TEAM PROCESS PATTERNS:
A MULTI-TASK EXAMINATION OF TEAM MEMBER INTERACTIONS AS THEY RELATE TO EFFECTIVENESS OUTCOMES

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Psychology

2012

ABSTRACT

TEAM PROCESS PATTERNS:
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This research explored optimal patterns of team process fulfillment (i.e., those indicative of favorable effectiveness outcomes). Behavioral data were collected from 381 assessment center teams containing a total of 2,092 job applicants. During this study, participants engaged in two mechanical production tasks as part of the employee selection procedure at an American automobile manufacturing company. Trained assessors closely monitored teams during each task and noted the interactions fulfilled by members. These interactions were later sorted into eight team process categories for testing. Based on theoretical and empirical research from the domains of team roles and team processes, hypotheses were formed concerning how each team process should optimally be fulfilled with regard to the total amount of interactions carried out by members as well as the sharing or distribution of that process fulfillment among members. Bivariate correlations served as tests of relationships between the total/sharing of each team process and each outcome; comprehensive multivariate pattern-based analyses tested the relative importances of all team processes simultaneously. Among the results was the finding that the optimal pattern of team process fulfillment depends on the stage of team development (i.e., an initial task versus a subsequent task) and the outcome included in the model (i.e., performance quantity versus performance quality).

This work is dedicated to my husband, Josh,
who has supported and tolerated me throughout this process;
and to my wonderful parents, Cathryn and Andrew,
who have always pushed me to excel in the best and gentlest of ways –
for which I am eternally grateful.

ACKNOWLEDGEMENTS

Completing this thesis project would not have been possible without the guidance and aid of my mentors, peers, and loved ones.

I owe my deepest gratitude to my advisor, Dr. Richard P. DeShon, who has provided me with training, encouragement, advice, support, and patience over the past three years. I have taken every opportunity to learn from him and am tremendously grateful for the time and energy he has devoted to my education thus far.

I am also indebted to my thesis committee members, Dr. Steve W. J. Kozlowski and Dr. Ann Marie Ryan, who set aside their valuable and limited time to participate in the development and assessment of this project. I consider myself extremely lucky and humbled to have received input and acceptance from these individuals.

Many thanks are also due to my fellow graduate students, whose reassuring and kind words I have appreciated immensely. In particular, Tara Rench and Charlotte Powers – who helped in preparing the data for this thesis – have become peer models for me and continue to be especially positive influences on my development.

Lastly, I am appreciative of my extraordinary family members, who manage to simultaneously distract me, anchor me, and keep me sane.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Organizational scientists and practitioners have long been interested in understanding teamwork, particularly with regard to how teams deliver value to organizations above-and-beyond what individuals provide. Team effectiveness is thought to result not only from each member's personal characteristics and task-related contributions, but also from the successful coordination of members' interactions throughout a task (Kozlowski, Gully, Nason, & Smith, 1999; Kozlowski & Ilgen, 2006; Marks, Mathieu, & Zaccaro, 2001; Morgeson & Hofmann, 1999). These interactions are considered manifestations of underlying team processes that link inputs like the ability of each member to outcomes like the quality of results produced by the team (Cohen & Bailey, 1997; Hackman, 1987; Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Mathieu, Maynard, Rapp, & Gilson, 2008; McGrath, 1984).

Despite the acknowledged importance of understanding team processes (c.f., Faraj & Sproull, 2000; Kozlowski, Gully, Nason, & Smith, 1999; Smith, Smith, Olian, Sims, Obannon, & Scully, 1994), relatively little research has empirically assessed their behavioral manifestations in teams or how many different processes simultaneously affect team effectiveness outcomes (LePine, Piccolo, Jackson, Mathieu, & Saul, 2008). Thus, the primary purpose of the current work is to survey the research literatures associated with team processes and to examine a comprehensive picture of the relationships among team process patterns and effectiveness. In the sections that follow, I will first provide context for this endeavor by reviewing the popular framework used to conceptualize team effectiveness: The input-process-outcome model. This review will culminate in the development of a comprehensive model of team effectiveness that takes into account various critical aspects of earlier models. Next, I will introduce a novel method for operationalizing team processes, namely via the categorization of member interactions via team role clusters. In this vein, I will attempt to show the value of a team roles taxonomy for team effectiveness research (and the value of an alternative perspective *from* team effectiveness research *for* the team roles literature) – two domains that have until now been handled almost entirely separately. Then, I will introduce my hypotheses, outlining how each team process manifests and how it functions as part of a comprehensive pattern of member interactions affecting team effectiveness outcomes across multiple tasks. Finally, I will present my methodology and results, as well as a detailed discussion of my findings, limitations, and recommendations for future research.

The Evolution of the Input-Process-Outcome Team Effectiveness Model

Over the past five decades, countless scholars have sought to understand what factors contribute to team effectiveness. The most popular framework used to consider issues of team effectiveness originates from McGrath's (1964; 1984) input-process-outcome (IPO) model. In it, *inputs* are characteristics of the individual (e.g., personality, background), the team (e.g., size, power structure), and the environment (e.g., external stressors, reward conditions) that enhance or constrain team processes. *Processes* are interactions among team members that take place as they progress through their tasks (e.g., goal adjustment, problem solving, information sharing) and influence the favorability of team outcomes as well as preexisting inputs (via a feedback loop). *Outcomes* are the final results created by the team and may be output-related like the quantity and quality of a final product, ability-related like increases in relevant skills, or affect-related like member satisfaction, one's commitment to team mates, and the team's viability as a continuing entity.

Several authors have updated the IPO model or offered alternatives since its introduction. For one, Gladstein's (1984) IPO model included team- and environment-level inputs, but not individual ones. In addition, while McGrath suggested that the type of task at hand is a direct influencer of team processes, Gladstein cited task type (i.e., characteristics like complexity and interdependence) as a moderator for the link between processes and outcomes. A few years later, Hackman (1987) proposed another model that – he argued – is easier to test empirically and more applicable to real-world managers. Although Hackman's model held the same basic input-process-outcome structure as did McGrath's, it included only two input categories (as in Gladstein, 1984): Organizational context (environment) and team design. Rather than incorporating task characteristics as a process-outcome moderator, Hackman included it as a preliminary input. Hackman's model incorporated only one broad outcome, team effectiveness, which he ultimately broke down into the same features as in McGrath's model: The quantity and quality of team results, team commitment, team viability, and member satisfaction. This four-faceted conceptualization of team effectiveness has since been widely adopted in the literature. In addition to these changes, Hackman emphasized synergy as a moderator between inputs and processes, and material resources as a moderator between processes and outcomes. Although present in McGrath's (1964; 1984) original framework, neither Gladstein nor Hackman included feedback loops in their models.

Like their predecessors, Cohen and Bailey's (1997) IPO framework also recognized the importance of task (e.g., interdependence) and team characteristics (e.g., type of team) in determining team processes and outcomes. An additional key element of Cohen and Bailey's team effectiveness model was their recognition of the nested nature of inputs (individuals within teams within organizations). Cohen and Bailey also emphasized that certain inputs could directly as well as indirectly influence team effectiveness outcomes.

While Gladstein (1984), Hackman (1987), and Cohen and Bailey (1997) sought to offer alternatives to McGrath's original IPO framework, Ilgen, Hollenbeck, Johnson, and Jundt (2005) strived to update it using decades of empirical research support. These authors argued that the original IPO framework for studying teams should be modified for a few reasons. First, there are mediators that link inputs to outcomes that are not processes but rather emergent states. Emergent states "tap qualities of a team that represent member attitudes, values, cognitions, and motivations" (Marks, Mathieu, & Zaccaro, 2001, p. 357); they describe the state of the team (e.g., the team is highly cohesive) rather than interactions among members (i.e., a member steps in to help a team mate in need). Marks and colleagues (2001), who popularized this difference between processes and emergent states, emphasized that the latter could be inputs or outcomes in the IPO framework – but not processes. Alternatively, Ilgen and colleagues (2005) believed that emergent states and processes both belonged in the same "mediator" category linking inputs to outcomes. The other issue Ilgen et al. took with the original IPO model was its one-cycle, linear structure (also see Cohen & Bailey, 1997; Hackman, 1987; McGrath, 1991). However, it should be noted as already mentioned that McGrath's (1964) original framework (p. 114) did in fact include feedback loops – though they are not often included in its reproductions (e.g., in Hackman, 1987). Regardless of this issue, Ilgen and colleagues' argument for considering teams with regard to time is a wise one. On the whole, researchers have now adopted a view of teams as dynamic systems that develop and adjust over time as members interact and complete their tasks (e.g., Kozlowski & Bell, 2012; Kozlowski, Gully, Nason, & Smith, 1999; McGrath, Arrow, & Berdahl, 2000). The complex, time-based conceptualizations of teams that are now popular in the literature (e.g., DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004; Stachowski, Kaplan, & Waller, 2009; among others) call for an IPO model that takes such dynamics into account. To address this, Ilgen and colleagues added a feedback loop to their IPO model linking outcomes to inputs; and further allowed for inputs, processes, and outcomes to influence one another reciprocally throughout each IPO cycle.

Mathieu, Maynard, Rapp, and Gilson (2008) provided the most recent update to the IPO model. Building on McGrath's (1964) original model structure, Cohen and Bailey's (1997) nesting of individuals within teams within organizations, and Ilgen and colleagues' (2005) feedback loop as well as their consideration of the mediating category including both processes and emergent states, Mathieu and colleagues described an input-mediator-outcome framework of team effectiveness. They also discussed the effects of time in the model: Teams (1) develop continuously as they mature in the long-term (Kozlowski, Gully, Nason, & Smith, 1999) and (2) undergo shorter-term cyclical episodes in which certain team processes are more critical than others (Marks, Mathieu, and Zaccaro, 2001).

All in all, the original IPO model and its many adaptations make much intuitive sense. Different team members bring important contributions to the team (inputs), and after interacting with one another the members begin to develop characteristics that define them as a collective (emergent states) as well as methods of coordinating their interactions (processes) to accomplish task goals and progress forward (outcomes). These IPO cycles repeat – with previous outcomes influencing future inputs – for as long as team mates continue to work together. Further, reciprocal relationships exist among inputs, processes, and outcomes, as well as among different levels of variables such that each team is a complex system that evolves over time. Still, there are two issues which, if solved, could further enhance our understanding of team effectiveness.

First, exactly where emergent states fit in the framework remains unclear. McGrath (1964; 1984) considered them team-level inputs; Marks, Mathieu, and Zaccaro (2001) would argue that they are either inputs or outcomes; Ilgen and colleagues (2005) and Mathieu et al. (2008) would consider them explanatory mechanisms (mediators) underlying input-outcome relationships. The differences in opinion may result from the developmental nature of emergent states: They are not "pure" inputs because they exist only after teams have developed to some extent; yet they are not "pure" outcomes in models ultimately describing the path toward team effectiveness. Emergent states may indeed fit best as input-outcome mediators, but as mediators that reciprocally influence member interactions (processes) rather than having direct ties to inputs and outcomes. That is, emergent states may affect processes and vice versa, but processes alone (explicit and implicit interactions among members) may mediate the connection between inputs and outcomes. Morgeson and Hofmann's (1999) theory of the emergence of collective constructs (i.e., emergent states) provides support for this claim. These authors describe a cycle of effects in which team members' actions meet with one another to form interpersonal interaction "events," which when patterned produce an "event cycle." These patterned interactions allow for the creation of emergent states that subsequently influence team members' interactions. Figure 1 depicts a team effectiveness model consistent with this perspective. This figure includes aspects from each of the previous models discussed and is an attempt to show a complete depiction of the "current" state of the IPO model.

The second issue of note is the lack of comprehensive knowledge regarding team processes. In some cases, scholars describe processes or assume they exist as mediators between inputs and outcomes, but only test the linear or reciprocal effects among inputs, outcomes, and/or emergent states (c.f., Barrick, Stewart, Neubert, & Mount, 1998; Chang & Bordia, 2001). However, targeted investigations of how team members interact with one another and what those interactions mean for team effectiveness outcomes also seem critical to understanding team effectiveness. In many other cases, researchers do measure and test the effects of team processes, albeit in studies exploring only broad categories of team processes (e.g., transition versus interpersonal processes, Mathieu & Schulze, 2006) or – if narrower categories are used – then focus lies on only one or a few processes per study. Numerous examples of these studies will be discussed later during hypothesis development. For now, note that there exist many unique pockets of team process research that – if combined and assessed simultaneously – would produce a fuller picture of team process patterns leading toward favorable effectiveness outcomes.

In addition, because it has been traditional to study team processes with regard to the overall amount of one or a few types of interactions occurring among members, we know relatively little regarding whether – and how – team process fulfillment may be optimally shared among members. In other words, is it better for one or a few members of a team to take on certain responsibilities (e.g., leadership, idea generation, production) or is it better for more or all team members to share those responsibilities? The answer will likely change depending on what team process is being assessed and how team members are concurrently fulfilling other team processes. This perspective, which I consider as playing not a competing role but rather a supportive one to extant frameworks, considers team member interactions as manifestations of shared, dynamic team process patterns that evolve as teams develop.

As I will describe in detail later, a wealth of theory and empirical evidence suggests that teams may be most successful when certain processes are fulfilled and shared by most if not all members while other processes are fulfilled and shared by one or a few members. Given these foci, the basic question at the heart of the current research endeavor is: *From the time when team* *members begin to work together until the time they are finished, how do they fulfill and share team processes in ways that lead to favorable team effectiveness outcomes?*

Focusing on Team Processes

Although scholars have modified the specific details of the IPO framework over time, for example with regard to whether to nest inputs based on level, or where to include emergent states, its basic structure remains intact. As its name suggests, the framework's major components are inputs, processes, and outcomes. Understanding each of these steps in the model is important, and the linkages among them equally important. However, as previously mentioned, comprehensive empirical investigations of various team processes are rare and – as a result – each team process' relative influence on team effectiveness outcomes is largely unknown. Consequently, I sought to delve into the many areas of team process research to learn more about how each manifests and functions in teams as they develop. Before introducing each of these areas and my associated hypotheses, I will first more explicitly define team processes and discuss methods for categorizing their manifestations.

Team processes are most often defined as *interactions among team members* – including those directed toward task completion as well as those that function to strengthen social ties among members. These interactions constantly occur within a team – from the moment members first begin working together to the moment when they disband. Note that team processes – or member *interactions* – are distinct from *behaviors* in that the former necessitates the context of multiple people while the latter does not. Thus, I will use the label of "interaction" rather than "behavior" throughout this paper. Team processes should also not be confused with team traits or emergent states; they are the team members' coordinated activities themselves rather than characteristics that describe the team (Marks, Mathieu, & Zaccaro, 2001). Because of the myriad possible interactions that might occur within a team, careful categorization is required to properly operationalize these team process manifestations. Fortunately, a number of taxonomies exist that might suit this purpose (e.g., Bowers, Morgan, Salas, & Prince, 1993; Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995; McIntyre & Dickinson, 1992; McIntyre & Salas, 1995; Stevens & Campion, 1994).

There are a number of reasons why using a taxonomy to organize clusters of similar interactions is advantageous versus examining the effects of each interaction separately. Chief among these reasons is the fact that categories comprised of multiple interrelated items allow for greater generalizability and reliability across contexts and over time (Epstein & O'Brien, 1984; Hanisch, Hulin, & Roznowski, 1998). Different people may engage in different interactions across contexts, and the same (or different) people may engage in different interactions over time. Nevertheless, if the nature and purpose of these interactions is similar, or if the items have what scholars refer to as "behavioral coherence" (c.f., Weiss & Adler, 1984; Magnusson & Endler, 1977), then it is preferable to treat them as manifestations of the same underlying construct (i.e., the same team process). In practical terms, this means that it is possible to cluster similar interactions to form higher-order variables for testing and interpretation.

To further illustrate the value of these taxonomies, it is useful to describe where they fall on a spectrum ranging from the narrowest representations of team processes to the broadest representations. At the narrowest end, there may be countless interactions, while the broadest end includes the most general constructs used to conceptualize team processes. For example, a single interaction representative of a team process might be "Team member compromises his own preferences with the preferences of another team member" or "Team members collectively establish a strategy for task completion," while general process categories might be termed "social roles" and "task roles" or "teamwork" and "taskwork." As will be described at length later, task roles or taskwork involve interactions focused on accomplishing work-related goals, while social roles or teamwork involve interactions that function to enhance the interpersonal relationships among team members. Note that each of these broad categories is comprised of multiple sub-dimensions, namely sets of narrower team processes. For example, teamwork includes sub-dimensions like monitoring others' progress, providing feedback and assistance, and communicating effectively (McIntyre & Salas, 1995). Most researchers choose to focus on the level of these narrower sub-dimensions (e.g., Aritzeta, Ayestaran, & Swailes, 2005; Blenkinsop & Maddison, 2007; Chong, 2007; LaFond, Jobidon, Aubé, & Tremblay, 2011; Salas, Sims, & Burke, 2005) – as I will in the current endeavor – although some scholars do incorporate the broader dimensions instead or in addition (e.g., LePine, Piccolo, Jackson, Mathieu, & Saul, 2008; Mumford, Van Iddekinge, Morgeson, & Campion, 2008; Stewart, Fulmer, & Barrick, 2005).

Having described the usefulness of taxonomies and where the focal manifestations of team processes lie on a spectrum of conceptual breadth, I now return to my original point – that there are a number of taxonomies available in the literature. However, while many of those classification schemes incorporate individuals' behaviors, only Marks, Mathieu, and Zaccaro's (2001) was developed specifically for the purpose of classifying team member interactions as process manifestations. In addition, only these authors incorporated time as an essential process component. Marks and colleagues' "temporal" (i.e., attending to the effects of time) taxonomy is unique in that it describes how members enact team processes during each stage of task completion. Their taxonomy is also exemplary because it contains a relatively high number of dimensions (10), resulting in a seemingly comprehensive method of classification. However, Marks and colleagues' taxonomy is not without flaws. Most problematic is the fact that, although the authors expressed knowledge of many applicable taxonomies already extant in the literature, they ultimately developed team process categories not based on an integration of those conceptually-sound and empirically-supported taxonomies but rather based on separate domains of empirical research as well as their own "applied experiences with teams" (Marks, Mathieu, & Zaccaro, 2001, p. 362). As a result, their taxonomy seems disconnected from earlier attempts and lacks cumulative knowledge. For example, as Rousseau, Aubé, and Savoie (2006) describe, Marks and colleagues' taxonomy does not include an innovation dimension – a dimension that *is* incorporated in most other taxonomies.

Because of these issues, it is worthwhile to look elsewhere in the literature for rigorously-developed taxonomies suitable for classifying and conceptualizing team processes. One domain that may be particularly useful in this regard is the literature focusing on team roles. Although traditionally thought of as dichotomous characteristics of individuals (i.e., Team member A fulfills a certain team role or he does not), team roles could also be defined at the team-level as *clusters of similar interactions occurring among team members over time*. They are distinguishable from team-related skills or competencies, which instead involve a person's *ability* to act in certain ways regardless of whether he does so in reality (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995). Team roles have a long history in research as well as practice; yet, the area has developed almost entirely separately from more mainstream team effectiveness research. Even so, Mumford, Campion, and Morgeson's (2006) recent integration of 120 team roles examined over the course of 60 years of team roles research provides a 10-

category taxonomy that may be appropriate for the current endeavor. Notably, Mumford and colleagues incorporated time as well as context when developing this classification system.

Although Mumford and colleagues' taxonomy seems strong in that it is based on decades of empirical research, as of right now it has only been applied in empirical research a handful of times (c.f., Caughlin, 2010; Mumford, Van Iddekinge, Morgeson, & Campion, 2008). Accordingly, one secondary contribution of the current research is to test this promising taxonomy from a team process perspective, integrating the two literatures along the way. In the following sections, I will review team roles taxonomies to demonstrate their usefulness for team effectiveness research via a valid categorization of team member interactions (i.e., manifestations of team processes). I will also demonstrate similarities between the team roles and team effectiveness research streams and discuss how each could be enhanced by the other, providing a valuable integration of literatures.

An Introduction to Team Roles

Team roles have been discussed in research and practice for over 60 years. During that time a number of frameworks have emerged in attempts to describe how individuals fulfill team roles. Benne and Sheats (1948) first addressed the topic by developing a taxonomy of team roles based on observations of small problem-solving teams in a training laboratory. These authors described 27 categories, distinguishing among task, maintenance, and individual team roles. Someone who fulfills a *task role* enhances team effectiveness by working toward task success (e.g., the "initiator-contributor" suggests new ideas or methods for completing the work). Someone who fulfills a *maintenance role* enhances team effectiveness by preserving interpersonal relationships among members (e.g., the "harmonizer" mediates disagreements within the team). Someone who fulfills an *individual role* inhibits team effectiveness by striving toward selfish goals at the expense of the team's goals (e.g., the "blocker" stubbornly opposes other members' ideas and conclusions).

Benne and Sheats theorized that different team roles should be fulfilled over time, depending on the stage of team development and task progress, and that each member should be knowledgeable about multiple team roles as well as when to fulfill them. Though they published this idea over 60 years ago, little research has directly investigated whether individuals engage in behaviors consistent with multiple team roles, or whether certain team roles are more critical than others at different stages of team development. However, there is much research available in other literatures to suggest that they do (as will be reviewed in later sections of this paper).

A few years after Benne and Sheats' initial work, Bales (1950) composed a similar taxonomy consisting of 12 team roles. Like Benne and Sheats, Bales distinguished among individual task roles (e.g., "gives suggestion"), social-emotional roles (e.g., "shows solidarity"), and dysfunctional roles (e.g., "shows antagonism"). Bales (1958) later broadened his taxonomy to represent 3 factors: A person's activity, task ability, and likeability. He applied this 3-factor framework to a laboratory sample of problem-solving and decision-making teams to examine the behavioral tendencies of leaders. For example, a person with high activity, low task ability, and low likeability would be labeled as having the team role of "overactive deviant." Bales described this person as showing "domination" rather than "leadership" (p. 447). Overall, Bales' (1950; 1958) work evidenced the usefulness of observing and classifying individuals' behaviors and is often cited in this regard.

Three decades later, McCann and Margerison (1989) introduced another team role taxonomy (see also Margerison & McCann, 1995). Based on their earlier research examining managers' work preferences, they invented a "team management wheel" composed of eight behavioral categories. Rather than separating helpful team roles from harmful ones as did Benne and Sheats (1948) and Bales (1950), McCann and Margerison suggested that each team role has strengths and weaknesses. They based their taxonomy on a theoretical relationship between individuals' team roles and their personalities and work preferences. As some examples, their team management wheel includes the "creator-innovator," who comes up with new ideas and tends to be independent and future-oriented; and the "thruster-organizer," who makes decisions, completes the work, and tends to be analytical and focused. While their predecessors assumed that each individual tends to belong to just one team role, McCann and Margerison argued that each individual could belong to a few roles simultaneously. Specifically, they theorized that each team member could fulfill one primary role and may fulfill, in addition, up to two secondary roles.

Belbin's (1981; 1993; 2010) team role taxonomy is very similar to McCann and Margerison's, in particular with regard to the existence of primary and secondary team roles, as well as the idea that each one has strengths and weaknesses. Belbin's taxonomy is comprised of nine categories, including the "specialist," who contributes unique knowledge or skill to the team, and the "implementer," who puts others' ideas into action. Belbin is often credited with the idea that teams with balanced roles, in which each member fulfills a *different* role (versus multiple members fulfilling overlapping roles), perform better than teams that lack such role balance (although McCann and Margerison (1989) discuss a similar idea).

Belbin's and McCann and Margerison's taxonomies were innovative in that they each included one team role that functioned outside of the team environment. Belbin's "resource investigator" and McCann and Margerison's "explorer-promoter" involve developing and utilizing external contacts on the team's behalf. Ancona and Caldwell (1988) expanded on this idea of external team roles. Using data from product team interviews and logs, these researchers identified seven team roles that operate outside of the team's immediate environment. As a few examples, a "scout" collects external information and brings it back to the team, and a "guard" protects internal information from external parties.

A number of other team role taxonomies have been developed, each with a unique set of categories used to cluster individuals' behaviors (e.g., Barry, 1991; Davis, Millburn, Murphy, & Woodhouse, 1992; Dubrin, 1995; Parker, 1990; Spencer & Pruss, 1992; Woodcock, 1989). And as mentioned earlier, Mumford, Campion, and Morgeson (2006) recently identified 120 team roles in the literature – most of which overlap substantially. Across studies, one common finding is clear: The fulfillment of team roles is critical for team success. However, as can be gathered from this brief review, team roles scholars have traditionally linked team roles to individuals by measuring and categorizing each *person's* team role rather than assessing how team roles may be fulfilled by multiple team members jointly. As a result, when considering patterns of team roles among members, scholars have focused on configurations of *individuals* (i.e., Member A embodies one particular team role, Member B embodies another, Member C embodies another, etc.; c.f. Blenkinsop & Maddison, 2007; Caughlin, 2010; Chong, 2007; Partington & Harris, 1999; Prichard & Stanton, 1999; Senior, 1997; van der Water, Ahaus, & Rozier, 2008) rather than on (team-level) configurations of *team role* fulfillment (i.e., the team embodies this, that, and another team role to a great extent and its members share some team roles more than others).

Integrating the Team Roles and Team Effectiveness Literatures

By labeling each team member as belonging to only one or a few team roles, scholars disregard all behaviors the member engages in that are inconsistent with those categories. Yet, in reality, a person tends to serve more than just one function in a team. For example, an engineering project manager may spend the *most* time organizing team tasks ("organizer" role; Barry, 1991), but may also spend *some* time working on product design ("contributor" role; Parker, 1990) or encouraging coworkers ("people-supporter" role; Dubrin, 1995). Like this engineering project manager, most people tend to fulfill behaviors consistent with *multiple* team roles. Accordingly, a team-level perspective that allows for multiple members to engage in each team role over time may be useful in understanding team effectiveness.

Though some scholars have *theorized* about team role sharing among members over time (e.g., Belbin, 2010), to my knowledge this phenomenon has been tested only peripherally and only when talking about the overall balance of team roles (i.e., the idea that all team roles should be represented via each member acting out a unique role; which is quite different than talking about how multiple team members might share team roles). One exception to this tradition is work by Stewart, Fulmer, and Barrick (2005). These authors used a survey assessment based on Mumford and colleagues' (2006) team roles taxonomy to assess student project team members' perceptions of one another's task- and social-oriented team role behaviors. Stewart and colleagues evidenced that these teams tended to perform better (i.e., receive higher grades) when a greater proportion of members engaged in task-oriented team roles; and stronger social cohesion was reported in these teams when a greater proportion of members engaged in social-oriented team roles. Although a step in the right direction, the self-report measures used in this study, the one time-point research design, and the focus on broad categories (e.g., "task" versus "contracting," "contributing," etc.) of team roles culminate in a need for further testing. In particular, a behavior-based investigation into whether and how each team role may be optimally shared among members, and at different stages of the team's development, seems warranted and serves as the focus of the current research.

Also note that only one study has yet addressed how members' team role fulfillment might change over time. Aritzeta, Ayestaran, and Swailes (2005) surveyed student project teams twice (the second survey occurring four months after the first), and found that individuals' team role preferences changed between surveys. They suggested that a reduction in role ambiguity might be the cause: Individuals may learn more about their (one) role preference as time progresses. This interpretation reflects the tradition in team roles research of treating team roles like stable traits, characteristics, or preferences. Of course, the change in preferences discovered by Aritzeta and colleagues may not have been due to each individual becoming more certain about his preferred team role, but instead to individuals tending to share the fulfillment of team roles over time (and to engage in multiple team roles themselves, and to have different preferences depending on the most salient team role at the time). If this is the case, and I will argue later that it is, then members' preferences for and fulfillment of different team roles early on versus later makes sense.

Fortunately, the lack of attention paid to the sharing of team role fulfillment across members can be addressed using knowledge from team effectiveness literatures regarding other constructs – namely, processes. Take for example a team member who usually carries out just one function but may engage in other functions if his or her teammates are busy or incapable. This *backup behavior* involves the shifting of work "among members to achieve balance during high periods of workload or pressure" (Salas, Sims, & Burke, 2005, p. 560). Research has evidenced that teams whose members receive this type of assistance when needed tend to perform better than those that do not (Porter, Gogus, & Yu, 2010). Using team roles terminology, backup behavior occurs when a team member has trouble completing his own work and needs others to step in, take over, or assist. Thus, the sharing of this team process might result in better team effectiveness outcomes – a relationship that will be discussed further later.

As another example, many contemporary scholars contend that leadership behaviors can be carried out by multiple people when no one authority figure is predetermined (Carson, Tesluk, & Marrone, 2007; Small & Rentsch, 2010). In these cases, each team member may phase in and out of the leadership function based on who can contribute the most value at each time point (Friedrich, Vessey, Schuelke, Ruark, & Mumford, 2009) and who has the strongest leader identity (DeRue & Ashford, 2010). This phasing in and out is important because it allows members to efficiently make use of each member's knowledge and skills throughout a task. I will return to the value of research regarding these examples later. For now, it is appropriate to note the likelihood that team roles function in the same way such that each team member can engage in any number of team roles during task work and, accordingly, that each team role is likely fulfilled by multiple members over time.

By considering team roles in this fashion, similarities with team processes like backup behavior and leadership become clear. Team processes are the interactions occurring among team members. Although they have historically been treated as individual characteristics, team roles are also conceptualized as phenomena that manifest via person-to-person interactions occurring in the team context. In view of that, it seems appropriate to think of them from a team-level perspective – as shared, dynamic patterns – and to integrate team roles into other areas of research as team process categories. Because of this similarity as well as the substantial presence of team roles in research and practice, team roles may provide a strong method for classifying member interactions (i.e., team processes). As its literature has evolved separately from team process-focused research, I will draw from a variety of domains when making predictions regarding how team members may optimally interact with regard to each team role (process) category. In doing so, I will integrate knowledge from these different areas and contribute value to each.

Development of Hypotheses

All hypotheses will focus on how team processes manifest via member interactions and how they relate to team effectiveness outcomes. This section will include a discussion of each team process in turn, as well as theoretical and empirical support providing evidence as to why certain levels and distributions of team processes may result in better or worse team effectiveness. I will begin by introducing simple hypotheses regarding bivariate relationships between each team process and effectiveness. I will then move toward describing a novel and comprehensive approach to studying all types of member interactions simultaneously – as team process patterns.

The labels and definitions described in this section are consistent with Mumford, Campion, and Morgeson's taxonomy (2006), which consists of 10 categories: Contractor, creator, contributor, completer, critic (task roles); cooperator, communicator, calibrator (social roles); consul, and coordinator (boundary-spanning roles)[1]. As mentioned earlier, these authors included numerous earlier taxonomies and used rigorous methods to produce their own, resulting in a uniquely cumulative method for the classification of team member interactions.

Before beginning this discussion, it seems vital to note that there are many ways team processes may manifest in a team, but not all manifestations are "created equal." For example, with regard to the total amount of interactions taking place among team members, there may be differences in how certain team processes predict team effectiveness outcomes depending on whether the team is engaging in an initial or subsequent task. In terms of the sharing of behaviors among team members, a flat distribution may be optimal for certain team processes, while a more differentiated distribution may be optimal for others. Thus, I will draw knowledge from a variety of literatures to suggest hypotheses testing how the total amount and sharing of team processes among members may predict team effectiveness outcomes. I will also describe if and how these relationships might change over time (i.e., across tasks).

Contracting. Because teams involve multiple people working simultaneously to achieve common goals, there is a need for contracting interactions that *structure, organize, and coordinate the task-related actions of team members*. Examples of contracting interactions include suggesting task deadlines for the team, motivating members to achieve team goals, and keeping members focused on taskwork. Research shows that engaging in a greater number of contracting interactions allows members to plan and coordinate their actions toward enhanced effectiveness (Janicik & Bartel, 2003; Rousseau & Aubé, 2010; Weingart, 1992). Mumford and colleagues (2006) argue that this team process is especially advantageous for new teams whose members have little experience working together. Providing task structure to teams early in their development helps members function as a successful collaborative unit (McIntyre & Salas, 1995; Vecchio, 1987) and sets the team on a trajectory for later success (Mathieu & Rapp, 2009).

In addition, the sharing or distribution of contracting interactions among team members should also be a valuable indicator of team effectiveness. Current trends in shared leadership research support this perspective. Leadership generally involves structuring, coordinating, and facilitating team members' actions during a task (Morgeson, DeRue, & Karam, 2009; Tschan, Semmer, Gautschi, Hunziker, Spychiger, & Marsch, 2006). Note that, although leadership traditionally encompasses both task- and social-oriented features, contracting interactions are concerned only with the former (social-oriented issues are encompassed by other process categories to be discussed later).

Team leadership is traditionally treated as a formal function fulfilled by one person (usually a manager) supervising a set of autonomous individuals and aimed at facilitating team effectiveness. However, in recent decades organizations have moved toward an alternative style of work – one structured around teams of interdependent individuals working to collectively achieve goals without the direct supervision of a predetermined leader. As a result, "shared," "distributed," and "collective" models of team leadership have become popular. In these models, rather than one individual within a team holding the position of "leader," enhanced performance is thought to result by allowing leadership to be carried out by multiple team members such that each one can phase in and out of the (shared) leadership function during a task (DeRue & Ashford, 2010; Carson, Tesluk, & Marrone, 2007; Gronn, 2002; Morgeson, DeRue, & Karam, 2010; Small & Rentsch, 2010). The reasons why team members phase in and out of leadership are still largely unknown, but scholars suggest that it may occur because a particular member is able to contribute unique expertise (Friedrich, Vessey, Schuelke, Ruark, & Mumford, 2009) or emotional support (Pescosolido, 2002) and because a member's identity as a leader has been reinforced in the past (DeRue & Ashford, 2010).

The benefits of sharing leadership among multiple interdependent team members are numerous. For example, Hiller, Day, and Vance (2006) argue that collective leadership is valuable because it results in an enhanced ability for "getting things done, regardless of the task" (p. 388). These authors surveyed transportation road maintenance team members about how often they engaged in leadership functions, and discovered that collective leadership within a team predicted supervisor-rated team performance. Further demonstrating the value of shared leadership in field teams, Pearce and Sims (2002) found that change management team members' perceptions of shared leadership predicted team effectiveness as rated by customers, managers, and fellow team members. In their study, shared leadership accounted for more variance in team effectiveness than did the traditional (vertical) leadership method.

These studies, like many empirical investigations of shared leadership, focused on team members' perceived *amount* of shared leadership within their teams. The theory underlying shared leadership, however, also necessitates a direct examination of the *distribution* of leadership across members (Gronn, 2000; Mayo, Meindl, & Pastor, 2003). A (flat) distribution (i.e., much leadership sharing) would involve actions being carried out by many or all team members; a (differentiated) distribution (i.e., little leadership sharing) would involve actions being carried out by one or a few members. Using a sample of students engaging in a semester-long top management team simulation exercise, Small and Rentsch (2010) discovered that teams tend to have flatter leadership distributions as they developed over time. Their direct measure of leadership sharing among team members (operationalized as network decentralization) was positively associated with an objective indicator of team effectiveness.

Other social network studies provide additional support for this relationship. For example, Mehra, Smith, Dixon, and Robertson (2006) tested whether different leadership distributions have unique effects on team performance. Using a sample of field-based sales teams, they found that distributed-coordinated leadership structures (in which a formal leader and an emergent leader were able to coordinate effectively) resulted in higher sales than did distributed-fragmented structures (in which the formal leader and an emergent leader were *un*able to coordinate effectively) or traditional leader-centered structures (in which there was only a formal leader and no emergent leaders). To my knowledge, Mehra and colleagues' (2006) work represents the only attempt to explicitly compare different patterns of "contracting"-like behaviors across members of a team. More nuanced patterns across team members may exist when no formal leaders are in place, but such patterns have not yet been explored.

Based on these findings, I hypothesize the following:

Hypothesis 1a. The total amount of contracting interactions among team members will be positively associated with effectiveness outcomes. These relationships will be stronger in an initial task versus a subsequent task.

Hypothesis 1b. The sharing of contracting interactions among team members will be positively associated with effectiveness outcomes. These relationships will be equivalent across tasks.

Creating. One reason team-based work structures are popular is because synergies are believed to exist among members that help produce results superior to individuals' work. Therefore, the use of teams should allow for more innovation and better strategy adjustment than would individuals. But various difficulties exist in teams that prevent members from originating ideas (e.g., groupthink; Janis, 1982; social loafing, Latané, Williams, & Harkins, 1979) or vocalizing them (e.g., production blocking, Diehl & Stroebe, 1987; evaluation apprehension, Collaros & Anderson, 1969). Interactions that overcome such difficulties and *change or give original structure to task strategy* belong to the "creating" team process category. This team process may manifest via a variety of interactions, including coming up with new approaches to taskwork, reframing the team's mission, and presenting solutions to task-related problems that arise. Because creating interactions involve originating or innovating team tactics, a greater number of creating interactions within a team almost always leads to better team effectiveness outcomes (West & Anderson, 1996). In addition, Mumford and colleagues (2006) argue that creating interactions may promote effectiveness most in teams that are meeting for the first time (and do not yet have a strategy) and for teams that are in transition (Gersick, 1989) or have recently performed poorly (and therefore need to adjust their strategy). In these situations especially, a greater number of creating interactions should result in more favorable team effectiveness outcomes.

In addition to the positive relationship between the *amount* of creating interactions and team effectiveness, their *distribution* among members may have important implications. Research literatures focusing on team problem solving, creativity, and idea generation offer conceptual similarities with creating interactions and therefore provide appropriate lenses for thinking about how they may be optimally distributed. Scholars have demonstrated that teams tend to problem-solve at or below the level of their best member (e.g., Bonner, 2004; Bonner, Baumann, & Dalal, 2002; Libby, Trotman, & Zimmer, 1987). For example, Miner (1984) used an undergraduate sample to evaluate the different strategies utilized by team members during the Winter Survival Exercise. This exercise involves making a series of choices about how to act in an emergency situation, each of which constrains the structure of the task as well as the options that can be used in later choices. Miner discovered that team decisions were superior to the average of individuals' decisions, equal to the perceived best individual's decision, and inferior to the actual best individual's decision.

Similarly, recent research investigating team creativity evidences that individuals are better able to leverage their own diverse set of creative skills toward enhanced performance than are teams (Taylor & Greve, 2006). With regard to idea generation, Girotra, Terwiesch, and Ulrich (2010) proved that individuals who first work independently and then together tend to generate more ideas, to generate better quality ideas, and to more accurately recognize the value of their ideas than do team members who do not first work independently. These results lend further support to the notion that teams may *not* be more effective idea-generating units than are lone individuals.

Translating these results to the creating interactions at the focus of the current section, it seems likely that the most effective teams will be those involving fewer members engaging in creating interactions. Notably, scholars have shown that team members' ability to recognize which members are most adept at originating and innovating team strategies increases across similar tasks (Littlepage, Robison, & Reddington, 1997). With the increased ability to recognize others' creating-related expertise (i.e., in a subsequent task versus an initial task) should come a stronger relationship between the distribution of creating interactions and team effectiveness outcomes.

To summarize, research from problem solving, creativity, and idea generation domains provides useful information regarding how the amount and distribution of creating interactions among team members will relate to team effectiveness outcomes. Mumford and colleagues suggest that more creating interactions translate to greater team effectiveness – especially in teams meeting for the first time or in transition stages (i.e., while working on an initial *and* subsequent task). In addition to the effects of the total amount of creating interactions among team members, I will examine whether less sharing of this team process among members is associated with more favorable team effectiveness outcomes. I will also test whether these effects are stronger after members have had time to understand which members hold creating-related expertise (i.e., in a subsequent task versus and initial task).

Hypothesis 2a. The total amount of creating interactions among team members will be positively associated with effectiveness outcomes. These relationships will be equivalent across tasks.

Hypothesis 2b. The sharing of creating interactions among team members will be negatively associated with effectiveness outcomes. These relationships will be stronger in a subsequent task versus an initial task.

Contributing. Each member of a team holds a unique set of knowledge, skills, and abilities, but team members do not always share their expertise with others. Contributing interactions involve *providing critical information to fellow team members*, for example by training team mates, clarifying one's own credentials or skills, or choosing to work on parts of the task particularly suited for one's expertise. The importance of contributing behaviors lies in sharing information that directly affects team effectiveness outcomes. Generally, carrying out a greater number of contributing interactions results in team success via the disclosure of expertise that is immediately useful as well as the development of a shared understanding of "who knows what" that can be accessed later when needed (Lewis, 2004; Moreland, 1999). Indeed, Stasser and colleagues' work evidences that the quality of teams' decisions depends on the appropriateness of the information used to make them (Stasser, 1992; Stasser, Taylor, & Hanna, 1989; Stasser & Titus, 1985). Additionally, contributing interactions may be particularly important in the early stages of team development, when team members have little experience working together and are still assessing each member's potential value (Ginnett, 1990; Jackson & Moreland, 2009; Mumford, Campion, & Morgeson, 2006).

Given that a greater *amount* of contributing interactions should lead to enhanced team effectiveness, what is the optimal *distribution* of these interactions among team members? Transactive memory research shows that, in order for an organized and accurate shared understanding of "who knows what" within a team, each member must first share his or her unique set of knowledge, skills, and abilities (c.f., Yuan, Fulk, Monge, & Contractor, 2010). Consequently, each team member takes on the role of "expert" in certain areas and can be called upon for help when needed, providing "quick and coordinated access to specialized expertise, ensuring that a greater amount of high-quality and task-relevant knowledge is brought to bear on collective tasks" (Lewis & Herndon, 2011, p. 1254).

Related research in the domain of team mental models, which involves collective knowledge within the team not only about each member's expertise but also regarding how members work together socially (Mohammed & Dumville, 2001), speaks to one important benefit of the distribution of expertise across team members: The ability of members to compensate for one another's "gaps" in expertise. Namely, communicating about and maintaining a network of expertise within a team is associated with enhanced success via specialization. Rather than requiring every person to learn all aspects of a task, team members can each focus on the areas they know best and can step in to inform others regarding those areas when required (Cooke, Salas, Cannon-Bowers, & Stout, 2000).

Discussing expertise via contributing interactions is especially important for strangers who are just beginning to work together (Hollingshead, 1998a) and have no knowledge one another's capabilities. Of course, contributing interactions deal not only with talking about one's expertise, but also with knowing when to actually provide useful information and being effective when delivering that information (Choi, Lee, & Yoo, 2010; Faraj & Sproull, 2000). In general, the development, maintenance, and application of collective knowledge networks (transactive memory systems, team mental models) has been consistently linked to favorable team effectiveness outcomes in a wide variety of domains (e.g., in classroom project teams, Jackson & Moreland, 2009; for the most recent review see Lewis & Herndon, 2011).

Overall, the literature described thus far suggests that the amount and distribution of contributing interactions among team members positively influences team effectiveness outcomes. Although these ideas are conceptually similar to others that have been expressed in the transactive memory, team mental models, and more general expertise distribution literatures, there is little empirical research measuring actual contributing interactions via observation – most studies have used survey methodologies to diagnose *perceptions* of knowledge networks rather than monitoring the actual sharing and coordination of expertise (exceptions include Burtscher, Kolbe, Wacker, & Manser, 2011; and Palazzolo, 2005). I seek to contribute to these domains by assessing interactions more objectively and less obtrusively.

This issue is especially relevant because contradictory findings have recently been published regarding the role of expertise-related communication in the development and application of knowledge networks. Traditionally, scholars assumed that communication plays an important role throughout team development (e.g., Hollingshead, 1998b; Hollingshead & Brandon, 2003; Wegner, 1986). For example, Lewis (2004) measured communication, transactive memory strength, and performance in student teams and found that teams whose members communicated more often developed stronger knowledge networks. Jackson and Moreland (2009) attempted to build on these results by measuring the same variables across two time points in order to see whether the importance of communication in developing knowledge networks changed over time. The authors discovered that communication was more important earlier in team development versus later, suggesting that the value of contributing interactions (which involve communicating and applying member expertise) for enhancing team effectiveness may be greater in the early stages of team development. In further support of Jackson and Moreland's findings, Pearsall, Ellis, and Bell (2010) recently evidenced that early communication regarding member roles and expertise was critical to transactive memory development; and Littlepage, Hollingshead, Drake, and Littlepage (2008) demonstrated that communication was *not* required for team members to access their *existing* knowledge networks.

These results are consistent with theories of tacit (Wittenbaum, Stasser, & Merry, 1996) or implicit (Rico, Sánchez-Manzanares, Gil, & Gibson, 2008) coordination, which involve team members' ability to anticipate one another's needs and dynamically adjust their interactions without first needing to communicate with one another to strategize. Implicit coordination is thought to develop as a result of team members' shared understanding of one another's capabilities – one way to reach such an understanding, of course, is via early communication regarding expertise. With regard to contributing interactions, implicit coordination may manifest in a number of ways. For example, an "expert" may notice that a team member misunderstands the task and consequently takes time to train him; or he may take responsibility for an aspect of the task that is particularly suited to his expertise. Note that contributing interactions are information-oriented and involve communicating and applying one's knowledge. They should therefore be distinguished from the function-oriented completer behaviors (to be discussed next) that involve finishing one's own work as well as filling in for other members who are unable to finish theirs.

Consistent with these theories and findings, another contribution of my research involves an investigation of whether contributing interactions are more important in an initial task versus a subsequent task (i.e., earlier versus later in team development). Further, I will utilize an objective and unobtrusive observation-based methodology for measuring contributing interactions. Based on the preceding discussion, I hypothesize the following:

Hypothesis 3a. The total amount of contributing interactions among team members will be positively associated with effectiveness outcomes. These relationships will be stronger in an initial task versus a subsequent task.

Hypothesis 3b. The sharing of contributing interactions among team members will be positively associated with effectiveness outcomes. These relationships will be stronger in an initial task versus a subsequent task.

Completing. When considering how work is done in teams, it may be assumed that all members are involved to similar extents. However, many times work is disjunctive such that some team members are involved more heavily than others. Completing interactions are critical in these situations because they *ensure that one's own and one's team mates' task responsibilities are fulfilled*. The latter case does not involve simply requesting that team mates complete their work but rather actually stepping in to finish it on their behalf. Thus, the completing team process may manifest via interactions like finishing one's own task-related commitments, volunteering to take on certain team "to do"s, or assisting team mates struggling to finish their individual duties. Completing interactions are essential throughout a task, but may become more critical as the team's deadline approaches – especially if it is behind schedule (Hackman & Walton, 1986; Moon & Illingworth, 2005; Mumford, Campion, & Morgeson, 2006). Empirical evidence has established a substantial link between allocating greater effort toward one's taskwork, as well as more helping of others to complete theirs (i.e., backup behaviors), and enhanced team effectiveness (e.g., Druskat & Kayes, 1999; Marks, Mathieu, & Zaccaro, 2001; McIntyre & Dickinson, 1992; McIntyre & Salas, 1995; Salas, Sims, & Burke, 2005).

But there is also merit in discovering how completing behaviors can be optimally distributed among team members to increase the likelihood of success. To reiterate, completing behaviors deal with two major areas: (1) Ensuring that one's own task responsibilities are fulfilled, and (2) ensuring that those of team mates are fulfilled. Based on extant theory and research findings, I suggest that team effectiveness outcomes will be most favorable if all members engage in similar amounts of completing behaviors, which might occur in one of a few different ways.

First, it might occur when the task lacks interdependence such that teams can be successful if members attend only to their own tasks and not to one another's. This is analogous to a set of distinct individuals each completing a distinct amount of work and then summing across those individuals' work to create the team's final output. The relationship associated with this situation is clear – the more effort each individual puts into finishing his own work, the better he and his team (additively) perform (Blau, 1993). The second situation in which all members engage in about the same amount of completing behaviors occurs for especially interdependent tasks and involves team members attending to their own *as well as* others' work. This case occurs most often when team members do not have adequate resources to fulfill their individual responsibilities and therefore require team mates' aid (Salas, Sims, & Burke, 2005). Hence, members both attempt to finish their own work and simultaneously to compensate for team mates' shortcomings. Notably, teams that are able to shift work among members in times of need tend to perform better than teams that are unable to (Porter, Hollenbeck, Ilgen, Ellis, West, & Moon, 2003; Porter, 2005).

Original research by Barnes, Hollenbeck, Wagner, DeRue, Nahrgang, and Schwind (2008) suggests that helping team mates has beneficial effects for the "helpee" but potentially harmful effects for the "helper." In a laboratory study involving student teams engaging in a decision-making simulation, the authors discovered that helping team mates results in helpers neglecting their own work – especially when the workload is evenly distributed among team members. However, whether there were negative consequences for team effectiveness outcomes was not investigated. Work by Porter, Gogus, and Yu (2010) shows that helping team mates results in improved team performance *when the helping is useful* (i.e., when workload is not evenly distributed and some members clearly require aid to perform efficiently).

Thus, in addition to the expectation that greater effort and more sharing of effort toward members' own task duties will result in team success, one would also expect to find a positive relationship between the amount and sharing of *helping* interactions and team effectiveness. Therefore, I expect to find positive relationships between the amount and sharing of completing interactions (which involve both finishing one's own work as well as helping others to finish theirs) among members and team effectiveness outcomes. Note that assessing completing interactions involves *both* aspects of shifting work among team members – in cases where helping others proves unnecessary, completing interactions likely manifest via team members working on their own individual responsibilities rather than attending to others; in cases where helping is useful, completing interactions likely manifest via team members attending to one another's responsibilities as well as their own.

It is worthwhile to consider these same arguments from the reverse perspective. That is, the previously discussed arguments contend that more sharing of completing interactions, both with regard to finishing one's own work and helping others to finish theirs, should be associated with favorable team effectiveness outcomes. The reverse also holds: If fewer team members engage in completing interactions such that the distribution of these behaviors is less shared (more centralized or differentiated), then the team will perform poorly. When described in this way, conceptual links with the social loafing literature become apparent. Steiner (1972) provided one of the most popular descriptions of how individuals tend to reduce personal effort in team situations. This phenomenon was later termed "social loafing" by Latané, Williams, and Harkins (1979) and has since been studied in a variety of contexts (Comer, 1995). Imbalanced workload among team members is detrimental whenever this imbalance is unexpected or when it results in process losses. Further, teams with members who "loaf" perform worse than teams with members who do not (see Shepperd, 1993), providing further support for my prediction of positive relationships between the sharing of completing interactions and team effectiveness outcomes.

My review of the literature for this section revealed a surprising lack of empirical evidence regarding how completing-like interactions (i.e., working, putting forth effort, team monitoring, helping team mates) actually manifest in teams (one exception is Weingart, 1992) – a gap I strive to fill. Although I found some evidence that completing interactions might be more important towards the beginning of a task (Porter, Gogus, & Yu, 2010), I found none to suggest that they might be more or less critical for team effectiveness *across* tasks (i.e., in an initial task versus a subsequent task or vice versa). In view of that, neither of the following hypotheses includes a prediction about differences in effects across tasks.

Hypothesis 4a. The total amount of completing interactions among team members will be positively associated with effectiveness outcomes. These relationships will be equivalent across tasks.

Hypothesis 4b. The sharing of completing interactions among team members will be positively associated with effectiveness outcomes in both tasks. These relationships will be equivalent across tasks.

Critiquing. In the earlier section regarding creating interactions, I mentioned that there may be a number of issues inhibiting team members from originating new ideas and suggestions. For example, many times individuals fear that others will perceive their contributions negatively and, as a result, neglect to speak up at all or generally perform worse in team situations (Diehl & Stroebe, 1987). When members overcome these difficulties to originate or innovate team strategies, they engage in creating interactions. Once a member proposes an idea or carries out a strategy, critiquing interactions serve to *evaluate and challenge team ideas and decisions*. As a few examples, team members engage in critiquing interactions when they scrutinize their team members' task-related suggestions or present any negative information that goes against the team's existing task arrangement or strategy. In general, carrying out more critiquing interactions reduces the likelihood of blind consensus-seeking (Janis, 1982; Lawrence & Lorsch, 1969; Nemeth & Chiles, 1988) and provides multiple perspectives that ultimately lead to more favorable team effectiveness (e.g., more innovative and comprehensive decision-making, De Dreu & Beersma, 2001; De Dreu & West, 2001; Simons, Pelled, & Smith, 1999) via the stimulation of divergent thought (Nemeth, 1995).

When considering the optimal amount of critiquing interactions, one domain of organizational research seems especially relevant – the one involving employee voice as a challenge-oriented citizenship behavior. Different from affiliation-oriented citizenship behaviors that people perform in order to cooperate with and preserve relationships among peers (e.g., courtesy, Organ, 1988), challenge-oriented citizenship behaviors in the form of employee voice involve actively appraising the status quo in order to promote or prohibit change (Van Dyne, Cummings, & McLean Parks, 1995). Although research linking voice with effectiveness outcomes has traditionally been conducted at the individual level (e.g., Whiting, Podsakoff, & Pierce, 2008; Van Dyne & LePine, 1998), a recent study by MacKenzie, Podsakoff, and Podsakoff (2011) investigated its effects for workgroups and organizations. The authors aptly describe the difficulties in predicting optimal amounts of challenge-oriented (i.e., critiquing) behaviors:

> "On the one hand, because the essence of challenge-oriented behavior involves making constructive suggestions, one would expect this behavior to improve unit or organizational performance. On the other hand, because this form of behavior may disrupt interpersonal interactions and upset the status quo, it has the potential to decrease unit or organizational performance. This suggests that it may not be safe to assume that

challenge-oriented behavior has a positive net effect on unit or organizational performance." (p. 562)

Using a sample of restaurant employees, MacKenzie and colleagues (2011) evidenced that challenge-oriented citizenship behaviors enhance team effectiveness up to a point but then impair it after that point. Similarly, critiquing interactions may best aid team success in moderate amounts. If too few critiquing interactions are carried out, team members may lack the critical evaluation needed to avoid issues like groupthink (Janis, 1982); if too many take place, their accumulation may lead to relationship conflict and consequently to impaired performance (Jehn & Mannix, 2001). It In addition, critiquing interactions may only be well-received once team members have come to trust and understand one another's expertise and intentions. In the early stages of team development, critiquing interactions may be less influential because team members do not yet hold confidence in the value of one another's input; in later stages, the sense of trust that has built among members should allow for critiquing interactions to have advantageous effects on team effectiveness outcomes.

Thus, the current study contributes value by validating MacKenzie and colleagues' novel findings in a different sample, by comparing relationships at two time points (across tasks), and by assessing *actual* critiquing interactions rather than surveyed perceptions. There are many reasons to suspect that behavioral observation will be a truer indicator of team performance than are survey measures, the most prominent of which is that the former is not subject to individual response biases (e.g., gender differences, personality-related differences, social desirability expectations, differences in conceptual frames of reference; for reviews of these issues see Vandenberg & Lance, 2000; or Schmitt & Kuljanin, 2008). Such biases have prompted a call for researchers to rely less on single-source, retrospective, simultaneous survey measures of team processes and performance (c.f. LePine, Piccolo, Jackson, Mathieu, & Saul, 2008).

In addition to investigating how the *amount* of critiquing interactions impacts team effectiveness across tasks, I intend to explore the relationship between the *distribution* or sharing of critiquing interactions across members and team effectiveness outcomes. The focal question here is: Given the importance of critiquing interactions for team success, is it better for *more* team members to engage in critiquing, or for just *one* or a few members to play "devil's advocate?" In one of the earliest and most popular discussions of methods for fostering dissent in situations where blind conformity is likely, Janis (1982) recommended placing a team member into the role of "devil's advocate." This person's task is to evaluate ideas and plans under consideration. Since then, a number of scholars have shown that using a devil's advocate results in more favorable outcomes than does relying on an "expert" within the group or on traditional consensus (e.g., greater consideration of unique knowledge in hidden profile research, Brodbeck, Kerschrieter, Mojzich, Frey, & Schulz-Hardt, 2002; lessened likelihood of escalation of commitment in decision-making teams, Greitemeyer, Schulz-Hardt, & Frey, 2009). Especially promising is research showing not only that including a devil's advocate bolsters team effectiveness but also that *authentic* devil's advocates, or those that are not placed into roles by experimenters but rather emerge naturally, stimulate team effectiveness more than do "role-playing" devil's advocates (Nemeth, Brown, & Rogers, 2001; Nemeth, Connell, Rogers, & Brown, 2001; Schulz-Hardt, Jochims, & Frey, 2002).

Taken together, these studies suggest that critiquing interactions may be optimal "in the minority," or when carried out by a few team members (versus one or many). Indeed, it is likely that more team members evaluating already-proposed ideas and strategies results in reduced time available for generating new ideas or actually completing the work. Further, teams whose members all evaluate one another's ideas and actions may suffer from relational conflict and, consequently, reduced team performance and satisfaction (Jehn, 1997). Because the current study assesses minority dissent as it naturally emerges and in the context of a number of other behaviors that are simultaneously occurring, it provides a uniquely realistic portrayal of the impact of critiquing on team effectiveness.

In addition, relatively little research has yet (to my knowledge) compared the relationship between minority dissent or "challenging" behaviors and team performance at multiple time points. In the early stages of team development, critiquing interactions are likely discounted in efforts to maintain consensus (Goncalo, Polman, & Maslach, 2010) or because members do not hold yet understand one another's capabilities. In later stages, team members may be more likely to take critiquing interactions seriously and to reap the associated benefits of dissent. In support of these ideas, there is evidence that teams that neglect to engage in process conflict (disagreements about *how* the task should be completed; Jehn, 1997) toward the beginning of their task perform poorer versus teams that do engage in early process conflict (Goncalo, Polman, & Maslach, 2010). In addition, Jehn and Mannix (2001) discovered that high performing teams are characterized by little process conflict toward the beginning of team development and more process conflict as they progress onward.

In summary, the amount and distribution or sharing of critiquing interactions should influence team effectiveness. In testing these relationships in a new sample, across time points, and with behavioral indicators rather than survey measures, I will build on previous research in several important ways. First, because critiquing interactions may have greater impact on team effectiveness after members have had ample opportunity to assess one another's capabilities, I will investigate whether relationships between the amount and distribution of critiquing interactions and team effectiveness outcomes become stronger from one task to the next. Second, I will directly assess whether critiquing interactions are more useful when only one or a few members fulfill them. Extant dissention and devil's advocate research would suggest so, but there is not yet ample evidence directly comparing team effectiveness outcomes based on the number of members involved.

Hypothesis 5a. Lesser and greater amounts of critiquing interactions among team members will be associated with unfavorable effectiveness outcomes; moderate amounts will be associated with favorable effectiveness. These relationships will be stronger in a subsequent task versus an initial task.

Hypothesis 5b. The sharing of critiquing interactions among team members will be negatively associated with effectiveness outcomes. These relationships will be stronger in a subsequent task versus an initial task.

Up to this point, all team process categories have consisted of task-oriented interactions aimed at accomplishing taskwork. I will next discuss team processes concerned with developing and maintaining interpersonal relationships and social ties among team members.

Communicating. Communicating interactions entail *the creation and maintenance of a social environment conducive to positive collaboration*. Examples of communicating interactions include listening to team mates when they speak, addressing others by their first name, using humor to alleviate tension among team members, and engaging in friendly small talk. Note that the communicating team process category does not include *all* verbal interactions as would be consistent with the classic definition of communication, but only those verbal interactions that specifically involve attempts to enhance or maintain the social climate among team members. Many authors have evidenced that greater fulfillment of communicating interactions results in more favorable team effectiveness outcomes at one point in time (c.f., Allen, 1984; Bstieler & Hemmert, 2010). Additionally, communicating interactions among team members may be especially important in an initial task via the creation of social norms that can be enacted later (Mathieu & Rapp, 2009; Perlow & Repenning, 2009; Tschan, Semmer, Gautschi, Hunziker, Spychiger, & Marsch, 2006).

Aside from the importance of the *amount* of communicating interactions for team success, is there an optimal *distribution* of these interactions among team members? In other words, do more effective teams consist of more or fewer members engaging in positive verbal interactions related to the creation or maintenance of a desirable social climate? In researching this question I discovered little empirical evidence supporting one alternative or the other. Although there are many studies demonstrating the importance of communication in general (e.g., verbal interactions as proxies for coordination and cooperation information, see Kozlowski & Bell, 2012), there are relatively few studies focusing on the specific types of (positive) verbal interactions that belong in this category. Consequently, the optimal proportion of team members engaging in this team process – and whether that proportion changes from one task to the next – is yet unknown. Therefore, in an effort to explore all possibilities, I suggest only that there are no relationships between the sharing of communicating interactions among team members and effectiveness outcomes in early or later stages of team development.

Hypothesis 6a. The total amount of communicating interactions among team members will be positively associated with effectiveness outcomes. These relationships will be stronger in an initial task versus a subsequent task.

Hypothesis 6b. The sharing of communicating interactions among team members will not be associated with effectiveness outcomes in either task.

Calibrating. Teams deal with a variety of interpersonal issues, including social conflicts and insecurities among members. These issues can be ameliorated via calibrating interactions that *make the team aware of interpersonal issues and suggest ways to improve them.* Creating norms for social interactions, settling disputes or mediating tensions among members, and eliciting feedback about member status are all examples of calibrating interactions. A greater amount of calibrating-like interactions has been shown to result in more favorable team effectiveness outcomes (Behfar, Peterson, Mannix, & Trochim, 2008; DeChurch & Marks, 2001; Tekleab, Quigley, & Tesluk, 2009). Take for example a situation where team members disagree about how to carry out their task (i.e., undergo process conflict). Appropriate mediation of this disagreement lessens the likelihood that the situation escalates or becomes personal, thereby avoiding relational conflict and enhancing team effectiveness (Jehn, 1997). If the argument does become personal, calibrating interactions that involve re-focusing team members toward task issues serve to reorient them toward success.

The positive relationship between calibrating interactions and team effectiveness outcomes is likely stronger for newly-formed teams because it is often in the early stages of development that teams undergo process uncertainty and social conflicts (Tuckman, 1965; Tuckman & Jensen, 1977). Consequently, calibrating interactions create initial norms regarding how team members should interact interpersonally. Recent research by Mathieu and Rapp (2009) lends support. These authors evidenced that teams whose members initially developed high-quality norms for teamwork performed better over time than did teams whose members initially developed lower-quality norms. Similarly, Kuhn and Poole (2000) discovered that teams' early patterns of conflict management – one of the constructs tapped by the calibrating team process– influenced their later decision-making effectiveness.

Of course, calibrating deals not only with conflict management but also with soliciting feedback about each member's status as it relates to teamwork. Consider a team whose members are communicating ineffectively or who seem to lack a sense of trust in one another's skills. Calibrating in this situation might entail summarizing these social issues vocally and facilitating a discussion among members to fix them. Without this, the team may continue operating sub-optimally and their performance will likely suffer. As this example illustrates, the maintenance of a team's social climate is important because interpersonal issues often spillover into task-related ones. A variety of studies have demonstrated that team effectiveness is enhanced when calibrating interactions are fulfilled more often (e.g., with regard to team satisfaction and viability; Pirola-Merlo, Hartel, Mann, & Hirst, 2002; or performance quantity and quality, Burke, Stagl, Klein, Goodwin, Salas, & Halpin, 2006; Campion, Medsker, & Higgs, 1993). Although no research has yet investigated changes in these relationships over time or across tasks, they may be strongest near the beginning of team development when social issues are most likely to occur (Tuckman, 1965; Tuckman & Jensen, 1977).

Aside from the effects of the total *amount* of calibrating interactions within the team, how might the *distribution* of such behaviors among team members influence effectiveness outcomes? This question is difficult to answer because there is a paucity of research regarding different distributions of calibrating-like interactions across members (e.g., conflict management, social support, feedback seeking, peer mediation). Nonetheless, it may be that the distribution of calibrating interactions among team members affects effectiveness outcomes only indirectly. For example, calibrating may set a positive interpersonal "tone" for team functioning that supports other member functions later. In this vein, Carson, Tesluk, and Marrone (2007) discovered that a team's climate for social support predicted shared leadership emergence which in turn predicted team performance.

To review, previous research in a variety of domains suggests that the amount of calibrating interactions across team members may be positively associated with team effectiveness outcomes. In addition, some empirical research investigating the early development of teamwork strategies and norms leads me to predict that these relationships will be stronger in an initial task versus a subsequent task. My results will offer novel insight into how the sharing of calibrating interactions among team members impacts team effectiveness. A paucity of research leads me to suspect only that there is no direct relationship. However, there may be relationships among calibrating and other team processes that hold direct links with team effectiveness, which will help shed light on the indirect value of calibrating interactions for team success.

Hypothesis 7a. The total amount of calibrating interactions among team members will be positively associated with effectiveness outcomes. These relationships will be stronger in an initial task versus a subsequent task.

Hypothesis 7b. The sharing of calibrating interactions among team members will not be associated with effectiveness outcomes in either task.

Cooperating. Many scholars have noted an overemphasis on the functions of team leaders and an underemphasis on those of their followers (Benne & Sheats, 1948; Barry, 1991; Katzenback & Smith, 1993). A focused examination of cooperating interactions – as in the current endeavor – should contribute to this gap. This team process involves *complying with the expectations and norms of the team and its external influences* and manifests when team members adhere to rules and support team decisions. In order to understand how cooperating fits with the other team processes already described, consider first its distinctiveness from the critiquing team process. While critiquing interactions entail pointing out flaws in others' ideas or actions, cooperating interactions involve conforming to influence attempts and supporting others' leads. As I mentioned earlier, the value of critiquing for team effectiveness lies in preventing premature consensus-seeking while team members discuss an issue or strategy. While critiquing interactions entail a focus on the negative aspects of an idea, cooperating interactions instead push members to attend to its positive aspects. Much research suggests that teams whose members engage in more cooperating interactions tend to ultimately perform better (c.f., Driskell & Salas, 1992; Eby & Dobbins, 1997; Smith, Smith, Olian, Sims, O'Bannon, & Scully, 1994).

Note that most cooperating interactions are conceptually similar to the types of behaviors traditionally carried out by "followers." Formally, followers are non-leader members of teams; informally, any team member may follow another's lead (or an external entity's lead) in a variety of ways (van Knippenberg & Hogg, 2003; van Knippenberg, van Knippenberg, De Cremer, & Hogg, 2004). For example, a team member might disagree with a team mate's perspective but ultimately defer because of status or expertise. But not all cooperating interactions deal with following team mates' leads – others involve abiding by rules set into place by external entities (e.g., a common employer). The relationship between this latter type of interaction and team effectiveness is obvious – if team members attend to these rules, then they are more valuable to their team mates as well as the external entities (i.e., have more favorable outcomes).

Like the other social-oriented team processes already discussed (communicating and calibrating), extant research provides little insight into the optimal distribution of cooperating interactions among team members. Are teams most effective when everyone engages in cooperating interactions or when fewer do; or does the distribution of this particular team process not affect team outcomes at all? From the perspective of the leadership literature, one might argue that, if *more* team members should engage in contracting interactions over time, then perhaps *more* should also engage in cooperating interactions over time – claiming leadership (for themselves) or granting leadership (to others) based on the needs of a given moment (DeRue & Ashford, 2010). However, I found no empirical evidence to support the notion that greater sharing of cooperating-like interactions results in team success. Thus, for the purposes of the current endeavor I hypothesize only that there is no relationship between the sharing of the cooperating team process among members and team effectiveness outcomes. I will explore alternative possibilities regarding whether more or fewer team members engaging in these cooperating interactions leads to team success.

Hypothesis 8a. The total amount of cooperating interactions among team members will be positively associated with effectiveness outcomes. These relationships will be equivalent across tasks.

Hypothesis 8b. The sharing of cooperating interactions among team members will not be associated with effectiveness outcomes in either task.

Patterns including all team processes. In the preceding sections, I described how the overall amount and sharing of *each* team process among members may affect team effectiveness outcomes across two tasks. For example, I suggested that favorable team effectiveness would be marked by a high total number of contracting interactions within the team or much sharing of this team process among members. In the current section, I seek to explore what team process patterns – which include all eight types of interactions as predictors of team effectiveness simultaneously – are associated with favorable outcomes.

Multivariate, pattern-based investigations of predictors provide a more comprehensive understanding of a phenomenon than would each predictor-to-outcome relationship on its own. Focusing on predictor patterns allows one to see whether specific profiles of values associated with any number of variables are indicative of an outcome of interest. Predictor patterns have been used successfully in a variety of research domains, including in career interests (c.f., Davison & Davenport, 2002), commitment attitudes (c.f., Sinclair, Tucker, Cullen, & Wright, 2005), verbal statements (c.f., Wheelan, Davison, & Tilin, 2003), contextual behaviors (c.f., Shoda, Mischel, & Wright, 1993; 1994), managerial traits and styles (c.f., Hautaloma, Dickinson, & Inada, 1992), and personalities associated with people or occupations (c.f., Asendorpf, 2006;

Borges & Gibson, 2005; Dilchert, 2007; Egan & Stelmack, 2003; Gramzow, Sedikides, Panter, Sathy, Harris, & Insko, 2004).

Over the past decade or so, a number of scholars have begun to examine *interaction* patterns in teams, although each effort has involved a different strategy and focus. Keyton (1999) sampled employees from a variety of organizations and evidenced that dysfunction results in work teams when one member behaves inconsistently (i.e., friendly versus unfriendly) over time and consequently causes others to become confused and behave inconsistently as well. Jehn and Mannix (2001) used a student sample and showed that favorable team performance resulted when process, relationship, and task conflict occurred at certain levels during each part of a task. Perlow, Gittell, and Katz (2004) observed and interviewed software-engineering teams to demonstrate patterns and correlates of helping among members. LeCouteur and Feo (2011) studied netball (basketball-like sport) teams and discovered that, in addition to the importance of frequent communication among team members, certain types of information being communicated at critical times – and in optimal sequence – were critical determinants of team outcomes.

Each of these investigations was focused on understanding interaction patterns in teams with regard to a specific issue – namely friendliness (Keyton, 1999), conflict (Jehn & Mannix, 2001), helping (Perlow, Gittell, & Katz, 2004), and communication (LeCouteur & Feo, 2011) among team members. This approach is similar to the one I took in the preceding sections of this paper (and the approach most often taken by team process researchers), where each section concentrated on the relationships among the amount and sharing of a certain team process and effectiveness outcomes. Aside from those domain-specific questions, there is substantial merit in determining what types of team process patterns – or patterns that incorporate all team processes simultaneously – emerge in successful teams. Their identification may be critical to understanding, training, providing feedback to, and adjusting team members' interactions towards an enhanced likelihood of success.

Consider recent research by Stachowski and colleagues (2009). In an attempt to assess team interaction patterns during crises, the authors observed employees working in nuclear power plant control room crews. They coded employees' verbal communications and nonverbal behaviors, for example by counting the number of times an employee expressed a task-related warning or marking when team meetings began and ended. They compared whether high-performing teams engaged in each type of behavior more or less frequently than did average-performing crews, but ultimately found no significant effects. Next, they aggregated employee behaviors using pattern detection software and applied discriminant analysis to compare the number, length, and complexity of different teams' interaction patterns. They evidenced that better-performing teams engaged in fewer, shorter, and simpler interaction patterns (though these comparisons were not always significant).

It should be noted that Stachowski and colleagues' (2009) results, while promising with regard to exploring the optimal pattern of interactions in crisis situations, may not translate to other circumstances. Because of the crisis context, as well as the fact that only 14 teams' data was used in their research, the authors called for future scientific investigations of interaction patterns in larger samples and new domains. The current research seeks to answer this call by determining optimal patterns associated with overall amounts and sharing of team processes among members. Practically speaking, this will support an understanding of whether a given team process should be fulfilled to a greater or lesser extent and whether it should be shared across more or fewer team members *relative to other team processes* and *at two different stages of team development*.

Determining the optimal pattern of amounts of team processes. In a study aimed at developing a test of team role-related knowledge, Mumford, Van Iddekinge, Morgeson, and Campion (2008) discovered a positive relationship between a team member's task role knowledge and the quality of his performance in task roles, as well as a positive relationship between his social role knowledge and the quality of his performance in social roles – even after accounting for ability and personality variables. In their tests of the relative importance of task role knowledge versus social role knowledge for overall role performance, task roles emerged as more predictive. These findings suggest that task-oriented team processes (contracting, creating, contributing, completing, critiquing) might be more important for – that is, stronger predictors of – team effectiveness outcomes than social-oriented ones (cooperating, communicating, calibrating). Similarly, Stewart and colleagues (2005) showed that team performance was predicted by task-oriented role fulfillment but not by social-oriented role fulfillment. Note that, while Mumford and colleagues (2008) assessed team role *knowledge*, Stewart and colleagues (2005) assessed members' perceptions of actual team role *fulfillment*. However, similar conclusions can be made regarding the relative importance of some team roles versus others (i.e., task roles may be more critical than social roles for team performance). Unfortunately, neither of these research teams investigated the relationships between each narrower taxonomy category and effectiveness outcomes. Thus, it may be the case that *some* task roles are more critical than others, or that upon examining narrower categories certain ones emerge as critical regardless of whether they incorporate task- or social-oriented interactions. Because these two studies were yet the only ones to assess team role fulfillment using Mumford and colleagues' (2006) taxonomy, it seems pertinent to look elsewhere for information regarding whether team members should fulfill certain types of interactions to greater or lesser extents.

On that note, LePine and colleagues (2008) recently conducted a meta-analysis of the relationships between team processes and team effectiveness outcomes. The authors used Marks, Mathieu, and Zaccaro's (2001) taxonomy to classify team process studies. Among their results is the finding that transition (task-oriented processes), action (task-oriented processes), and interpersonal (social-oriented processes) activities are all related to team performance positively and with comparable strengths. This finding, contrary to Mumford and colleagues' as discussed above, suggests that task- and social-oriented team processes might be similarly critical for team success. LePine and colleagues also investigated the relationships among narrower categories of team process and team performance outcomes, and evidenced positive and significant relationships across the board: Engaging in all team processes to greater extents results in team success. Nonetheless, some team processes held stronger relationships with team performance than others. In particular, goal specification, strategy formulation, and motivation seemed to be the strongest predictors and systems monitoring (which involves activities focused on tracking internal and external resources) seemed to be the weakest. Taken together, these potentially "critical" team process categories show conceptual similarities with the contracting, creating, and contributing team taxonomy categories used in the current research. These are all task-oriented team processes, suggesting that task-oriented team processes might be *slightly* more critical for team performance outcomes than are social-oriented team processes.

Aside from these empirical findings, extant team development theory can also provide guidance. Notably, team development scholars have formally called for longitudinal empirical investigations like the current endeavor (c.f. Kozlowski & Bell, 2012). An area rife with theory but lacking in empirical evidence, the team development literature includes a number of popular stage-based frameworks describing how teams likely develop over time. A major focus of these theories is on the types of interactions occurring among members when they first meet; later when they endure conflicts, come to understand one another, and develop shared norms; and ultimately when they produce results (c.f. Kozlowski, Gully, Nason, & Smith, 1999; Tuckman, 1965; Tuckman & Jensen, 1977). For example, Kozlowski and colleagues (1999) discuss four phases through which teams develop. The earliest stage, *team formation*, involves team members acquiring social knowledge: Seeking out information about one another and developing norms and shared climate perceptions. The second stage, *task compilation*, involves team members acquiring task knowledge: Learning skills, practicing, helping team mates, and regulating their goals and efficacy perceptions. The third stage, *role compilation*, involves breaking up the task into member responsibilities, coordinating explicitly and implicitly, and discussing the task. The fourth stage, *team compilation*, involves adjusting and continuously improving one's own and team mates' effectiveness. By examining the phases in this framework from a "social" versus "task" perspective, it seems like social-oriented processes (e.g., socializing, developing interaction norms) may be more critical earlier in team development and task-oriented processes (e.g., assigning responsibilities, coordinating efforts, maintaining/improving efficiency) may be more critical later. It is likely the case, however, that this is an oversimplification of a complex phenomenon. It may be that both social- and task-oriented processes are important throughout a team's life cycle such that teams whose members strategize and coordinate early on and adjust those strategies later (i.e., task processes) as well as who create and maintain a positive social environment throughout taskwork (i.e., social processes) are most successful. Tuckman (1966) touched on this idea in his classic stage model of team development by suggesting that social processes (which he termed “group structure” issues) and task processes (which he termed “task activities”) were critical at every stage of team development. Given the inconsistencies among all perspectives mentioned in these last few pages, as well as the fact that few empirical investigations have assessed all or many team processes simultaneously, I will not set forth a specific hypothesis regarding what optimal patterns of team process fulfillment will look like in an initial and a subsequent task. However, these theories and findings do suggest broadly that *fulfilling some team processes will be more critical relative to others* and that *which team processes are most critical will change from task-to-task.*

Thus, I seek to determine what specific patterns of team process (amount) fulfillment are associated with favorable team effectiveness outcomes in an effort to inform the literature and provide a comprehensive picture of how successful teams interact. Rather than focusing on broad categories (i.e., task- versus social-oriented processes) as have others, I will investigate the value of the total amount of interactions fulfilled in each team process relative to others. Consistent with Mumford and colleagues’ (2008) and LePine and colleagues’ (2008) findings, I suspect that the most critical team processes will be task-oriented ones. However, popular team development theories suggest that which team processes are most critical may change from one task to the next and, further, that these team processes can and should be described more narrowly than those broad categories allow. Thus, an open-ended exploration seems more suited to answering these questions.

Determining the optimal pattern of sharing of team processes. Traditionally, team roles scholars contend that teams perform best when members each fulfill (i.e., specialize) in a different team role (c.f. Belbin, 1993). The importance of this “team role balance” among members has been supported in some studies (e.g., Prichard & Stanton, 1999; Senior, 1997;

Stewart, Fulmer, & Barrick, 2005) but negated in others (e.g., Blenkinsop & Maddison, 2007; Partington & Harris, 1999; van der Water, Ahaus, & Rozier, 2008). In addition, there have been a few attempts to identify whether team members balancing *certain* team roles rather than others is important for team success (e.g., Chong, 2007; Partington & Harris, 1999). However, only one researcher (to my knowledge) has yet looked at these issues using Mumford and colleagues' taxonomy. Caughlin (2010) recently investigated team role fulfillment in undergraduate student teams engaging in an information-sharing business simulation. His focus in that research was on linking a team member's personality with his or her individual team role, and then linking the number of individuals characterized by each team role with team effectiveness outcomes. Pertinent to the current endeavor is his (marginally significant) finding that having greater balance in terms of each team member taking on a unique team role led to more favorable effectiveness outcomes. However, Caughlin took the approach of assigning each team member to a team role – a perspective that, although traditional in team roles research, the current endeavor attempts to avoid.

In this vein and as discussed earlier, I will investigate team process patterns from the team-level perspective, looking at the amounts and sharing of different types of interactions regardless of which member is doing what. To my knowledge no scholars have yet examined team roles in this way. The current endeavor should inform the team roles literature by determining the optimal fulfillment of team roles (i.e., the overall pattern of team processes related to favorable effectiveness outcomes, regardless of which members are doing what). This perspective echoes my earlier discussion of the importance of conceptualizing team-level phenomena (i.e., phenomena that exist primarily because of the context of the team) at the team-level rather than at the individual-level.

Thus, I will assess whether this conceptualization of individual-level team roles and team role balance translates to the team-level when roles are considered shared, dynamic phenomena. In the patterns of team process sharing I will explore, it will be possible to see whether sharing or differentiation is better for each team process *relative to others* and across all team processes simultaneously. Note that, while sharing involves more team members engaging in the same types of interactions, differentiation involves one or a few team members fulfilling a team process uniquely. Of course, the various literatures discussed in earlier sections of this paper, which each touch on whether and how the sharing of one particular team process among members is optimal, is also relevant to some extent. As is the case for the patterns composed of team process amounts, it *seems* likely that the relationships among team process sharing and effectiveness outcomes will be similar when included in overall patterns. However, because the patterns discussed here incorporate the importance of sharing *each* team process *relative to others*, some relationships will clearly emerge as most (and least) impactful.

These comprehensive tests of team process manifestations – both in terms of the total amount of interactions carried out by team members in each category as well as the sharing of team process fulfillment among members – are fairly novel. The exploration of team processes in an effort to pick out critical ones that should (or should not) be fulfilled and should (or should not) be shared relative to others will provide a complete picture of optimal team member interactions at different stages of team development.

METHOD

Participants, Setting, and Tasks

The sample consisted of 2,092 people in 381 (four-to-six member) teams. The average team size was 5.49 members (SD = .67). Participants were job applicants engaging in tasks at an assessment center as part of the employee selection procedure at an American automobile manufacturing company. Although information about team member familiarity was not available, it is unlikely that participants were familiar with one another due to the randomized design of teams and the broad assortment of applicants vying for positions. Participant demographics were also not available.

Teams worked on two hands-on mechanical production tasks during the assessment center experience, both of which involved assembling as many correct automobile engine parts as possible during the allotted time. While working, all team members had access to a few tables, a central bin of (mixed up) assembly components, and a machine that identified malfunctioning parts. Some faulty components were purposefully provided such that, if used, final assemblies would not work properly. Teams were told that malfunctioning assemblies would not count toward their final production numbers and were responsible for devising their own strategy for checking errors. For example, some teams assigned one member to check for faulty components while other members produced assemblies; in other teams all members produced assemblies while simultaneously checking for faulty components. Teams were also free to create their own production strategies. That is, teams were asked only to assemble as many parts as possible in the allotted time – the ways in which they worked were up to them. While some teams decided to first remove components from the central bin and separate them before creating assemblies, other teams decided to pick components out of the central bin as needed while assembling.

Measures

Two assessors closely monitored team members during taskwork. These two assessors were consistent within teams (the same assessors observed each team during its entire stay at the center), but not always across teams (different sets of assessors observed different teams). Most assessors (94%) recorded observations for more than one team. Though a potential cause of noise in this study, the influence of assessor identity should be limited given that assessors were thoroughly trained for reliability and accuracy.

Note that all measures below were either collected or reviewed by the assessors.

Team performance. Mid-way through each task and at the end of each task, team members recorded the amount of correct assemblies they produced thus far as well as the amount of incorrect assemblies they produced. Each team's assessors monitored these meetings and checked teams' recorded answers for correctness. Team performance data are summed across the first and second halves of each task and represent team effectiveness outcomes in terms of *output quantity* (the number of correct parts produced) and *output quality* (the percentage of parts produced without error).

Team member interactions. Using checklists, assessors recorded *whether* each participant engaged in certain interactions during Tasks 1 and 2. Assessors also noted *how many times* each interaction occurred. 94 items comprised the checklist for Task 1; 101 items comprised the checklist for Task 2. The difference in number of checklist items is a result of different assembly components being produced across tasks (i.e., the nature of Task 2's assembly allowed for more items to be included than did Task 1's assembly). While most checklist items indicated the fulfillment of *appropriate* team process interactions ("positives"), some items ("negatives") indicated that necessary interactions were lacking. For example, an example of a positive contributing interaction was “Told or showed others the ideas that had improved his or her own work;” and a negative one was “Did not provide information or other assistance to team or a member when asked.”

Three researchers (graduate students from the local Organizational Psychology program) independently sorted the checklist items into the eight team process categories discussed earlier. The sorters agreed about which category (if any) each item belonged to in 94% of cases. The sorters then held a meeting to settle all remaining discrepancies and collectively agreed upon the appropriate category label (if any) for every remaining item. The full checklists for both tasks, as well as the associated team process category label for each interaction item, are provided in Table 1. Note that sorters were unable to match five Task 1 items and five Task 2 items. These items were removed from the final data set and are indicated in Table 1 via “NO MATCH” labels.

RESULTS

Preparing the Data

Calculating assessor agreement. As already mentioned, multiple assessors observed each team of participants. Before aggregating data across assessors for each team (for use in data analyses), I examined whether assessors agreed about the team member interactions that took place during taskwork. For 377 of the 381 teams in the sample, two assessors worked simultaneously to monitor participants, check off their interactions, and make notes. Three assessors worked to monitor the other four teams. In all cases, each assessor was assigned to observe and code interactions involving certain team members. In six-person teams, four team members were assigned to each assessor such that two team members were coded by both; in five-person teams, four team members were assigned to each assessor such that three team members were coded by both; in four-person teams, all four team members were assigned to both assessors. When there were three assessors observing a team rather than two, two assessors coded the same subset of members and the third coded the rest.

When calculating how much assessors agreed that interactions occurred (and how often they occurred), I ensured that comparisons were made only when more than one assessor observed a given participant. The average correlation of interaction data among assessor pairs was 1.00, indicating that – on average – assessors marked the same number of interactions for each participant. To apply a more stringent test to this data, I calculated the percentage of times when assessors were observing the same participants *and* marked the exact same number of interaction occurrences (i.e., if one assessor marked "4" and the other marked "4" then they were agreement; if one assessor marked "4" and the other marked "3," "5," or any other number not equal to "4," then they were not in agreement). With this method, the average percent agreement among assessors was 82.85% (*minimum* = 70.74%; *maximum* = 91.09%; *SD* = 3.41%). All agreement statistics were within acceptable limits.

Aggregating data across assessors. Favorable agreement among assessors, as discussed above, indicates that they tended to have similar data regarding which interactions were and were not occurring during taskwork as well as how often each interaction occurred. This method is popularly used to justify aggregating data across assessors – which was my next step in preparing the data for analyses. To do so, I simply averaged data across assessors for each interaction involving each participant. Thus, the final data for teams' interactions are the mean numbers of times they occurred during taskwork as noted by the assessors present.

Creating "total" and "sharing" team process variables. I next clustered interaction items into team process categories. As a result, each team member's data stream represents the number of times he engaged in every interaction.

I summed this information across members to calculate the *total* number of interactions in each team process category for every team. As mentioned in the preceding measures section, some interactions contributed to team process totals positively while others contributed negatively. Accordingly, when summing interactions, positive interactions counted as "+1"s and negative interactions counted as "-1"s.

To calculate the *sharing* of each team process among members, I divided the number of team members engaging in its associated interactions by the total number of team members. For these sharing variables, only positive interactions ("+1"s) were included in calculations.

Finalizing performance data. Team performance was originally recorded separately for the first half and the second half of each task. I combined the data from both halves to create team performance *quantity* (i.e., the number of assemblies correctly produced) and *quality* (i.e., the percentage of assemblies produced without error).

Descriptive Statistics for All Variables

Before testing hypotheses, I calculated descriptive statistics for all variables from Task 1 and Task 2 (see Table 2). A few of these merit brief review. First, note that some teams fulfilled team processes to a greater extent (e.g., completing) than others (e.g., creating). While some of this is due to simple differences in team strategies and working styles, it is likely also because there were more opportunities – that is, assessor checklist items – for some team processes versus others. The information presented in Table 2 also shows that the quantity of assemblies produced during Task 1 was much greater than in Task 2. This difference exists because in each case teams were given the same amount of time to produce assemblies, but the specific ones produced in Task 2 took longer than did the ones in Task 2.

Correlations among All Variables

Tables 3 and 4 provide results from bivariate correlations carried out for each pair of variables in the dataset. I will next review each significant relationship in turn.

First, the *total* number of interactions in any given team process category was associated with the total number of interactions in other categories[2], suggesting that teams whose members engaged in a given team process to some extent also engaged in other team processes to similar extents. As one example, teams whose members engaged in more calibrating interactions during Task 1 also engaged in more completing ($r = .24$, $p < .001$), contracting ($r = .21$, $p < .001$), contributing ($r = .39$, $p < .001$), cooperating ($r = .11$, $p < .05$), creating ($r = .15$, $p < .01$), and critiquing ($r = .12$, $p < .05$) interactions during Task 1.

In a similar fashion, the *sharing* of any given team process among members was in many cases related to the sharing of other team processes. For example, for teams in which many members engaged in (i.e. shared) the contributing team process during Task 1, many members also tended to engage in calibrating ($r = .23$, $p < .001$), communicating ($r = .23$, $p < .001$), contracting ($r = .15$, $p < .01$), cooperating ($r = .20$, $p < .001$), and creating ($r = .14$, $p < .01$) interactions during Task 1. These significant relationships indicate that teams in which many members fulfill a given team process (i.e., *share* that team process) also tend to share fulfillment of other team processes, while teams that specialize or differentiate in the types of interactions fulfilled by each member tend to do so across the various team processes.

Team process totals were also sometimes related to team process sharing, suggesting that teams whose members engage in many (or few) interactions associated with any given team processes tend to consist of many (or few) members fulfilling team processes. The total number of contracting interactions in Task 1, for example, was associated with greater sharing of contracting ($r = .51$, $p < .001$), contributing ($r = .13$, $p < .01$) and critiquing ($r = .12$, $p < .05$) team processes among members in Task 1.

Finally, the most important relationships in Tables 3 and 4 for the current research are those linking the total number of team process interactions and the sharing of team processes among members with effectiveness outcomes. These correlations can be interpreted as tests of my hypotheses regarding the direction and strength of relationships between the amounts and sharing of each team process with effectiveness outcomes.

In Task 1, better team performance with regard to the *quantity* of assemblies produced correctly was associated with greater amounts of completing (r = .10, *small*[3]) and cooperating (r = .10, *small*) team processes and with less sharing of the communicating (r = -.15, p < .01), contracting (r = -.16, p < .01), contributing (r = -.10, *small*), and creating (r = -.10, *small*) team processes among team members; better team performance with regard to the *quality* of assemblies produced was associated with greater amounts of cooperating (r = .15, p < .01) and creating team process interactions (r = .12, p < .05), and with more sharing of the completing (r = .11, p < .05) and creating (r = .13, p < .05) team processes among team members.

In Task 2, better team performance *quantity* was associated with greater amounts of calibrating (r = .14, p < .01), communicating (r = .15, p < .01), completing (r = .13, p < .05), and creating (r = .11, p < .05) team process interactions, and with more sharing of the calibrating (r = .10, p < .05) team process among team members and less sharing of the critiquing (r = -.15, p < .01) team process among team members; better team performance with regard to the *quality* of assemblies produced was associated with greater amounts of completing (r = .13, p < .05) and creating (r = .17, p < .01) team process interactions, fewer amounts of critiquing (r = -.10, *small*) team process interactions, and with less sharing of the critiquing team process among members.

Aside from these tests of the linear relationships among each team process and outcome, Hypothesis 5a asserted that an upside-down "U"-shaped curve would describe the relationship between the total amount of critiquing interactions carried out by team members and effectiveness outcomes. To test this relationship, I squared the total amount of critiquing interactions in Tasks 1 and 2 and then regressed team performance outcomes (quantity and quality of output produced in Tasks 1 and 2) onto those squared variables after controlling for the total amount of critiquing interactions. These regressions did not produce significant results.

Identifying Performance-related Team Process Patterns

Next, I sought to identify optimal patterns of team process totals, and the sharing of team processes among members – namely, patterns including all team processes as simultaneous predictors of effectiveness outcomes. I used Davison and Davenport's (2002) multiple regression-based procedure for this purpose. While other popular multivariate methods allow one to look for tendencies in a dataset and to establish patterns of predictors, most disregard how predictors relate to outcomes of interest when establishing these patterns. Alternatively, Davison and Davenport's procedure identifies a pattern of predictor values that specifically occur at favorable levels of an outcome. Configural frequency analysis can also be used in this manner, but requires predictors and outcomes to be discrete rather than continuous. If a variable is continuous, then artificial categories can be created before inclusion in the analysis. However, artificial categorization leads to reduced information being incorporated in the test and, as such, configural frequency analysis is not ideal for the current endeavor.

Davison and Davenport's procedure has yet been applied by only a handful of researchers. To ensure the reader understands how I conducted this analysis, I outline my steps in detail below. Note that I carried out this analysis to find optimal patterns of team process *totals* and then again to find optimal patterns of team process *sharing* among members. I identified patterns associated with favorable performance *quantity* in Task *1*, favorable performance *quality* in Task *1*, favorable performance *quantity* in Task 2, and favorable performance *quality* in Task *2*.

The first step of Davison and Davenport's procedure involves identifying the pattern of predictors (i.e., the total *or* sharing of team process interactions among members) associated with favorable standing on an outcome (i.e., team performance quantity *or* quality). Per their directions, I first regressed each performance outcome onto the set of eight predictor variables representing the *total* or *sharing* of team processes among members. Recall that *total* variables represent the overall positive minus negative interactions for a given team process, summed across team members; and the *sharing* variables represent the proportion of team members engaging in interactions associated with a given team process.

Via these multiple regressions, I obtained the unstandardized regression weight for each team process predictor and then computed the average weight across predictors. I then calculated the difference between the unstandardized regression weight for each team process predictor and the average weight among all eight predictors. Tables 5 and 6 present the unstandardized regression weights, their associated standard errors, the average weight across predictors, and the difference between each predictor's unstandardized regression weight and the average weight across predictors. Figure 2 shows the resulting performance-related team process vectors for *team process totals*; Figure 3 shows the vectors for *team process sharing* among members.

Each predictor's value in these vectors represents the "optimal" value associated with favorable team performance *relative to the values for every other predictor*. That is, because multiple regression provides unstandardized regression weights demonstrating the relationship among each predictor and the outcome while controlling for the relationships among other predictors and the outcome, the values in the criterion-related team process vectors can be interpreted as *relative* to the other values (for other predictors) in the same vector. Thus, "peaks" in a vector mean that high-performing teams engage in *more* of that predictor (i.e., team process total or sharing) relative to other predictors, while "lulls" mean that they engage in *less*.

To determine whether each team process predictor had a "significant" influence in the performance-related vectors, Davison and Davenport (2002) recommend using null hypothesis testing via calculation of the *t*-statistic, or the difference between an estimated parameter and its true value divided by the standard error of the estimated parameter, to see whether the difference between the unstandardized regression weight for each predictor and the average weight across predictors is significant. Instead of using a true value in the *t* calculation – which is unknown – the average unstandardized regression weight across predictors is used. Thus, the test statistic is $t = [b_V - \mu(b)]/s(b_V)$, where b_V is the unstandardized regression weight for a particular predictor, $s(b_V)$ is the standard error associated with that weight, and $\mu(b)$ is the average unstandardized regression weight across predictors. After calculating the *t* value for each team process predictor, I compared it to the critical *t* value associated with 90%, 95%, 99.99%, and 99.999% confidence in determining significant differences given the available degrees of freedom and a two-tailed distribution. As shown in Tables 5 and 6, some predictors' vector values are significant using this method. However, all vector values – those that are significant and those that are not – are ultimately included in my (and Davison and Davenport's) tests of whether teams that fulfill interactions consistent with these vectors perform better than those that do not (to be discussed later). Consequently, the fact that some predictors are significant while others are not is slightly misleading because all predictor values (whether significant or not) are ultimately useful determinants of teams' performance. Nonetheless, *t* values, along with stars indicating significance where appropriate, are provided in the rightmost columns of Tables 5 and 6.

I will first review the performance-related team process vectors for *totals* predictors, as depicted in Figure 2. As can be seen in these vector charts, the null hypothesis, H_0: $b_V = \mu(b)$, was rejected for one predictor when predicting Task 1 performance quantity, three predictors when predicting Task 1 performance quality, four predictors when predicting Task 2 performance quantity, and two predictors when predicting Task 2 performance quality.

- The vector of team process totals values associated with favorable Task 1 performance quantity is marked by *more* calibrating, completing, and cooperating interactions; *fewer* communicating, contributing ($p < .05$), and creating interactions; and an *average* amount of contracting and critiquing interactions.
- The vector of team process totals values associated with favorable Task 1 performance quality is marked by *more* calibrating, communicating, cooperating ($p < .05$), and creating interactions; *fewer* completing, contributing ($p < .01$) and critiquing ($p < .10$) interactions, and an *average* amount of contracting interactions.
- The vector of team process totals values associated with favorable Task 2 performance quantity is marked by *more* calibrating ($p < .05$), communicating ($p < .05$), completing, and creating interactions; and *fewer* contracting, contributing ($p < .01$), cooperating, and critiquing ($p < .10$) interactions.
- The vector of team process totals values associated with favorable Task 2 performance quality is marked by *more* calibrating, communicating, completing, contracting, and creating ($p < .10$) interactions; and *fewer* contributing, cooperating, and critiquing ($p < .001$) interactions.

As for the performance-related team process vectors for *sharing* predictors (as depicted in Figure 3), the null hypothesis, H_0: $b_V = \mu(b)$, was rejected for two predictors when predicting Task 1 performance quantity, one predictor when predicting Task 1 performance quality, two predictors when predicting Task 2 performance quantity, and one predictor when predicting Task 2 performance quality.

- The vector of team process sharing values associated with favorable Task 1 performance quantity is marked by *more* sharing of completing and cooperating (p < .10) team processes among members; *less* sharing of communicating, contracting (p < .10), and creating team processes among members; and *average* sharing of calibrating and critiquing team processes among members.
- The vector of team process sharing values associated with favorable Task 1 performance quality is marked by *more* sharing of completing and creating team processes among members; and *less* sharing of calibrating, communicating, contracting, contributing (p < .10), cooperating, and critiquing team processes among members.
- The vector of team process sharing values associated with favorable Task 2 performance quantity is marked by *more* sharing of calibrating (p < .01), communicating, and completing team processes among members; *less* sharing of contracting, contributing, cooperating, and critiquing (p < .01) team processes among members; and *average* sharing of creating interactions among members.
- The vector of team process sharing values associated with favorable Task 2 performance quality is marked by *more* sharing of calibrating, communicating, completing, contracting, contributing, and creating team process among members; and *less* sharing of cooperating and critiquing (p < .01) team processes among members.

Next, I investigated how closely the interactions carried out by each team in the sample matched (i.e., covaried) with these performance-related team process patterns. If these patterns truly represent “optimal” team process fulfillment, then teams whose interactions more closely match them should perform better than those who do not.

For this purpose, per Davison and Davenport (2002), I computed the covariance between the values in the performance-related team process patterns (presented in Tables 5 and 6 and Figures 2 and 3) and each team’s actual interaction data (with regard to *total* team process interactions and the *sharing* of team processes among members). This calculation can be described by $Cov_{tc} = (1/V)\sum_{v}(X_{tv} - X_t)(X_{cv} - X_c)$, where V is the number of predictors (eight), X_{tv} is team t’s datum for each predictor, X_t is team t’s average score across the (eight) predictors, X_{cv} is the value for each predictor in the performance-related team process vector, and X_c is the average of all (eight) predictor scores in the performance-related team process vector. Using this formula, a covariance score was assigned to each team in the sample.

Regressing performance outcomes onto these covariance scores allows one to examine the extent to which each team’s data corresponds with the performance-related team process patterns discussed earlier. Because these covariance scores include by necessity a *level* component (i.e., height on the y-axis), it is important to separate the effects of the *level* of a given team’s process pattern from the effects of the *matching* of its pattern to the optimal one when predicting performance. If the level (average value across predictors) significantly and positively predicts performance, this means that a greater overall amount of team process interactions or the greater sharing of team processes in general results in better effectiveness outcomes. Above and beyond the level effect, if the matching effect is significant and positive, then teams that more closely match the "optimal" performance-related team process patterns perform better than those that do not.

To this end, I ran hierarchal regressions in which the first step involved entering teams' average scores across predictors (X_t) and the second step involved entering teams' covariances (amount of match with regard to values from the performance-related team process patterns, Cov_{tc}). Results from these regressions are presented in Tables 7 and 8 and are described in detail next.

When predicting performance outcomes from team process *totals*, the *level* of a team's process pattern positively predicted Task 1 performance quality (β = .09, p < .10), Task 2 performance quantity (β = .15, p < .01), and Task 2 performance quality (β = .12, p < .05). Above and beyond that effect, the *matching* of a team's team process pattern with "optimal" performance-related team process vector positively predicted all Task 1 and Task 2 performance outcomes (βs ranged from .15, p < .01, to .24, p < .001). These results indicate that greater overall amounts of team process interactions are associated with better performance in most cases. And, after controlling for those relationships, the matching of a team's data with the "optimal" performance-related team process pattern was positively associated with all four performance outcomes.

When predicting performance outcomes from team process *sharing*, the *level* of a team's process pattern negatively predicted Task 1 performance quantity (β = -.19, p < .001) and positively predicted Task 1 performance quality (β = .09, p < .10). Above and beyond that effect, the *matching* of a team's process pattern with the "optimal" performance-related team process pattern positively predicted all Task 1 and Task 2 performance outcomes (βs ranged from .16, p < .01, to .24, p < .001). These results indicate that less sharing of team processes among members is associated with better Task 1 performance quantity and greater sharing is associated with better Task 1 performance quality. After controlling for these relationships, the matching of a team's data with the "optimal" performance-related team process vector was positively associated with all four performance outcomes.

DISCUSSION

Considering the Results

Main effects. A review of theory and empirical evidence from a variety of literatures led to specific predictions regarding the direction and strength of relationships between team process totals, and team process sharing among members, and team effectiveness outcomes. Some of these predictions were fully supported while others were supported partially or not at all. The results associated with each hypothesis are detailed in Table 9. Rather than repeat that information here, I will instead discuss which team process totals and sharing variables were actually associated with effectiveness outcomes.

In Task 1, teams produced a greater number of error-free assemblies (team performance *quantity*) when members fulfilled more completing or cooperating interactions or when a smaller proportion of team members engaged in communicating, contracting, contributing, and creating team processes. Teams in Task 1 produced a higher percentage of error-free assemblies (team performance *quality*) when members fulfilled more cooperating or creating interactions or when a greater proportion of members engaged in completing and creating team processes. These results have important implications for researchers and practitioners interested in enhancing a team's effectiveness in the initial phase of its development. Specifically, complying with external and internal influences (cooperating) seems integral to success both with regard to producing high output volumes and low error rates. In addition, if team performance *quantity* is more important than *quality*, then one should focus on increasing the likelihood that team members finish their own and others' work assignments (completing); if team performance *quality* is important, then the focus should be on prompting team members to originate and innovate strategies for taskwork (creating).

Also of note is the difference in direction for relationships between the sharing of team processes and performance quantity versus the sharing of team processes and performance quality. Teams that produced a greater number of error-free assemblies (team performance *quantity*) tended to have members who shared team processes less (i.e., communicating, contracting, contributing, creating); while teams that produced a higher percentage of error-free assemblies versus total assemblies (team performance *quality*) tended to have members who shared team processes more (completing, creating). Accordingly, if what one seeks are teams that produce a large number of products, then it may be better to train or instruct members to specialize in the types of interactions they engage in rather than share them; if one desires for teams to have low error rates, then members should share roles rather than specialize.

In Task 2, teams produced a greater number of error-free assemblies (team performance *quantity*) when members fulfilled more calibrating, communicating, completing, or creating interactions or when *more* members engaged in calibrating interactions or *fewer* engaged in critiquing interactions. Teams in Task 1 produced a higher percentage of error-free assemblies (team performance *quality*) when members fulfilled *more* completing or creating interactions or *fewer* critiquing interactions or when fewer members engaged in critiquing interactions. By comparing the types of team processes important for effectiveness in Task 2 versus Task 1, one can infer what teams should do early on in their development versus later.

The Task 2 results indicate that teams whose members complete their own and others' task work, and teams whose members often originate and innovate strategies for task work, are more effective both with regard to producing high output volumes and to generating output with low error rates. There are also some differences between which variables are critical for performance quantity versus quality: If the former type of performance is preferred, then one should focus on increasing the likelihood that team members discuss interpersonal issues and suggest ways to fix them (calibrating) or create an maintain a positive social environment (communicating); if the latter type is preferred, then the focus should be on prompting team members to avoid evaluating and challenging one another's ideas (critiquing). In addition, recall that in Task 1 performance *quantity* was associated with less team process sharing while performance *quality* was associated with more team process sharing. In Task 2, this difference remained – albeit was much less noticeable.

Pattern effects. After examining bivariate relationships among *each* team process variable and *each* team effectiveness outcome, the next step involved identifying optimal patterns of interactions *across all* team processes that were indicative of team success. Davison and Davenport's (2002) multiple-regression based procedure was used to detect optimal patterns of total amounts of team process interactions for Task 1 performance quantity, Task 1 performance quality, Task 2 performance quantity, and Task 2 performance quality; and to detect optimal patterns of team process sharing for each of these same outcomes. As opposed to looking at bivariate relationships between a process and an outcome separately, working with comprehensive predictor patterns allows one to understand which team processes are *most* critical for success *relative to others*. As mentioned earlier, this pattern perspective (and analysis) of team process interactions is fairly novel; usually, team effectiveness researchers focus on one or a few team processes at a time (e.g., conflict, coordination, communication, problem-solving) rather than including many in the same set. By examining all team processes simultaneously, it is possible to cultivate a fuller, more inclusive understanding of which team processes are most critical for success earlier versus later in team development, as well as which ones are most critical for performance outcomes with regard to quantity versus quality.

In earlier sections of this paper I made predictions for which team process patterns would be most optimal. Based on pertinent findings in the team roles literature, and a recent meta-analysis of team processes' relationships with effectiveness outcomes, it seemed likely that task-oriented processes would be more critical than social-oriented processes. Alternatively, team development theory led me to believe that different processes might emerge as most important depending on the stage of team development – namely, in an initial versus a subsequent task. Another focus was on sorting out inconsistencies in the team roles literature by exploring whether team process "balance" (i.e., specialization of team process fulfillment) would always be better for team performance, both across tasks and across team processes.

The results already described included details and figures for the identified "optimal" team process patterns with regard to favorable performance quantity and quality in Tasks 1 and 2. Results showed that *some* team process (totals) patterns were marked by greater fulfillment of task-oriented versus social-oriented processes, while other patterns were marked by greater fulfillment of social-oriented versus task-oriented processes, and still others were marked by some task-oriented *and* some social-oriented processes being fulfilled to greater extents. Looking at the patterns simultaneously, it is clear that task-oriented processes aren't always better for performance than social-oriented ones or vice versa. Instead, specific processes seem especially critical for team success at each time point and for each outcome.

Recall that there have been inconsistent findings in the team roles literature with regard to whether team members' activities should be balanced or shared. In some cases, it has been shown that each member of a team should carry out a different type of activity (i.e., team members should specialize); in other cases, it has been shown that overlap or sharing is more beneficial than specialization. Results here showed that the answer differs depending on which team process is at focus. For example, the optimal pattern of team process sharing for performance quantity in Task 1 includes *more* members engaging in completing and cooperating interactions and *fewer* members engaging in communicating, contracting, and creating interactions.

Also of relevance are the differences in level or elevation across team process patterns – specifically, differences among patterns associated with favorable performance quantity versus those associated with favorable performance quality. In the earlier discussion of main effects results (bivariate relationships among processes and performance outcomes), I mentioned that high-performing teams in terms of quantity consisted of members who shared team processes *less*, while high-performing teams in terms of quality consisted of members who shared the fulfillment of team processes *more*. This effect is also evident in the team process patterns provided in Figure 3. By comparing the team process patterns for performance quantity with those for performance quality, it is clear that the levels or elevations of the latter are greater than the former. This suggests again that high-performing teams in terms of *quantity* tend to share less (on average, across all team processes) and high-performing teams in terms of *quality* tend to share more.

After identifying optimal team process patterns, I regressed each performance outcome onto variables representing the level and matching of team process fulfillment. These analyses allowed me to parse apart the variance in performance outcomes accounted for into the variance due to (1) the level or elevation of a given team's process pattern and (2) the matching of a given team's process pattern to the optimal team process pattern. In most cases, the level effects were significant: For the total amount of team process interactions, teams with more elevated process patterns performed better; for the sharing of team processes, more elevated process patterns were better for performance quality and less elevated process patterns were better for performance quantity – again supporting the different effects of team process sharing depending on which performance indicator is being used. The incremental effects of matching were significant in all cases: The closer a given team's interaction pattern was to the optimal team process pattern (both with regard to total amounts of team process interactions fulfilled and the sharing of team processes among members), the better team performance was with regard to quantity and quality.

Practical Implications

Taken together, these results indicate substantial understanding regarding what specific configurations of member interactions are optimal at different phases of team development. One might consider a number of ways this knowledge can be applied in organizations to enhance the likelihood or ability of teams to approximate those configurations. Among the practical implications associated with these results is the ability to target resources toward team training initiatives focused on certain competencies and requirements versus others. Members could be trained to fulfill some team processes to greater or lesser extents, and to share or specialize in each team process based on these optimal patterns. Similarly, providing feedback regarding a team's current process pattern, the optimal process pattern, and information about how to make adjustments toward the latter may be extremely helpful to preexisting teams.

By aiming this investigation toward identifying team-level interaction patterns regardless of who members are or their individual characteristics, results should be informative for teams working in most if not all similar environments. In particular, these results may provide value to managers who are initially creating teams or those working with high churn teams (through which members often fluctuate in and out over the course of a project). Often times, team member selections are made in these situations based on a predetermined, desirable composition of individual qualities like personality and ability. However, given these results it seems likely that ideal newcomers are ones who can join a team and quickly fill in behavioral gaps due to the leaver's absence. These ideal newcomers may be, for example, employees with particularly high scores across the board for team role-related knowledge assessed using Mumford and colleagues' (2008) measure; or, they may be employees with particularly high scores in those team role categories that are currently lacking.

Finally, note that in team selection and composition decisions there is obvious merit in making a priori decisions about what types of team effectiveness is desired – greater volumes or lower error rates? The optimal configuration of team process interactions may be very different for each (as in the current research) and, accordingly, practitioners intending to make use of this perspective or methodology will need to consider which outcome is of most interest or value to them. By carefully thinking about these issues and putting knowledge garnered from these team process patterns into practice, managers can position themselves to understand, train, select, and provide feedback to their work teams.

Limitations and Recommendations for Future Research

There are a number of strengths associated with this research, including the rigorous behavior-based methodology used to collect data, the large field-based sample, the comprehensive approach applied for conceptualizing and analyzing team member interactions, the test of a fairly new and rigorously-developed team member interaction taxonomy, and the use of a novel and promising analysis for identifying optimal predictor patterns. However, as with any research endeavor, there are also certain limitations worth mentioning.

First, Mumford and colleagues' (2006) team role taxonomy was used to distinguish among different types of team member interactions (i.e., team processes). As discussed earlier, this taxonomy was developed based on decades of scientific and field-based knowledge, but has yet been tested only a handful of times. Because of the rigor with which it was developed, and clear similarities among how team roles and team processes are defined and categorized, it seemed worthwhile to evaluate this promising taxonomy from a novel perspective. However, it is possible that the current results might have differed if another taxonomy were used. Given the overlap among the categories in this taxonomy versus others in the team effectiveness literature, though, differences would surely be slight if not negligible.

Another limitation is the archival nature of this data. I had no influence on how it was collected, and as a result, the dataset lacked certain information that could have informed the conceptual basis for this paper. For example, there is a burgeoning focus in organizational psychology and behavior on determining whether certain members of a team have greater influence on team outcomes versus others (c.f. Humphrey, Morgeson, & Mannor, 2009; Pearsall & Ellis, 2006). It would have been interesting and informative to investigate whether critical members can drive (or fail to drive) the fulfillment of optimal team process patterns (e.g., leaders versus followers; members with greater ability, expertise, or status; or members with formal functions that have greater influence on team outcomes).

It also would have been useful to examine not only the number of team process interactions and how many members were fulfilling them but also the quality of those interactions. Aside from whether or not someone does something in a team, it should matter how well (or poorly) it is done. Recent work by Mathieu and Rapp (2009) reveals that the quality of a team's initial collective strategy for task work (i.e., early creating interactions) is positively associated with the favorability of its performance trajectory over time. Future research that measures creating-like interactions at multiple time points – for example, examining whether the quality of early creating interactions is especially influential for team effectiveness but the quality of later ones is less so – would certainly be valuable. Of course, longitudinal investigations of other team processes – preferably in the form of studies that collect and analyze data regarding as many team processes as possible – would also be instrumental in this way.

Another related and promising area for future research would involve examining not only optimal team process patterns in aggregate over the course of a task but also the optimal sequencing of team member interactions *within* a task. In addition to certain team processes being more critical than others in general at different stages of team development, it may be that some types of interactions should always (or never) follow others. Just as one might train teams to fulfill and share specific critical team processes, one might also train team members to be aware of how to dynamically coordinate their interactions towards success. Many popular team models are temporally-based and discuss the importance of dynamic coordination and sequencing (e.g., Kozlowski, Gully, Nason, & Smith, 1999; Marks, Mathieu, & Zaccaro, 2001; McGrath, 1993; Rico, Manzanares, Gil, & Gibson, 2008), but few empirical studies have been conducted in this complex yet vital area.

A final limitation associated with this study was the context of the sample, which included only selection assessment center teams from the American automobile manufacturing industry. As such, the results may not generalize to teams in other contexts, for whom different forms of team process fulfillment might prove better. Mumford and colleagues (2006) review a number of these situational influences; and findings from elsewhere in the team process literature can also inform researchers interested in extending or comparing the current results to those discovered in new contexts. For example, *contracting* and *creating* interactions might be more important in extremely ambiguous and complex situations in which members are uncertain about which steps to take (O'Driscoll & Beehr, 1994; Pescosolido, 2002). The significance of *contracting* interactions may also be greater in highly interdependent teams because of an increased need to manage others in order to succeed as a unit (Cheng, 1983). *Contributing* might be more beneficial for teams whose members hold diverse information applicable to the task because their collective performance is contingent on whether or not all relevant information is shared (Stasser, Taylor, & Hanna, 1989; Stasser & Titus, 1985). *Contributing* interactions may be more valuable for teams whose members vary in power status because these situations often result in lower-status members speaking up less, particularly with regard to information that challenges the relative expertise of higher-status members (Milanovich, Driskell, Stout, & Salas, 1998). Although optimal team process patterns discovered in the current endeavor tended to consist of few critiquing interactions (and little sharing of critiquing among team members), in other cases critiquing likely serves an invaluable role in team success. In particular, teams whose work requires making decisions or coming up with ideas might benefit from high levels and more sharing of *critiquing* (Katz & Kahn, 1978). When the team seems to be moving forward with a plan without adequately considering its related costs and consequences, pointing out its potential flaws will ultimately help the team to be successful (Janis, 1982; Lawrence & Lorsch, 1969). *Completing* interactions may be less useful when taskwork results in intangible output like an idea or decision because each team member's responsibilities are ambiguous (McGrath, 1984). *Communicating* may be particularly vital when the team's task is socially complex (i.e., if issues are emotionally-charged or if members have differing attitudes, Herold, 1978), when the team is under pressure such that members are stressed (McIntyre & Salas, 1995; Hackman, 1987), or when there is great diversity within the team (van Knippenberg, De Dreu, & Homan, 2004). Further, *communicating* interactions may be more critical for team effectiveness outcomes in discussion-based situations, for example in collaborative problem-solving teams, versus in production-based teams whose ultimate output does not depend so much on the positivity of the team's social climate. Finally, *cooperating* interactions may be particularly important when team members have already incorporated dissenting opinions in their decision-making and when members are deferring to others whose expertise is greater than their own (Libby, Trotman, & Zimmer, 1987; Littlepage, Robison, & Reddington, 1997). If it is the case that optimal team process patterns are context-dependent (and it is difficult to know whether it is without further study), then methodologies that first identify optimal patterns and then select, train, and provide feedback for teams (in each context) would be preferable.

Aside from the situational influences impacting which team processes are most and least critical for effectiveness outcomes, there may be contextual implications due to the nature of the parts produced in Tasks 1 and 2. The two tasks used in this research involved assembling specific subcomponents of automobile engines. Although one part was neither more complex nor difficult to produce than the other, it is possible that participants were more familiar with one than the other and – if so – this familiarity may have impacted their interactions and performance. Because the data is archival, however, it is impossible to know whether this is the case.

Finally, the likely competitive and individualistic goals of participants used in this research may serve as boundary conditions for the generalizability of my results. Participants were job applicants competing for open positions against their team mates. As such, it is probable that they held strong individual-oriented goals (i.e., attain the job for oneself; portray oneself as a “team player” at the cost of others) that may not generalize to other contexts where feelings of intra-team competition are rarer.

Conclusion

This research investigated how different team processes should optimally be fulfilled with regard to the total amount of interactions across members as well as the sharing (or, alternatively, the specialization) of team processes among team members. A number of predictions were made regarding the value of certain team process manifestations versus others that were based in extant knowledge from the team roles and team effectiveness/process-focused literatures. Bivariate tests of relationships between each team process and each effectiveness outcome were conducted, as were uniquely comprehensive pattern-based analyses focusing on the optimal fulfillment of all team processes simultaneously. Ultimately, the team process patterns identified in this endeavor can inform scholars interested in team issues like development, process fulfillment, and function/role specialization and sharing. Managers interested in enhancing team training, selection, and feedback initiatives will also benefit from learning about these results.

FOOTNOTES

[1] I do not describe or test Mumford, Campion, and Morgeson's (2006) boundary-spanning categories, which involve interactions outside the team environment, because they are simply outside the scope of the current endeavor.

[2] In the multiple regression analyses carried out in the "Identifying Behavior Patterns Predictive of Favorable Team Performance" section, the presence of multicolinearity – the significant relationships among predictors – may result in invalid parameter estimates regarding the usefulness of each individual predictor. It is assumed that multiple predictors included in a regression model are uncorrelated and – as a result – that each predictor's estimated effect on the outcome can be interpreted as existing while holding the effects of other predictors constant. However, when predictors are multicollinear, it becomes difficult to show that the relationship between a predictor and an outcome changes independently of the relationships among the other predictors and the outcome. Thus, multicollinear predictors may be redundant in that each does not provide unique predictive ability but rather overlapping predictive ability. As a result, standard errors associated with the estimates for predictors tend to be large and Type II errors are likely to occur such that I might incorrectly determine that no linear relationship exists between a predictor and an outcome when in fact such a relationship does exist. In order to check whether multicollinearity among predictors is problematic in the current research, I ran multiple regressions predicting Task 1 and Task 2 performance quantity and quality from the set of eight total team process predictors and the set of eight team process sharing predictors (the same regressions used to establish criterion-related predictor patterns). In all cases, tolerance values were sufficiently high and variance inflation factor values were sufficiently low, suggesting that multicollinearity does not present a critical issue in the current research.

[3] Because the sample size (and power) is less than the amount required to detect the significance of small effects, I also report (non-significant) small effects using Cohen's (1992) classification rules (small effect = .10 - .30).

APPENDICES

Table 1

Checklist items (team member interactions) sorted into team process categories

Task 1 Item	**Team Process**	**Value**
Asked for agreement, disagreement, or consensus on problems or suggestions.	Calibrating	+1
Rephrased or added information to others' suggestions.	Calibrating	+1
Asked for opinions, suggestions, or feedback from others.	Calibrating	+1
Summarized viewpoints in a disagreement between members; suggested compromise.	Calibrating	+1
Asked questions of a team member whose ideas or understanding of a task were unclear; asked others to clarify their ideas.	Communicating	+1
Accurately interpreted instructions when explaining them to others.	Communicating	+1
Thanked others for assistance, suggestions, or feedback.	Communicating	+1
Addressed comments to all group members during meetings.	Communicating	+1
Repeatedly engaged in small talk.	Communicating	+1
Addressed group members who had not been talking.	Communicating	+1
Addressed group members by their names.	Communicating	+1
Incorrectly interpreted instructions, suggestions, or ideas.	Communicating	-1
Repeatedly interrupted others by stating own opinion or changing the subject.	Communicating	-1
Addressed comments to only one or two group members during the meetings.	Communicating	-1
Assembled at a systematic, steady pace.	Completing	+1
Stood or moved to facilitate the discussion or assist others.	Completing	+1
Visually inspected and compared own assemblies to example unit.	Completing	+1
Handled exercise materials carefully (e.g., placed assemblies in bins, did not force gages).	Completing	+1
Implemented effective changes discussed in the team meeting.	Completing	+1
Was first to begin work on team meeting tasks.	Completing	+1
Increased speed or changed methods to complete additional units before end of assembly session.	Completing	+1

Table 1 (cont.)

Stated that he/she would improve own production, quality, or work methods.	Completing	+1
Disassembled during assembly session to correct errors.	Completing	+1
Did not participate or sat idle through most of assembly #2 or set-up.	Completing	-1
Assembled at a slow or erratic pace.	Completing	-1
Did not compare own work with example unit.	Completing	-1
Did not complete task correctly after repeatedly watching, asking, or being told how.	Completing	-1
Did not identify causes of errors in assemblies.	Completing	-1
Did not assist with counting, checking, or charting assemblies.	Completing	-1
Repeatedly suggested high production or quality goals for self or group.	Contracting	+1
Stated support for high goals for self or group.	Contracting	+1
Summarized group’s progress, decisions, or ideas.	Contracting	+1
Reminded others about the importance of quality, productivity, or safety.	Contracting	+1
Repeated instructions when others were not complying.	Contracting	+1
Reminded others about tasks to be completed or time remaining.	Contracting	+1
Summarized the group’s assembly session performance.	Contracting	+1
Outlined a structure to organize problems, evaluate changes, or ensure task completion.	Contracting	+1
Stated confidence in the group’s or another’s ability to improve performance.	Contracting	+1
Suggested that goal accomplishment was within group control.	Contracting	+1
Suggested that goal accomplishment was outside of group’s control (e.g., parts, facilities, or instructions).	Contracting	-1
Stated that the goal should be lowered.	Contracting	-1
Suggested slowing production, reducing quality checks, or inappropriately deviating from instructions.	Contracting	-1
Ordered group members to do tasks before asking for their input.	Contracting	-1

Table 1 (cont.)

Provided information or other assistance to team or a member without being asked.	Contributing	+1
Told or showed others the difficulties he or she had with assembly.	Contributing	+1
Provided information or other assistance to team or a member when asked.	Contributing	+1
Told or showed others the ideas that had improved his or her own work.	Contributing	+1
Did not tell others about changes that improved his or her own performance.	Contributing	-1
Did not provide information or other assistance to team or a member when asked.	Contributing	-1
Participated in the discussion to a limited extent or not at all.	Contributing	-1
Adapted or changed position because of comments critical of own position.	Cooperating	+1
Followed instructions for assembly and meetings.	Cooperating	+1
Followed instructions for safety concerns (e.g., pick up dropped parts, neat work area).	Cooperating	+1
Agreed to compromise and follow through with changes.	Cooperating	+1
Attended to comments critical of own position without arguing.	Cooperating	+1
Gave credit to or praised others for their ideas or performance.	Cooperating	+1
Followed exercise instructions when others stated resistance.	Cooperating	+1
Did not follow instructions for assembly or meetings.	Cooperating	-1
Did not follow instructions for safety concerns (e.g., pick up parts, neat work area).	Cooperating	-1
Violated instructions in a way that provided a direct personal advantage (e.g., assembling after time was called, copying from another’s suggestion sheet).	Cooperating	-1
Refused to try another’s idea; stated he or she would pursue his or her own work methods.	Cooperating	-1
Repeatedly discounted or argued over comments critical of own position.	Cooperating	-1
Identified inefficiencies or originated suggestions concerning sorting parts.	Creating	+1

Table 1 (cont.)

Originated specific and effective improvements concerning: parts supply, facilities, or exercise material.	Creating	+1
Originated specific and effective improvements concerning: assembly station set up (e.g., use stand as bin).	Creating	+1
Suggested others work faster or that they follow specific suggestions to improve quality, productivity or safety.	Creating	+1
Originated specific and effective improvements concerning: quality checking of parts or assemblies.	Creating	+1
Originated specific and effective improvements concerning: assembly sequence or procedures/assembly line.	Creating	+1
Tried several assembly methods before selecting one during assembly session 2.	Creating	+1
Suggested, implemented, or supported ineffective changes.	Creating	-1
Did not improve work methods in second assembly period.	Creating	-1
Did not suggest ideas of his or her own designed to improve operations.	Creating	-1
Stated that nothing further could be done to improve the process or that original assembly process was most effective.	Creating	-1
Suggested using initial assembly process in spite of recognized inefficiencies.	Creating	-1
Accurately stated the causes of increased or decreased productivity or quality.	Critiquing	+1
Accurately stated that a suggestion would improve or decrease productivity or quality for group or install team.	Critiquing	+1
Stated logical reason to support or discredit suggestion or recommendation (e.g., past experience or a benefit).	Critiquing	+1
Disagreed without stating the person was wrong.	Critiquing	+1
Identified inefficiencies or stated improvements were needed concerning: parts supply, facilities, or exercise material.	Critiquing	+1
Identified inefficiencies or stated improvements were needed concerning: assembly station set up (e.g., use stand as bin).	Critiquing	+1
Identified causes of errors in assemblies.	Critiquing	+1
Identified inefficiencies or stated improvements were needed concerning: quality checking of parts of assemblies.	Critiquing	+1

Table 1 (cont.)

Identified inefficiencies or stated improvements were needed concerning: assembly sequence or procedures/assembly line.	Critiquing	+1
Stated logical and systematic rationale to support or discredit suggestions and recommendations (e.g., identifying pros and cons, detailing specific impact of quality and quality).	Critiquing	+1
Asked questions which tested an assumption or a proposed change.	Critiquing	+1
Discounted effective solutions without providing factual or logical reasons.	Critiquing	-1
Disagreed with a suggestion without explaining why.	Critiquing	-1
Suggestions and comments focused on a single issue.	Critiquing	-1
Stated negative comments about the exercise without providing basis for such comments.	Critiquing	-1
Asked others for assistance on his/her own tasks.	NO MATCH	0
Suggested he or she was partly responsible for group's quality or productivity problems.	NO MATCH	0
Spoke of "I," instead of "we"; claimed credit for good ideas.	NO MATCH	0
Blamed others for quality or productivity problems.	NO MATCH	0
Threw or forced parts, assemblies, gages, or other exercise materials.	NO MATCH	0

Task 2 Item	**Team Process**	**Value**
Asked for agreement, disagreement, or consensus on problems or suggestions.	Calibrating	+1
Asked for opinions, suggestions, or feedback from others during discussion.	Calibrating	+1
Summarized both viewpoints in a disagreement between members; suggested compromise.	Calibrating	+1
Rephrased or added information to others' suggestions.	Calibrating	+1
Repeatedly engaged in small talk.	Communicating	+1
Accurately interpreted instructions when explaining them to others.	Communicating	+1
Asked questions of a team member whose ideas or understanding of a task were unclear; asked others to clarify their ideas.	Communicating	+1

Table 1 (cont.)

Addressed group members who had not been talking.	Communicating	+1
Addressed group members by their names.	Communicating	+1
Asked others if they were comfortable performing the station tasks.	Communicating	+1
Thanked others for assistance, suggestions, or feedback.	Communicating	+1
Addressed comments to all group members during meetings.	Communicating	+1
Incorrectly interpreted instructions, suggestions, or ideas.	Communicating	-1
Repeatedly interrupted other's discussion by stating own opinion or changing the subject.	Communicating	-1
Addressed comments to only one or two group members during the meetings.	Communicating	-1
Was first to begin work on team meeting tasks.	Completing	+1
Asked to work at a difficult station (e.g., cam install and parts distribution).	Completing	+1
Compared station set-up with the set-up diagram after disassembly, and corrected inconsistencies in own and other stations.	Completing	+1
Disassembled or recommended disassembly of cam units to correct errors.	Completing	+1
Kept busy or asked for more work during the second assembly and disassembly sessions.	Completing	+1
Volunteered to exchange work stations.	Completing	+1
Visually inspected and compared own work to diagrams or examples.	Completing	+1
Handled exercise materials carefully (e.g., placed assemblies in bin, did not force parts or gauges).	Completing	+1
Implemented effective changes discussed in the team meeting.	Completing	+1
Moved to facilitate the discussion or assist others.	Completing	+1
Did not participate or sat idle through most of the assembly #2, set-up, or disassembly.	Completing	-1
Asked to work at the least difficult station or refused to change stations.	Completing	-1
Refused to perform tasks outside of station description during second assembly session.	Completing	-1

Table 1 (cont.)

Did not compare own work with diagram or example.	Completing	-1
Did not identify causes of errors in assemblies.	Completing	-1
Did not complete task correctly after repeatedly watching, asking, or being told how.	Completing	-1
Did not offer assistance when he or she was available to help.	Completing	-1
Repeatedly suggested high production or quality goals or more cross training for self or group.	Contracting	+1
Reminded others about tasks to be completed or time remaining.	Contracting	+1
Stated support for high goals or more cross training for self or group.	Contracting	+1
Suggested that goal accomplishment was within group control.	Contracting	+1
Reminded others about the importance of quality, productivity, or safety.	Contracting	+1
Repeated instructions when others were not complying.	Contracting	+1
Outlined a structure to organize problems, evaluate changes, or ensure task completion.	Contracting	+1
Stated confidence in the group's or another's ability to improve performance.	Contracting	+1
Summarized group's progress, decisions, or ideas.	Contracting	+1
Summarized the group's assembly session performance.	Contracting	+1
Suggested that goal accomplishment was outside of group's control (e.g., parts, facilities, or instructions).	Contracting	-1
Stated that goals should be lowered or cross training eliminated.	Contracting	-1
Suggested slowing production, reducing quality checks, or inappropriately deviating from instructions.	Contracting	-1
Ordered group members to do tasks before asking for their input.	Contracting	-1
Accurately explained other station's tasks without having worked at that station.	Contributing	+1
Told or showed others the ideas that had improved his or her own work.	Contributing	+1
Assisted or arranged for assistance to team or a member without being asked.	Contributing	+1

Table 1 (cont.)

Told or showed others the difficulties he or she had with assembly.	Contributing	+1
Provided information or other assistance to team or a member when asked.	Contributing	+1
Did not tell others about changes that improved his or her own performance.	Contributing	-1
Participated in the discussion to a limited extent or not at all.	Contributing	-1
Did not provide information or other assistance to team or a member when asked.	Contributing	-1
Followed exercise instructions when others stated resistance.	Cooperating	+1
Followed instructions for assembly and meetings.	Cooperating	+1
Followed instructions for safety concerns (e.g., gloves, pick up dropped parts, neat work area).	Cooperating	+1
Gave credit to or praised others for their ideas or performance.	Cooperating	+1
Adapted or changed position because of comments critical of own position.	Cooperating	+1
Agreed to compromise and follow through with changes.	Cooperating	+1
Attended to comments critical of own position without arguing.	Cooperating	+1
Did not follow instructions for assembly or meetings.	Cooperating	-1
Did not follow instructions for safety concerns (e.g., gloves, picking up parks, keeping neat).	Cooperating	-1
Refused to try another's idea; stated he or she would pursue his or her own work methods.	Cooperating	-1
Repeatedly discounted or argued over comments critical of own position.	Cooperating	-1
Suggested others work faster or that they follow specific suggestions to improve quality, productivity or safety.	Creating	+1
Originated specific and effective improvements concerning: parts, facilities, exercise materials, individual station set up.	Creating	+1
Originated specific and effective improvements concerning: instituting or improving quality checks.	Creating	+1
Originated specific and effective improvements concerning: tracking models and cam box orders.	Creating	+1

Table 1 (cont.)

Originated specific and effective improvements concerning: reorganizing an assembly sequence or organizing disassembly.	Creating	+1
Originated specific and effective improvements concerning: reducing time when self or others are not working/redistributing stations tasks.	Creating	+1
Originated specific and effective improvements concerning: station assignments (e.g., placement or training).	Creating	+1
Tried several work methods before selecting one during assembly session 2.	Creating	+1
Identified inefficiencies and/or originated suggestions concerning sorting parts.	Creating	+1
Suggested, implemented, or supported ineffective changes.	Creating	-1
Stated that nothing further could be done to improve the process or that the original assembly process was most effective.	Creating	-1
Did not improve work methods at station for the second assembly period.	Creating	-1
Did not suggest ideas of his or her own to improve operations.	Creating	-1
Suggested using initial assembly process in spite of recognized inefficiencies.	Creating	-1
Identified causes of errors in assemblies.	Critiquing	+1
Accurately stated the cause of increased or decreased productivity or quality.	Critiquing	+1
Stated logical and systematic rationale to support or discredit suggestions and recommendations (e.g., identifying pros and cons, detailing specific impact of quality and quality).	Critiquing	+1
Asked questions which tested an assumption or a proposed change.	Critiquing	+1
Accurately stated that a suggestion would improve or decrease productivity or quality.	Critiquing	+1
Stated logical reason to support or discredit suggestion or recommendation (i.e., past experiences or benefit).	Critiquing	+1
Identified inefficiencies or stated improvements were needed concerning: parts, facilities, exercise materials, individual station set up.	Critiquing	+1

Table 1 (cont.)

Identified inefficiencies or stated improvements were needed concerning: instituting or improving quality checks.	Critiquing	+1
Identified inefficiencies or stated improvements were needed concerning: tracking models and cam box orders.	Critiquing	+1
Identified inefficiencies or stated improvements were needed concerning: reorganizing an assembly sequence or organizing disassembly.	Critiquing	+1
Identified inefficiencies or stated improvements were needed concerning: reducing time when self or others are not working/redistributing stations tasks.	Critiquing	+1
Identified inefficiencies or stated improvements were needed concerning: station assignments (e.g., placement or training)	Critiquing	+1
Disagreed without stating the person was wrong.	Critiquing	+1
Stated negative comments about the exercise without providing basis for such comments.	Critiquing	-1
Discounted effective solutions without providing factual or logical reasons.	Critiquing	-1
Suggestions and comments focused on a single issue.	Critiquing	-1
Disagreed with a suggestion without explaining why.	Critiquing	-1
Threw or forced parts, assemblies, gages, or other exercise material.	NO MATCH	0
Asked others for assistance on his/her own tasks.	NO MATCH	0
Suggested he or she was partly responsible for group’s quality or productivity problems.	NO MATCH	0
Blamed others for quality or productivity problems.	NO MATCH	0
Spoke of “I,” instead of “we”; claimed credit for good ideas.	NO MATCH	0

Table 2

Descriptive statistics for all variables

	Task 1				Task 2			
	Min	Max	Mean	SD	Min	Max	Mean	SD
1. Total Calibrating	1.00	29.00	9.39	4.94	1.00	35.00	9.73	6.35
2. Total Communicating Interactions	-13.00	26.00	4.69	4.42	-7.00	26.00	7.62	5.28
3. Total Completing Interactions	1.00	48.00	19.45	7.71	-4.00	42.00	15.26	7.00
4. Total Contracting Interactions	.00	28.50	10.17	4.84	-1.00	30.00	10.08	4.96
5. Total Contributing Interactions	-3.00	30.00	6.66	4.58	-2.00	37.00	8.64	4.93
6. Total Cooperating Interactions	-14.00	26.00	6.45	5.75	-12.50	24.00	7.33	5.73
7. Total Creating Interactions	-9.00	20.00	5.53	5.13	-9.00	28.50	6.79	5.15
8. Total Critiquing Interactions	-3.00	45.00	10.34	5.61	-.50	40.00	12.28	6.04
9. Sharing Calibrating Interactions	.17	1.00	.77	.20	.17	1.00	.75	.21
10. Sharing Communicating Interactions	.00	1.00	.66	.27	.17	1.00	.80	.19
11. Sharing Completing Interactions	.50	1.00	.98	.07	.50	1.00	.96	.10
12. Sharing Contracting Interactions	.00	1.00	.74	.21	.00	1.00	.75	.20
13. Sharing Contributing Interactions	.00	1.00	.72	.23	.17	1.00	.80	.19
14. Sharing Cooperating Interactions	.00	1.00	.89	.18	.25	1.00	.91	.15
15. Sharing Creating Interactions	.00	1.00	.75	.21	.00	1.00	.74	.19
16. Sharing Critiquing Interactions	.00	1.00	.78	.19	.20	1.00	.82	.18
17. Performance Quantity	19.00	123.00	80.92	19.65	.00	34.00	11.99	4.91
18. Performance Quality	37.00	100.00	90.06	10.74	.00	100.00	80.53	21.91

Note. N = 381 for all variables except Performance Quantity and Quality. N = 368 for Task 1 Performance Quantity and N = 364 for Task 1 Performance Quality. N = 366 for Task 2 Performance Quantity and N = 364 for Task 2 Performance Quality.

Table 3

Correlations among all Task 1 variables

	1	2	3	4	5	6	7	8	9	10	11
1. Total Calibrating											
2. Total Communicating	.02										
3. Total Completing	.24***	.06									
4. Total Contracting	.21***	.17***	.06								
5. Total Contributing	.39***	.22***	.30***	.33***							
6. Total Cooperating	.11*	.20***	.35***	.12*	.32***						
7. Total Creating	.15**	.01	.19***	.12*	.13*	.24***					
8. Total Critiquing	.12*	.34***	.12*	.29***	.18***	.13*	.01				
9. Sharing Calibrating	.58***	-.01	.17**	.05	.24***	.13**	.13*	.07			
10. Sharing Communicating	.11*	.59***	.07	.09	.25***	.14**	-.05	.13*	.14**		
11. Sharing Completing	.05	.02	.18***	-.01	.03	.02	.11*	.01	.10*	.02	
12. Sharing Contracting	.03	.05	-.08	.51***	.16**	.06	.06	.15**	.12*	.11*	.05
13. Sharing Contributing	.22***	.14**	.25***	.13**	.69***	.25***	.06	.06	.23***	.23***	.10
14. Sharing Cooperating	.05	.15**	.20***	.03	.17**	.47***	.17**	.08	.15**	.15**	.15**
15. Sharing Creating	.09	-.04	.07	-.04	.05	.14**	.58***	-.14**	.19***	.03	.09
16. Sharing Critiquing	.07	.12*	.05	.12*	.12*	.11*	.06	.58***	.13*	.12*	.06
17. Performance Quantity	.06	.00	.10	.00	-.03	.10	.03	.03	-.08	-.15**	.01
18. Performance Quality	.04	.08	.03	.02	-.04	.15**	.12*	-.03	.07	.04	.11*

Table 3 (cont.)

	12	13	14	15	16	17
1. Total Calibrating						
2. Total Communicating						
3. Total Completing						
4. Total Contracting						
5. Total Contributing						
6. Total Cooperating						
7. Total Creating						
8. Total Critiquing						
9. Sharing Calibrating						
10. Sharing Communicating						
11. Sharing Completing						
12. Sharing Contracting						
13. Sharing Contributing	.15**					
14. Sharing Cooperating	.03	.20***				
15. Sharing Creating	.11*	.14**	.14**			
16. Sharing Critiquing	.23***	.08	.10	.06		
17. Performance Quantity	-.16**	-.10	.01	-.10	-.08	
18. Performance Quality	.02	-.01	.02	.13*	.01	.21***

Note. N = 381 for all correlations except those including Performance Quantity and Quality. N = 368 for correlations with Task 1 Performance Quantity; N = 364 for correlations with Task 1 Performance Quality; N = 356 for the correlation between Task 1 Performance Quantity and Task 1 Performance Quality. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Table 4

Correlations among all Task 2 variables

	1	2	3	4	5	6	7	8	9	10	11
1. Total Calibrating											
2. Total Communicating	.09										
3. Total Completing	.00	.18***									
4. Total Contracting	.11*	.18***	.14**								
5. Total Contributing	.34***	.33***	.17**	.30***							
6. Total Cooperating	.10	.24***	.27***	.11*	.17**						
7. Total Creating	.17**	-.02	.27***	.17***	.07	.14**					
8. Total Critiquing	.20***	.28***	.11*	.30***	.36***	.04	.04				
9. Sharing Calibrating	.56***	.03	-.05	.06	.21***	.01	.08	.13**			
10. Sharing Communicating	.06	.46***	.10	.07	.10	.08	.01	.06	.19***		
11. Sharing Completing	-.04	-.05	.34***	-.01	.09	.01	-.01	.03	.09	.08	
12. Sharing Contracting	.07	.01	.01	.58***	.20***	.04	.09	.18***	.17***	.11*	.07
13. Sharing Contributing	.12*	.07	.10	.07	.50***	.01	.00	.10	.24***	.17**	.16**
14. Sharing Cooperating	-.09	.10*	.12*	-.04	.02	.52***	.05	-.03	.03	.08	.04
15. Sharing Creating	.03	-.02	.09	.01	.03	.06	.54***	-.03	.14**	.03	.11*
16. Sharing Critiquing	.09	.07	.01	.06	.14**	-.06	.03	.52***	.17***	.07	.12*
17. Performance Quantity	.14**	.15**	.13*	.02	-.01	.09	.11*	-.02	.10*	.02	.05
18. Performance Quality	.06	.09	.13*	.07	.01	.08	.17**	-.10	.06	.06	.04

Table 4 (cont.)

	12	13	14	15	16	17
1. Total Calibrating						
2. Total Communicating						
3. Total Completing						
4. Total Contracting						
5. Total Contributing						
6. Total Cooperating						
7. Total Creating						
8. Total Critiquing						
9. Sharing Calibrating						
10. Sharing Communicating						
11. Sharing Completing						
12. Sharing Contracting						
13. Sharing Contributing	.19***					
14. Sharing Cooperating	.06	.07				
15. Sharing Creating	.12*	.15**	.11*			
16. Sharing Critiquing	.13*	.17***	-.05	.11*		
17. Performance Quantity	-.07	-.06	-.08	.00	-.15**	
18. Performance Quality	.03	.06	-.05	.08	-.11*	.40***

Note. N = 381 for all correlations except those including Performance Quantity and Quality. N = 366 for correlations with Task 2 Performance Quantity; N = 364 for correlations with Task 2 Performance Quality; N = 358 for the correlation between Task 2 Performance Quantity and Task 2 Performance Quality. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Table 5

Multiple regressions predicting team effectiveness from team process totals variables

Dependent Variable	Independent Variables	B	SE	Average Unstandardized Regression Weight Across Predictors	B - Average Weight Across Predictors	t
Task 1 Performance Quantity (R^2 = .03, F(8,359) = 1.20, p = ns)	Total Calibrating	.27	.23	.04	.23	1.02
	Total Communicating	-.05	.25		-.09	.34
	Total Completing	.21	.15		.17	1.14
	Total Contracting	.01	.23		-.03	.14
	Total Contributing	-.50	.27		-.53	1.99 *
	Total Cooperating	.35	.20		.31	1.54
	Total Creating	-.05	.21		-.08	.40
	Total Critiquing	.06	.20		.02	.10
Task 1 Performance Quality (R^2 = .05, F(8,355) = 2.47, p < .05)	Total Calibrating	.14	.12	.05	.08	.68
	Total Communicating	.23	.14		.18	1.33
	Total Completing	-.02	.08		-.07	.91
	Total Contracting	.07	.13		.01	.10
	Total Contributing	-.33	.15		-.39	2.65 **
	Total Cooperating	.30	.11		.24	2.21 *
	Total Creating	.18	.11		.13	1.11
	Total Critiquing	-.13	.11		-.19	1.72 t
Task 2 Performance Quantity (R^2 = .07, F(8,357) = 3.51, p < .001)	Total Calibrating	.13	.04	.03	.10	2.22 *
	Total Communicating	.16	.05		.13	2.44 *
	Total Completing	.07	.04		.03	.89
	Total Contracting	.00	.06		-.03	.55
	Total Contributing	-.13	.06		-.16	2.68 **
	Total Cooperating	.01	.05		-.02	.38
	Total Creating	.07	.05		.03	.66
	Total Critiquing	-.05	.05		-.08	1.83 t

Table 5 (cont.)

Dependent Variable	Independent Variables	B	SE	Average Unstandardized Regression Weight Across Predictors	B - Average Weight Across Predictors	t
Task 2 Performance Quality (R^2 = .07, $F(8,355)$ = 3.36, p = .001)	Total Calibrating	.22	.19	.14	.08	.40
	Total Communicating	.48	.24		.33	1.41
	Total Completing	.27	.18		.12	.70
	Total Contracting	.30	.25		.15	.62
	Total Contributing	-.14	.27		-.29	1.06
	Total Cooperating	.06	.21		-.08	.39
	Total Creating	.57	.23		.43	1.85[t]
	Total Critiquing	-.60	.21		-.74	3.59***

Note. B = Unstandardized regression weight. SE = Standard error. *N* = 364-368. ***versus critical *t* value of 3.35 ($p < .001$); **versus critical *t* value of 2.61 ($p < .01$); *versus critical *t* value of 1.97 ($p < .05$); [t]versus critical *t* value of 1.65 ($p < .10$).

Table 6

Multiple regressions predicting team effectiveness from team process sharing variables

Dependent Variable	Independent Variables	B	SE	Average Unstandardized Regression Weight Across Predictors	B - Average Weight Across Predictors	*t*
Task 1 Performance Quantity (R^2 = .06, $F(8,359)$ = 2.76, $p < .01$)	Sharing Calibrating	-2.88	5.19	-3.14	.26	.05
	Sharing Communicating	-9.29	3.87		-6.15	1.59
	Sharing Completing	6.97	15.28		10.11	.66
	Sharing Contracting	-11.60	4.98		-8.47	1.70[t]
	Sharing Contributing	-3.57	4.87		-.44	.09
	Sharing Cooperating	6.83	5.72		9.97	1.74[t]
	Sharing Creating	-7.57	5.03		-4.43	.88
	Sharing Critiquing	-4.00	5.40		-.86	.16
Task 1 Performance Quality (R^2 = .03, $F(8,355)$ = 1.44, p = ns)	Sharing Calibrating	1.86	2.88	2.88	-1.02	.35
	Sharing Communicating	1.70	2.14		-1.18	.55
	Sharing Completing	16.62	8.95		13.74	1.54
	Sharing Contracting	.08	2.79		-2.80	1.01
	Sharing Contributing	-2.21	2.68		-5.09	1.90[t]
	Sharing Cooperating	-.93	3.20		-3.81	1.19
	Sharing Creating	6.43	2.78		3.55	1.28
	Sharing Critiquing	-.50	3.03		-3.38	1.12
Task 2 Performance Quantity (R^2 = .06, $F(8,357)$ = 2.91, $p < .01$)	Sharing Calibrating	3.41	1.26	-.38	3.79	3.01**
	Sharing Communicating	.71	1.35		1.08	.80
	Sharing Completing	3.30	2.73		3.67	1.35
	Sharing Contracting	-1.56	1.29		-1.19	.92
	Sharing Contributing	-1.66	1.42		-1.29	.91
	Sharing Cooperating	-2.98	1.72		-2.61	1.52
	Sharing Creating	.44	1.34		.82	.61
	Sharing Critiquing	-4.65	1.41		-4.27	3.04**

Table 6 (cont.)

Dependent Variable	Independent Variables	B	SE	Average Unstandardized Regression Weight Across Predictors	B - Average Weight Across Predictors	*t*
Task 2 Performance Quality (R^2 = .04, $F(8,355)$ = 1.68, p = ns)	Sharing Calibrating	5.51	5.72	.63	4.88	.85
	Sharing Communicating	5.63	6.07		5.00	.82
	Sharing Completing	6.77	12.43		6.14	.49
	Sharing Contracting	1.56	5.89		.93	.16
	Sharing Contributing	5.22	6.44		4.59	.71
	Sharing Cooperating	-11.14	7.82		-11.77	1.50
	Sharing Creating	9.24	6.02		8.61	1.43
	Sharing Critiquing	-17.74	6.43		-18.38	2.86**

Note. B = Unstandardized regression weight. SE = Standard error. *N* = 364-368. ***versus critical *t* value of 3.35 ($p < .001$); **versus critical *t* value of 2.61 ($p < .01$); *versus critical *t* value of 1.97 ($p < .05$); [t]versus critical *t* value of 1.65 ($p < .10$).

Table 7

Hierarchal regression predicting team effectiveness outcomes from the level and matching of teams' patterns of team process totals

	Task 1				Task 2			
	Performance Quantity		Performance Quality		Performance Quantity		Performance Quality	
	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.01		$.01^{t}$		$.02^{**}$		$.02^{*}$	
Each Team's Average Value Across Team Processes		.07		$.09^{t}$		$.15^{**}$		$.12^{*}$
Step 2	$.02^{**}$		$.05^{***}$		$.05^{***}$		$.06^{***}$	
Each Team's Average Value Across Team Processes		.05		$.12^{*}$		$.16^{**}$		$.16^{**}$
Covariance Between Each Team's Process Values and Values in Criterion-related Pattern		$.15^{**}$		$.22^{***}$		$.23^{***}$		$.24^{***}$
Total R^2	$.03^{**}$		$.05^{***}$		$.07^{***}$		$.07^{***}$	
N	368		364		366		364	

Note. $^{t}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Table 8

Hierarchal regression predicting team effectiveness outcomes from the level and matching of teams' patterns of team process sharing

	Task 1				Task 2			
	Performance Quantity		Performance Quality		Performance Quantity		Performance Quality	
	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.04***		.01^t		.00		.00	
Each Team's Average Value Across Team Processes		-.19***		.09^t		-.05		.05
Step 2	.02**		.02**		.06***		.03***	
Each Team's Average Value Across Team Processes		-.13*		.21**		-.05		.02
Covariance Between Each Team's Process Values and Values in Criterion-related Pattern		.16**		.20**		.24***		.19***
Total R^2	.06***		.03**		.06***		.04**	
N	368		364		366		364	

Note. $^t p < .10$; $^* p < .05$; $^{**} p < .01$; $^{***} p < .001$.

Table 9

Hypothesized bivariate relationships among focal variables and actual results

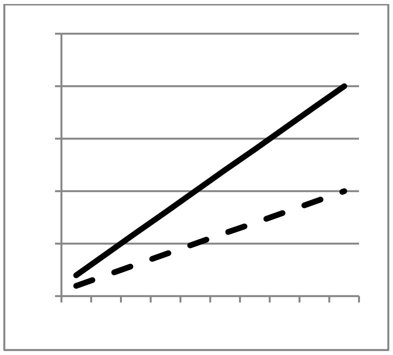
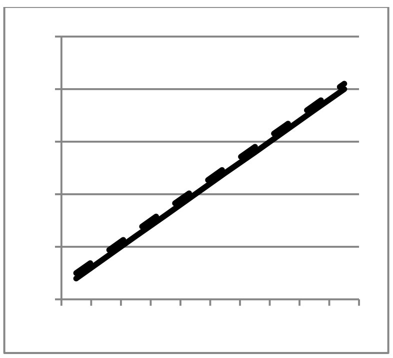
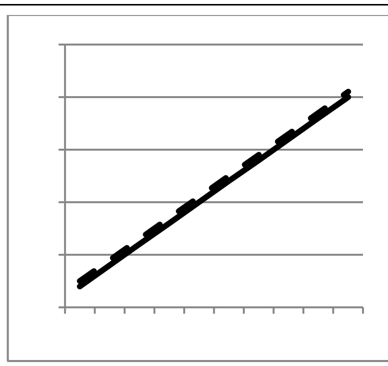
Predicted Relationships		Results
1a. The total amount of contracting interactions among team members will be positively associated with effectiveness outcomes. These relationships will be stronger in an initial task versus a subsequent task.		Task 1: No relationships found between the total amount of contracting interactions and team performance quantity or quality. Task 2: No relationships found between the total amount of contracting interactions and team performance quantity or quality.
1b. The sharing of contracting interactions among team members will be positively associated with effectiveness outcomes. These relationships will be equivalent across tasks.		Task 1: Relationship between the sharing of contracting interactions and team performance quantity was negative and significant, $r = -.16$, $p < .01$. No relationship found with team performance quality. Task 2: No relationships found between the total amount of contracting interactions and team performance quantity or quality.
2a. The total amount of creating interactions among team members will be positively associated with effectiveness outcomes. These relationships will be equivalent across tasks.		Task 1: No relationships found between the total amount of creating interactions and team performance quantity or quality. Task 2: Relationship between the total amount of creating interactions and team performance quantity was positive and significant, $r = .11$, $p < .05$. Its relationship with team performance quality was also positive and significant, $r = .17$, $p < .01$.

Table 9 (cont.)

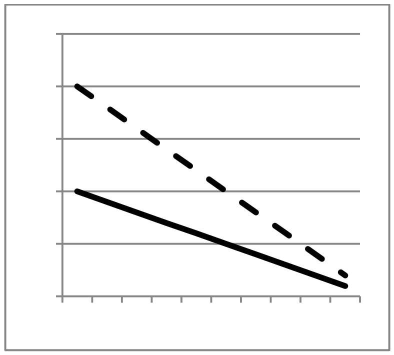
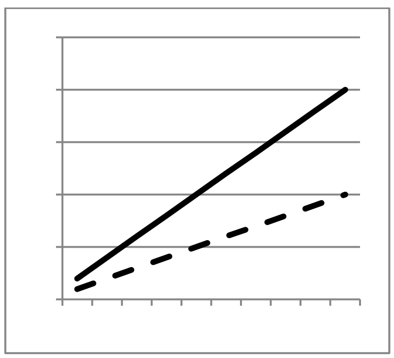
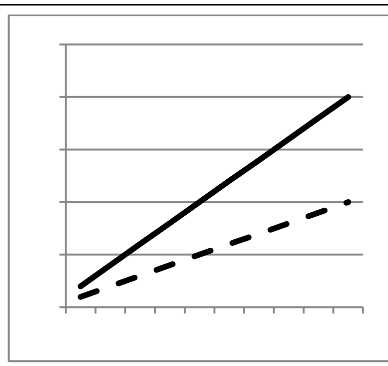
Predicted Relationships		Results
2b. The sharing of creating interactions among team members will be negatively associated with effectiveness outcomes. These relationships will be stronger in a subsequent task versus an initial task.		Task 1: Relationship between the sharing of creating interactions and team performance quality was positive and significant, $r = .13$, $p < .05$. No relationship found with team performance quantity. Task 2: No relationships found between the sharing of creating interactions and team performance quantity or quality.
3a. The total amount of contributing interactions among team members will be positively associated with effectiveness outcomes. These relationships will be stronger in an initial task versus a subsequent task.		Task 1: No relationships found between the total amount of contributing interactions and team performance quantity or quality. Task 2: No relationships found between the total amount of contributing interactions and team performance quantity or quality.
3b. The sharing of contributing interactions among team members will be positively associated with effectiveness outcomes. These relationships will be stronger in an initial task versus a subsequent task.		Task 1: No relationships found between the sharing of contributing interactions and team performance quantity or quality. Task 2: No relationships found between the sharing of contributing interactions and team performance quantity or quality.

Table 9 (cont.)

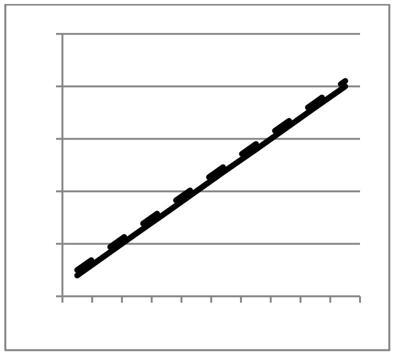
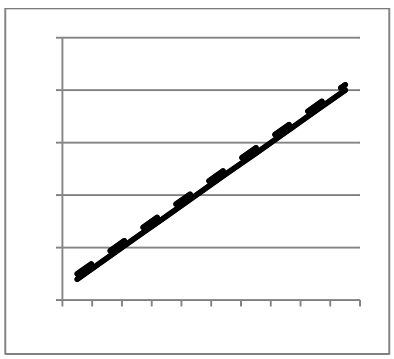
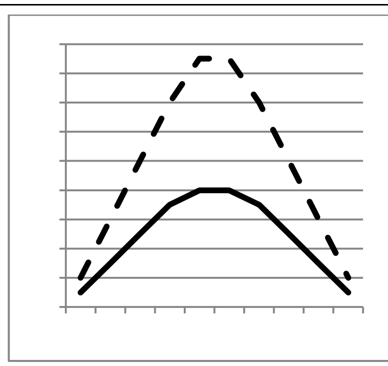
Predicted Relationships		Results
4a. The total amount of completing interactions among team members will be positively associated with effectiveness outcomes. These relationships will be equivalent across tasks.		Task 1: No relationships found between the total amount of completing interactions and team performance quantity or quality. Task 2: Relationship between the total amount of completing interactions and team performance quantity was positive and significant, $r = .13$, $p < .05$. Its relationship with team performance quality was also positive and significant, $r = .13$, $p < .05$.
4b. The sharing of completing interactions among team members will be positively associated with effectiveness outcomes in both tasks. These relationships will be equivalent across tasks.		Task 1: Relationship between the sharing of completing interactions and team performance quality was positive and significant, $r = .11$, $p < .05$. No relationship found with team performance quantity. Task 2: No relationships found between the sharing of completing interactions and team performance quantity or quality.
5a. Lesser and greater amounts of critiquing interactions among team members will be associated with unfavorable effectiveness outcomes; moderate amounts will be associated with favorable effectiveness. These relationships will be stronger in a subsequent task versus an initial task.		Task 1: No quadratic (or linear) relationships found between the total amount of critiquing interactions and team performance quantity or quality. Task 2: (Linear) relationship between the total amount of critiquing interactions and team performance quality was negative with a small effect size, $r = -.10$. No quadratic (or linear) relationships found with team performance quantity.

Table 9 (cont.)

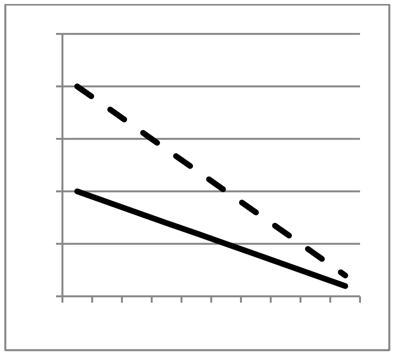
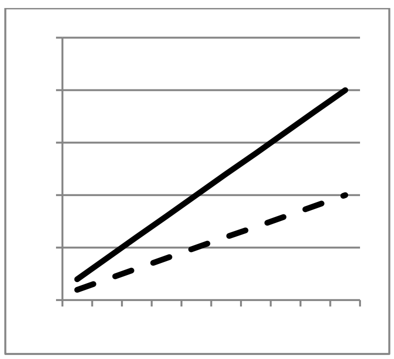
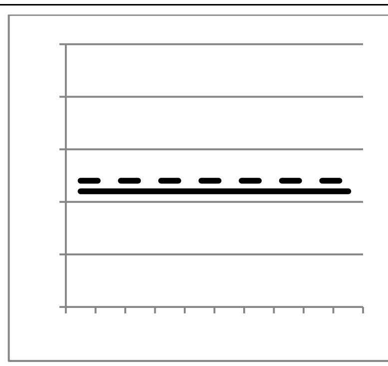
Predicted Relationships		Results
5b. The sharing of critiquing interactions among team members will be negatively associated with effectiveness outcomes. These relationships will be stronger in a subsequent task versus an initial task.		Task 1: No relationships found between the sharing of critiquing interactions and team performance quantity or quality. Task 2: Relationship between the sharing of critiquing interactions and team performance quantity was negative and significant, $r = -.15$, $p < .01$. Its relationship with team performance quality was also negative and significant, $r = -.11$, $p < .05$.
6a. The total amount of communicating interactions among team members will be positively associated with effectiveness outcomes. These relationships will be stronger in an initial task versus a subsequent task.		Task 1: No relationships found between the total amount of communicating interactions and team performance quantity or quality. Task 2: Relationship between the total amount of communicating interactions and team performance quantity was positive and significant, r = .15, p < .01. No relationship found with team performance quality.
6b. The sharing of communicating interactions among team members will not be associated with effectiveness outcomes in either task.		Task 1: Relationship between the sharing of communicating interactions and team performance quantity was positive and significant, $r = -.15$, $p < .01$. No relationship found with team performance quality. Task 2: No relationships found between the sharing of communicating interactions and team performance quantity or quality.

Table 9 (cont.)

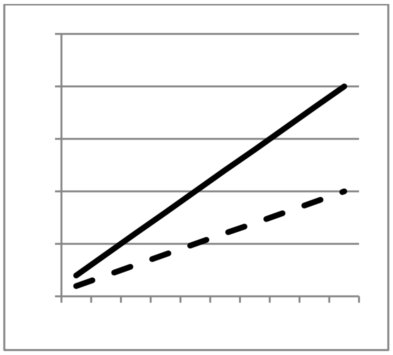
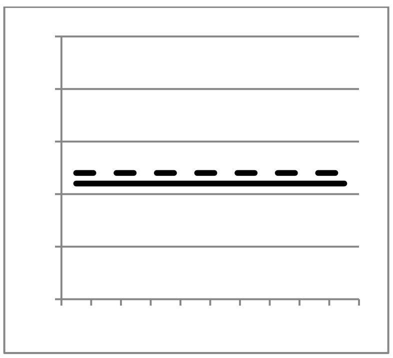
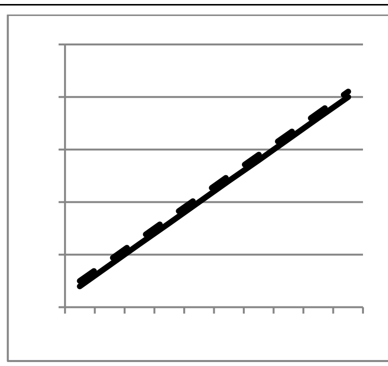
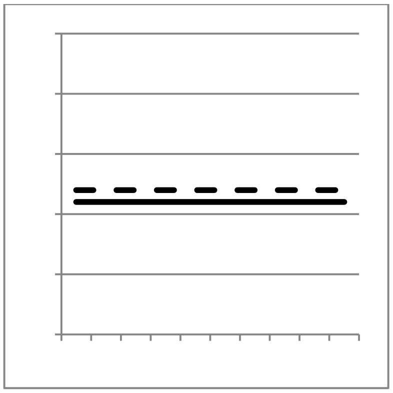
Predicted Relationships		Results
7a. The total amount of calibrating interactions among team members will be positively associated with effectiveness outcomes. These relationships will be stronger in an initial task versus a subsequent task.		Task 1: No relationships found between the total amount of calibrating interactions and team performance quantity or quality. Task 2: Relationship between the total amount of calibrating interactions and team performance quantity was positive and significant, $r = .14$, $p < .01$. No relationship found with team performance quality.
7b. The sharing of calibrating interactions among team members will not be associated with effectiveness outcomes in either task.		Task 1: No relationships found between the sharing of calibrating interactions and team performance quantity or quality. Task 2: Relationship between the sharing of calibrating interactions and team performance quantity was positive and significant, $r = .10$, $p < .05$. No relationship found with team performance quality.
8a. The total amount of cooperating interactions among team members will be positively associated with effectiveness outcomes. These relationships will be equivalent across tasks.		Task 1: Relationship between the total amount of cooperating interactions and team performance quality was positive and significant, $r = .15$, $p < .01$. No relationship found with team performance quantity. Task 2: No relationships found between the total amount of cooperating interactions and team performance quantity or quality.

Table 9 (cont.)

Predicted Relationships		Results
8b. The sharing of cooperating interactions among team members will not be associated with effectiveness outcomes in either task.		Task 1: No relationships found between the sharing of cooperating interactions and team performance quantity or quality. Task 2: No relationships found between the sharing of cooperating interactions and team performance quantity or quality.

Note. In charts, solid lines represent predicted Task 1 relationships and dashed lines represent predicted Task 2 relationships.

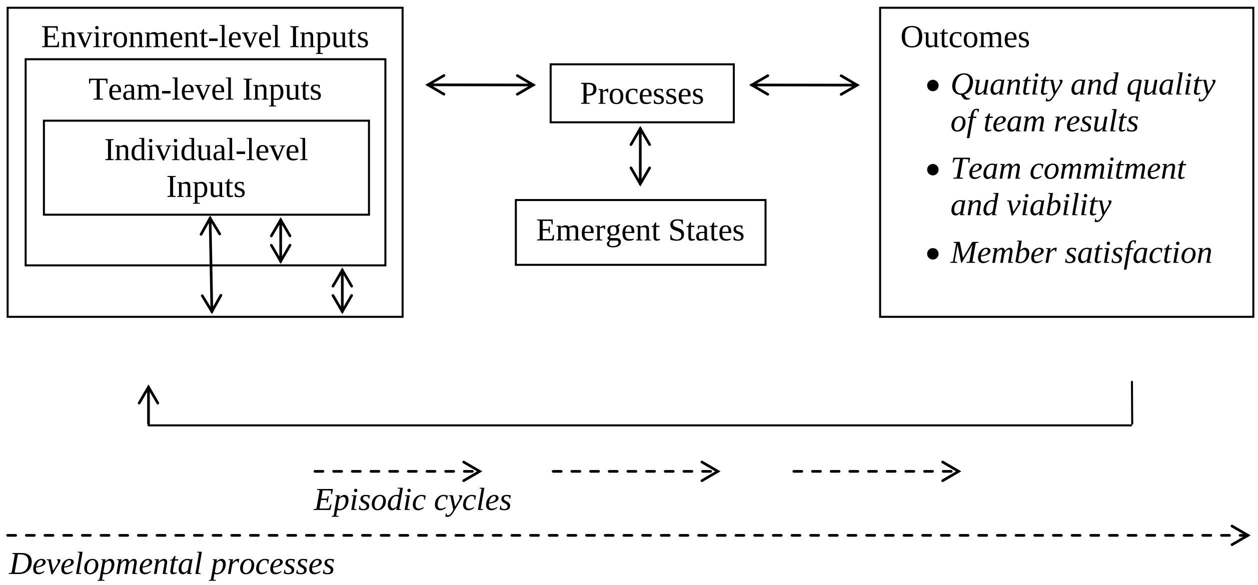


Figure 1. Cumulative input-process-outcome model of team effectiveness, incorporating aspects of earlier models described by McGrath (1964); Gladstein (1984); Hackman (1987); Cohen and Bailey (1997); Ilgen, Hollenbeck, Johnson, and Jundt (2005); and Mathieu, Maynard, Rapp, and Gilson (2008).

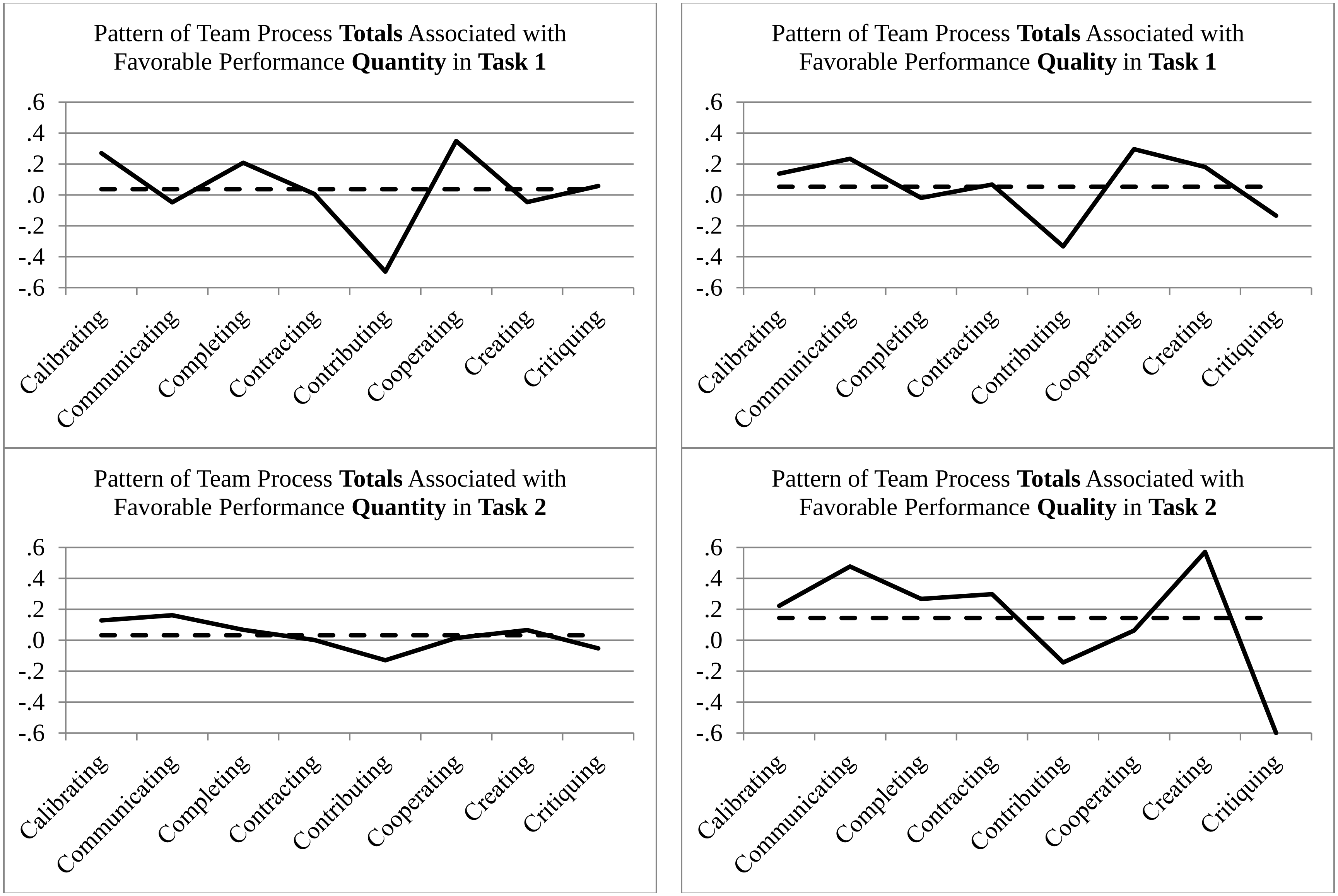


Figure 2. Patterns of team process totals associated with favorable performance outcomes. Solid lines are unstandardized regression weights for each predictor; dashed lines are the average of all predictors' unstandardized regression weights. N = 364-368.

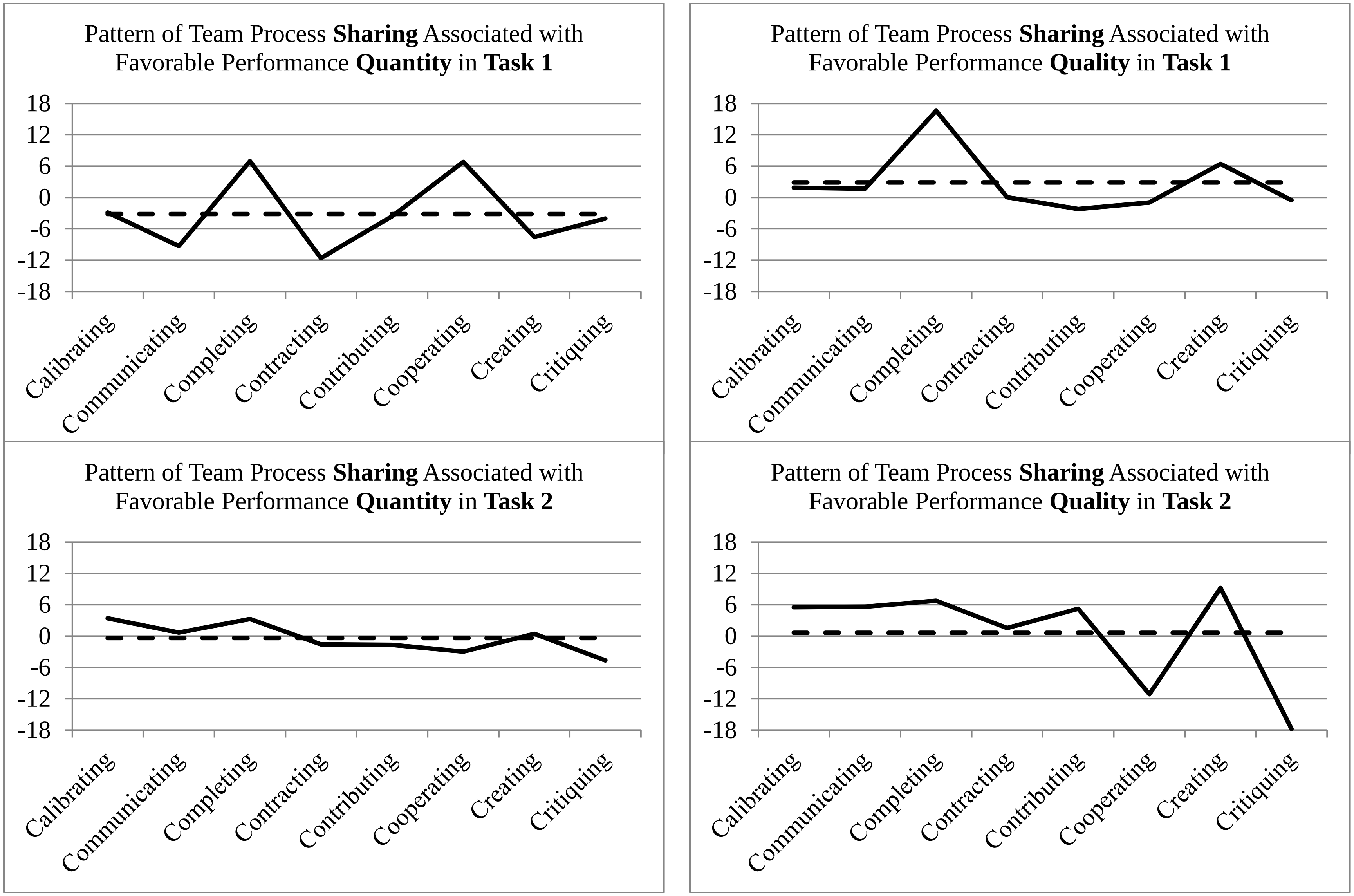


Figure 3. Patterns of team process sharing associated with favorable performance outcomes. Solid lines are unstandardized regression weights for each predictor; dashed lines are the average of all predictors' unstandardized regression weights. *N* = 364-368.

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