direct input.
2. My team members encourage me to search for solutions without supervision.
3. My team members urge me to assume responsibilities on my own.
4. My team members encourage me to view unsuccessful performance as a chance to learn.
5. My team members encourage me to learn by extending myself.
Appendix E

**Perspective-Taking, Study 1 and 2:**

**Interpersonal Reactivity Index (IRI); Perspective-Taking Scale (4)**

*Measurement: 6-point Scale: 1 (strongly disagree), 2 (moderately disagree), 3 (slightly disagree), 4 (slightly agree), 5 (moderately agree), 6 (strongly agree).*

*Note: 4 of 7 questions were chosen using factor analysis reported in Davis (1980).*

1. Before criticizing somebody, I try to imagine how I would feel if I were in their place.
2. I believe that there are two sides to every question and try to look at them both.
3. I try to look at everybody’s side of a disagreement before I make a decision.
4. When I’m upset at someone, I usually try to “put myself in his shoes” for a while.
Motivation, Study 1 and 2:

The situational motivation scale (SIMS) (8)

Measurement: 7-point Scale: 1 (corresponds not at all), 2 (corresponds a very little), 3 (corresponds a little), 4 (corresponds moderately), 5 (corresponds enough), 6 (corresponds a lot), 7 (corresponds exactly).

Note: 2 questions were chosen from each scale using factor analysis reported in Guy et al., (2000).

Please answer the following based on the question: “Why are you currently engaged in this activity?”

Intrinsic motivation:
1. Because I think that this activity is interesting.
2. Because I think that this activity is pleasant.

Identified regulation:
1. Because I think that this activity is good for me.
2. Because I believe that this activity is important for me.

External regulation:
1. Because I am supposed to do it.
2. Because it is something that I have to do.

Amotivation:
1. There may be good reasons to do this activity, but personally I don’t see any.
2. I do this activity but I am not sure if it is worth it.
Appendix G

Real Team, Study 2:

Real Team: From TDS ‘Enabling Conditions‘: (1 of 5 enabling conditions in the theory) (8)

Measurement: 5-point Scale: 1 (highly inaccurate) to 5 (highly accurate). Paper does not provide the entire scale.

Bounded
1. Team membership is quite clear – everybody knows exactly who is and isn’t on this team.
2. There is so much ambiguity about who is on this team that it would be nearly impossible to generate an accurate membership list. (-)
3. Anyone who knows this team could accurately name all its members.

Stable
1. Different people are constantly joining and leaving this team. (-)
2. This team is quite stable, with few changes in membership.
Team Effectiveness, Study 1:

Process Criteria of Team Effectiveness Scale from the Team Diagnostic Survey:

Measurement: 5-point Scale: 1 (highly inaccurate) to 5 (highly accurate). Paper does not provide the entire scale.

1. Productive Output:
   Effort-Related Process Criteria
   1. Members demonstrate their commitment to our team by putting in extra time and effort to help it succeed.
   2. Everyone on this team is motivated to have the team succeed.
   3. Some members of our team do not carry their fair share of the overall workload. (-)*
   Strategy-Related Process Criteria
   1. Our team often comes up with innovative ways of proceeding with the work that turn out to be just what is needed.*
   2. Our team often falls into mindless routines, without noticing any changes that may have occurred in our situation. (-)
   3. Our team has a great deal of difficulty actually carrying out the plans we make for how we will proceed with the task. (-)
   Knowledge-and Skill-Related Process Criteria
   1. How seriously a member’s ideas are taken by others on our team often depends more on who the person is than on how much he or she actually knows. (-)*
   2. Members of our team actively share their special knowledge and expertise with one another.
   3. Our team is quite skilled at capturing the lessons that can be learned from our work experiences.

2. Social Processes:
   Satisfaction with Team Relationships
   1. My relations with other team members are strained. (-)
   2. I very much enjoy talking and working with my teammates.
   3. The chance to get to know my teammates is one of the best parts of working on this team.

3. Individual learning and well-being
   Internal Work Motivation
   1. I feel a real sense of personal satisfaction when our team does well.
   2. I feel bad and unhappy when our team has performed poorly.
   3. My own feelings are not affected one way or the other by how well our team performs. (-)
   4. When our team has done well, I have done well.
   Satisfaction with Growth Opportunities
   1. I learn a great deal from my work on this team.
   2. My own creativity and initiative are suppressed by this team. (-)*
3. Working on this team stretches my personal knowledge and skills.

**General Satisfaction**
1. I enjoy the kind of work we do in this team.
2. Working on this team is an exercise in frustration. (-)
3. Generally speaking, I am very satisfied with this team.

Note: Asterisked items (*) were dropped from final analysis due to low Cronbach’s alpha.
Appendix I

Team Effectiveness, Study 2:

Process Criteria of Team Effectiveness Scale from the Team Diagnostic Survey:

Measurement: 5-point Scale: 1 (highly inaccurate) to 5 (highly accurate). Paper does not provide the entire scale.

1. Productive Output:
   Effort-Related Process Criteria
   1. Members demonstrate their commitment to our team by putting in extra time and effort to help it succeed.
   2. Everyone on this team is motivated to have the team succeed.
   3. Some members of our team do not carry their fair share of the overall workload. (-)
   Strategy-Related Process Criteria
   1. Our team often comes up with innovative ways of proceeding with the work that turn out to be just what is needed.
   2. Our team often falls into mindless routines, without noticing any changes that may have occurred in our situation. (-)
   3. Our team has a great deal of difficulty actually carrying out the plans we make for how we will proceed with the task. (-)
   Knowledge-and Skill-Related Process Criteria
   1. How seriously a member’s ideas are taken by others on our team often depends more on who the person is than on how much he or she actually knows. (-)*
   2. Members of our team actively share their special knowledge and expertise with one another.
   3. Our team is quite skilled at capturing the lessons that can be learned from our work experiences.

Note: Asterisked items (*) were dropped from final analysis due to low Cronbach’s alpha.
Appendix J

**Work Unit Questions, Study 1:**

Please answer the following questions with regard to your work team:
- How many people are on your team? (including yourself)
- How many male students are on this team?
- How many female students are on this team?
- Are you the informal leader of this team? (yes/no)
Appendix K

Work Unit Questions, Study 2:

Does your job involve teamwork?
   No, my job does not involve any teamwork.
   Yes, I work on one team.
   Yes, I work on multiple teams.

To what extent does your job require teamwork?
   10%  20%  30%  40%  50%  60%  70%  80%  90%  100%

Do you work on a team with at least 3 other people? (yes/no)

How many teams are you working on?

Please think about only yourself when answering these questions:
   What is your occupation or job title?
   What are your job duties and responsibilities?

Please tell us the name of the team you work on. If you work on more than one team, think of the team that consists mostly of your peers. Please keep this one team in mind throughout this study. Do not provide any identifying information in the team name. (50% of participants)

Please tell us the name of the team you work on. If you work on more than one team, think of the team that consists of members representing the greatest number of organizational hierarchical levels. Please keep this one team in mind throughout this study. Do not provide any identifying information in the team name. (50% of participants)

What are the goals and responsibilities of this team?
   Goals
   Responsibilities

The work I do in this team is important to my overall job performance. (measured using a six-point Likert scale from strongly disagree to strongly agree)

Consider that the ladder represents the place that people occupy in your organization. At the top of this ladder are the people who are in top management positions. At the bottom of the ladder are the people who are working on the lowest hierarchical levels of the organization. The higher you consider yourself in this ladder, the closer you will be to the people who are at the top of the organization, and the lower, the closer you will be to people who work at the bottom. Where would you place yourself on this ladder? (1–10)
When you consider the team that you are thinking of for the purpose of this study, which levels of hierarchy are included in this team? Check all levels included. (1–10)

How many people are on your work team? (in numbers)

What is the expected life span of your team?
- Less than one month
- Less than six months
- Less than one year
- Less than three years
- Less than five years
- More than five years
Transactive memory, leadership, effectiveness

The life span of my work team is uncertain

How much of your work with this team involves communication with the team members?
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

How much of your work with this team involves being dependent on the team members?
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

How much of your work with this team involves coordination with the team members?
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Appendix L

Demographic Questions, Study 1:

What is your age?

Gender
   Female
   Male

Please select which ethnicity you identify with primarily.
   Black or African American (Non-Hispanic/Latino)
   White (Non-Hispanic/Latino)
   Two or more races
   Asian (Non-Hispanic/Latino)
   American Indian or Alaskan Native
   Hispanic or Latino
   Italian American
   Native Hawaiian (Non-Hispanic/Latino)
   None of the above, please specify ____________________

Highest level of college completed
   Freshman
   Sophomore
   Junior
   Senior
   Some graduate school
   M.A. or M.S.
   PhD

Most recent semester completed
   First Semester
   Second Semester

Do you have any further comments? Please let us know:
Appendix M

**Demographic Questions, Study 2:**

What is your current employment status?
- I am not currently employed.
- Employed part time (20 or less hours per week)
- Employed full time (up to 40 hours per week)

Do you live in the United States?
- Yes
- No
  If you don’t live in the United States, please specify where you live:

In which region of the United States do you live?
- New England (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut)
- Middle Atlantic (New York, New Jersey, Pennsylvania)
- East North Central (Ohio, Indiana, Illinois, Michigan, Wisconsin)
- West North Central (Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas)
- South Atlantic (Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida)
  - East South Central (Kentucky, Tennessee, Alabama, Mississippi)
  - West South Central (Arkansas, Louisiana, Oklahoma, Texas)
- Mountain (Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada)
- Pacific (Washington, Oregon, California, Alaska, Hawaii)
  Other (please specify)

What is your age? (in numbers)

What is your Gender? (please select one):
- Female
- Male

What is your ethnicity?
- Black or African American (Non-Hispanic/Latino)
- White (Non-Hispanic/Latino)
- Two or more races (Non-Hispanic/Latino)
- Asian (Non-Hispanic/Latino)
- American Indian or Alaskan Native
- Hispanic or Latino
  - Italian-American
  - Native Hawaiian (Non-Hispanic/Latino)
  If none of the above, please specify
  What is the highest level of education you have completed?
- High School
Some college (not yet complete)
College degree (e.g., BA or BS)
Some Graduate School (not yet complete)
Graduate School Degree (e.g., MA, MS, MPH, PhD)

Time in current work organization (in numbers):
  Years
  Months

Time in current job (in numbers):
  Years
  Months

Time as member of this team (in numbers):
  Years
  Months

How many men are on this team? (in numbers)

How many women are on this team? (in numbers)

Are you the formal leader of this team? (yes/no/other, please explain)

Do you have any further comments? Please let us know:

Please enter your worker ID:
Attention Check Questions, Study 2:

Self-Report Attention Measure:

Instructions:
! Your answers to these questions will not affect the reimbursement via Amazon Mechanical Turk ! The following statements are important in order to improve our surveys and data quality. Please help us by answering as honestly as possible.

Questions: Measured on a 6-point Likert scale (high score means low attention)
1. I could have paid closer attention to the items than I did.
2. I probably should have been more careful during this Survey.
3. I put forth my best effort in responding to this Survey. (-)
4. I rushed through this Survey.
5. In your honest opinion, should we use your data in our analysis in this study? (Yes/No answer)

Hidden Attention Measure:

Questions:
1. If you are reading the statements carefully, select strongly disagree for this item.
2. Select slightly agree as an answer please.
3. Please select moderately disagree as an answer.
Appendix O

Study 1, scales used in Survey’s 1, 2, and 3:

<table>
<thead>
<tr>
<th>Scale Name</th>
<th>Survey 1</th>
<th>Survey 2</th>
<th>Survey 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Situational Motivation Scale (SIMS)</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Interpersonal Reactivity Index (IRI)</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Questionnaire for Transactive Knowledge Systems (Q-TRACKS)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Shared Leadership Scale (SLS)</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Team Diagnostic Survey (TDS)</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
References


Moreland, R. L., Argote, L., & Krishnan, R. (1996). Socially shared cognition at work: 


