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Mutual Performance Monitoring in Virtual Teams

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MUTUAL PERFORMANCE MONITORING IN VIRTUAL TEAMS

by

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ABSTRACT

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The use of virtual teams in organizations has become commonplace (SHRM, 2012). While a great deal of research on teamwork exists, much of it has focused on collocated teams. Spatial and temporal separations inherent in virtual teams make working together as a team more difficult. This research examined a teamwork process previously unexplored within virtual teams -- mutual performance monitoring. An experimental intervention was conducted and outcomes at both the individual and team levels of analysis were examined. A total of 161 participants were assigned to work together in 47 teams on a decision-making task. Participants communicated and worked together online using the technology-mediated communication methods of chat and email. As predicted, mutual performance monitoring was important for building collective efficacy, reducing social loafing, and increasing satisfaction with team members. However, mutual performance monitoring was found not related to team performance. Reasoning for the findings, along with implications, limitations, and future research ideas are discussed.

This thesis is dedicated to my loving family, both near and far.

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CHAPTER 1

INTRODUCTION

Organizations use team-based approaches as a way of dealing with an increased complexity in tasks. Teams are especially useful for complex tasks because they allow employees to share workload, monitor team behaviors, and combine expertise (Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000). As organizations have become more globalized, virtual teams have emerged as a way to connect employees separated by time and space through technology. While virtual teams may vary in their use of technology, they are considered interdependent groups of individuals working towards a common goal with their teamwork and communication processes mediated by technology.

Recent surveys indicate that many organizations use virtual teams (e.g., 64% from RW-3, 2010; 46% from SHRM, 2012). Organizations frequently use virtual teams because of the increased prevalence of hierarchically flat organizations, changes in organizations' environments, increased globalization, the shift towards knowledge work, and employee expectations of technology in the workplace (Townsend, DeMarie, & Hendrickson, 1998). Virtual teams allow organizations to compete within a global and dynamic environment. They provide organizations with competitive advantages, including access to a larger talent pool with little or no additional cost and easier organizational boundary spanning (Zaccaro & Bader, 2003). In addition, virtual teams provide faster response times for customers and increased workplace flexibility for employees (Cascio, 2000).

While virtual teams come with many advantages, they also face many challenges. For example, virtual teams are challenged with communicating effectively, developing a

shared awareness of the task environment and member actions, and building strong, interpersonal relationships among team members (Thompson & Coovert, 2006). The quality and quantity of communication within virtual teams is often constrained. Virtual teams often communicate asynchronously with methods void of face-to-face interactions, such as email and instant messaging. The spatial separation of members in a virtual team makes developing a shared awareness of the task environment and members more difficult. Coordinating actions becomes more difficult, in part due to deficiencies in team members' abilities to monitor each other's behavior, provide feedback, and adapt human and task resources. The challenge of developing strong, interpersonal relationships among team members can have effects on factors important to team effectiveness, such as cohesion and levels of relationship conflict (Beal, Cohen, Burke, & McLendon, 2003; DeChurch, Mesmer-Magnus, & Doty, 2013). The challenges associated with virtual teams can limit organizations' capitalization on their advantages.

Research Purpose

The purpose of this research was to examine a teamwork process, mutual performance monitoring, within virtual teams. Mutual performance monitoring was manipulated experimentally in order to examine its effects on performance, attitudinal, and behavioral outcomes. This research contribution was important because although many researchers argue mutual performance monitoring is a key behavior in teams (e.g., Marks, Mathieu, & Zaccaro, 2001; Salas, Sims, & Burke, 2005), there is an absence of empirical data on it within virtual teams. An awareness of team member actions is also seen as a key challenge faced by virtual teams (Thompson & Coovert, 2006). This research contributes to a better understanding of mutual performance monitoring and

virtual team effectiveness. Additionally, this research was important as it may have implications for organizations that use virtual teams, such as for management, training, or decisions regarding team technology investments.

The methodology and results of this research study on teamwork within virtual teams will be described. First, virtual teams and their teamwork processes are discussed and compared to collocated teams. Second, an experimental manipulation of mutual performance monitoring and its impact on performance, efficacy, social loafing, and satisfaction at individual and team-levels of analysis is evaluated. Third, the research implications, limitations, and recommendations for future research are described.

Virtual Teams

Virtual teams have become more common in organizations and continue to receive much research attention (e.g., Gajendran & Joshi, 2012; Hoch & Kozlowski, 2012; Krumm, Terwiel, & Hertel, 2013).Virtual teams are defined as:

> groups of geographically and/or organizationally dispersed coworkers that are assembled using a combination of telecommunications and information technologies to accomplish a variety of critical tasks. Virtual teams rarely, if ever, meet in a face-to-face setting. (Townsend et al., 1998, p. 17)

This definition highlights the traditional view of virtual teams. Team members separated geographically often communicate almost entirely through electronic means. Research on virtual teams initially focused on a comparison to collocated teams and the relative advantages and disadvantages. There has been a growing stream of research that conceptualizes virtualness as a factor in all teams (e.g., Bell & Kozlowski, 2002; Griffith, Sawyer, & Neale, 2003; Kirkman & Mathieu, 2005; Martins, Gilson, & Maynard, 2004).

There has been considerable variability in conceptualizations of virtualness. While most researchers agree the concept of virtualness is multidimensional, there is little agreement concerning the specific core dimensions. Table 1 presents a comparison of virtualness conceptualizations across several dimensions. Some authors view virtualness as a continuum from low to high, in that a single score could be assigned to a team (e.g., Griffith et al., 2003; Kirkman & Mathieu, 2005). Figure 1 presents an example conceptualization of virtualness as a low-high continuum. Other authors describe virtualness as represented by distinct elements that describe team interactions and design but cannot be combined into a single score (e.g., Bell & Kozlowski, 2002; Chudoba, Wynn, Lu, & Watson-Manheim, 2005; Gibson & Gibbs, 2006). A team high in virtualness when conceptualized as a continuum would reflect the traditional notion of a virtual team, while a team low in virtualness would reflect the traditional, collocated team.

In this research project, the task environment and communication methods were created to represent teams with high levels of virtualness. Based on the virtualness dimensions, the teams in this project were geographically separated and communicated asynchronously using virtual technology with low informational value. Additionally, the specific elements of these teams included a static team structure with a discrete life cycle. Teams with high levels of virtualness were chosen because they have a more challenging time working together and differences in teamwork processes are more likely to be recognized. A key area of virtual team interactions to understand is how members work together to complete a task -- their teamwork processes.

Table 1
Conceptualizations of Virtualness Dimensions

	Geographic Dispersion	Temporal Dispersion	Structure	Boundary Spanning	Technology Characteristics	Technology Dependence	Lifecycle	Time Spent Face-to-face
Bell and Kozlowski (2002)	X	X	X	X			X	
Cohen and Gibson (2003)	X					X		
Griffith et al. (2003)	X				X			X
Martins et al. (2004)	X	X		X			X	
Chudoba et al. (2005)	X	X	X	X	X			
Kirkman and Mathieu (2005)		X			X	X		
Gibson and Gibbs (2006)	X		X	X		X		
O'Leary and Cummings (2007)	X	X	X					
Schweitzer and Duxbury (2010)	X							X

Note: Some of these conceptualizations view virtualness as a continuum while others view it as containing specific elements.

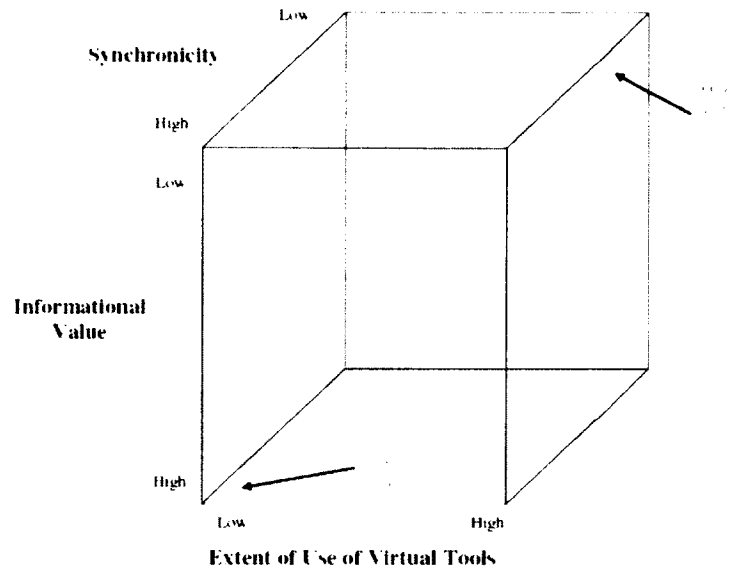

Figure 1. Example of virtualness as a low-high continuum from Kirkman and Mathieu (2005).

Teamwork Processes

Teamwork processes are "interdependent team activities that orchestrate taskwork in employees' pursuit of goals" (Marks et al., 2001, p. 358). Extensive research has been conducted on teams in order to describe how team members work together, however, research has struggled due to inconsistencies in defining, differentiating, and measuring teamwork constructs (LePine, Piccolo, Jackson, Mathieu, & Saul, 2008). Research on teams has brought about a large number of models that seek to identify the most important teamwork behaviors. Three of the most comprehensive and influential models will be examined.

Marks et al. (2001) describe teamwork as episodic in which certain behaviors are displayed during performance episodes, between performance episodes, and throughout the episodic cycle. There are three higher-order team

processes: transition, action, and interpersonal; represented by 10 specific behavior dimensions. Transition processes occur between performance episodes and include mission analysis, goal specification, and strategy formulation and planning. Action processes occur during performance episodes and include monitoring progress toward goals, systems monitoring, team monitoring and backup, and coordination. Interpersonal processes occur throughout the episodic cycle and include conflict management, motivation and confidence building, and affect management.

Cannon-Bowers, Tannenbaum, Salas, and Volpe (1995) reviewed the literature on teamwork to identify the knowledge, skill, and attitudinal requirements of teams. For teamwork skill requirements, the area most relevant to teamwork processes, 130 skill labels were sorted yielding eight teamwork skill requirements. The teamwork skill requirements were adaptability, shared situational awareness, performance monitoring and feedback, leadership or team management, interpersonal relations, coordination, communication, and decision-making.

Salas et al. (2005) reviewed models of team effectiveness and argued that there are five key dimensions of teamwork. These dimensions are most important to team performance and include team leadership, mutual performance monitoring, backup behavior, adaptability, and team orientation. These five dimensions are supported by three coordinating mechanisms: shared mental models, closed-loop communication, and mutual trust.

The presented models of team performance represent different, yet convergent, conceptualizations of teamwork processes. These models seek to describe teamwork processes that determine team effectiveness in slightly different ways by focusing on

behaviors, skill requirements, or dimensions. While there are some teamwork processes unique to certain approaches (e.g., team orientation is only mentioned in Salas et al., 2005), there is quite a bit of overlap. One teamwork process that is included in all presented team effectiveness models is mutual performance monitoring.

The models of team performance were developed to be generally applicable with most relevance to certain types of teams than others. Virtual teams are not usually the focus, and this type of team faces additional challenges in performing teamwork processes. Geographic dispersion and asynchronous communication patterns make teamwork processes in virtual teams more difficult than in collocated teams.

Virtual team interactions can be more challenging as they are often void of non-verbal cues. Virtual teams have difficulty remaining aware of member actions and developing mutual trust (Priest, Stagl, Klein, & Salas, 2006; Zaccaro, Ardison, & Orvis, 2004). Fletcher and Major (2006) examined teamwork processes in dyads with varying technological mediation (face-to-face, audio only, shared workspace). They found differences in teamwork processes for mutual performance monitoring, feedback, and backup behaviors based on the type of technology used.

Based on the agreement of team effectiveness models on mutual performance monitoring as an important teamwork process (e.g., Cannon-Bowers et al., 1995; Marks et al., 2001; Salas et al., 2005), this teamwork process was the focus of the present

research. This research seeks to understand mutual performance monitoring within virtual teams as previous research on the topic was not found.

Mutual Performance Monitoring

Performance monitoring in organizations has commonly been conceptualized as a skill and responsibility of leaders (Fleishman et al., 1992; Hackman & Walton, 1986; McGrath, 1962; Mintzberg, 1973; Neider & Schriesheim, 1988; Quinn, 1988). Supervisors monitor employee performance through direct observation or by utilizing technology (e.g., electronic performance monitoring). Although performance monitoring by supervisors is important, in more complex and hierarchically flat organizations, employees must also be able to monitor their own performance. Self-monitoring refers to the periodic performance assessments that allow an individual to estimate the likelihood of goal attainment (Weldon, Jehn, & Pradhan, 1991).

When teams are used to organize work, a new form of monitoring is possible, mutual performance monitoring. This behavior is defined as "observing the activities and performance of other team members" (Dickinson & McIntyre, 1997, p. 25). Mutual performance monitoring can be accomplished directly through observation or indirectly through inquiries about performance (e.g., asking for a project update). Effective mutual performance monitoring in teams is characterized by regular observation of team member actions and timely identification of performance lapses. Previous research has indicated the importance of mutual performance monitoring in collocated teams on a variety of team performance outcomes with both student and employee samples (e.g., Bijlsma-Frankema, de Jong, & van de Bunt, 2008; De Jong & Elfring, 2010; Langfred, 2004; Marks & Panzer, 2004; Porter, Gogus, & Yu, 2010; Rosenstein, 1994).

Mutual performance monitoring in teams is multidirectional. Each team member can monitor and be monitored by other team members. This is different from one-way performance monitoring by supervisors and self-monitoring by individuals. When compared to monitoring by supervisors, mutual performance monitoring provides the advantages of increased opportunities for performance feedback and decreased perceptions of surveillance through an increased sense of fairness. Monitoring by team members may also serve as a way to reduce monitoring requirements of supervisors. Teams that engage in high amounts of monitoring are more likely to recognize team members that are not contributing or behaviors that are detrimental to team performance through maladaptive teamwork behaviors, such as social loafing, an outcome measured in this research. Mutual performance monitoring also provides social pressure on team members to perform because of an increased transparency of actions.

Mutual performance monitoring was manipulated experimentally in the current research to yield high and low levels. The differential impact of these two levels of mutual performance monitoring was examined on individual-level and team-level outcomes. The individual-level outcome was satisfaction with team members and the team-level outcomes were team performance, social loafing, and collective efficacy. The theoretical model and hypotheses are presented as Figure 2.

Individual-level Outcomes

Satisfaction with team members. Performance monitoring within virtual teams is different from within collocated teams. Monitoring team members separated by time

and space requires the use of electronic methods and can be done secretly without the person being monitoring aware of the monitoring. Previous research has conceptualized the construct of team monitoring in different ways. Some research has conceptualized monitoring as a team process that leads to increased collaboration (e.g., Dickinson & McIntyre, 1997; Salas et al., 2005), whereas others have conceptualized monitoring in teams as similar to surveillance (e.g., De Jong & Dirks, 2012; De Jong & Elfring, 2010; Langfred, 2004). The conceptualization of monitoring as surveillance is outcome-focused (e.g., monitoring meeting of deadlines or task completion), while monitoring as a team process is focused on the role it plays throughout the goal attainment process. The conceptualization of monitoring as similar to surveillance suggests that it has the potential to be viewed as intrusive by team members.

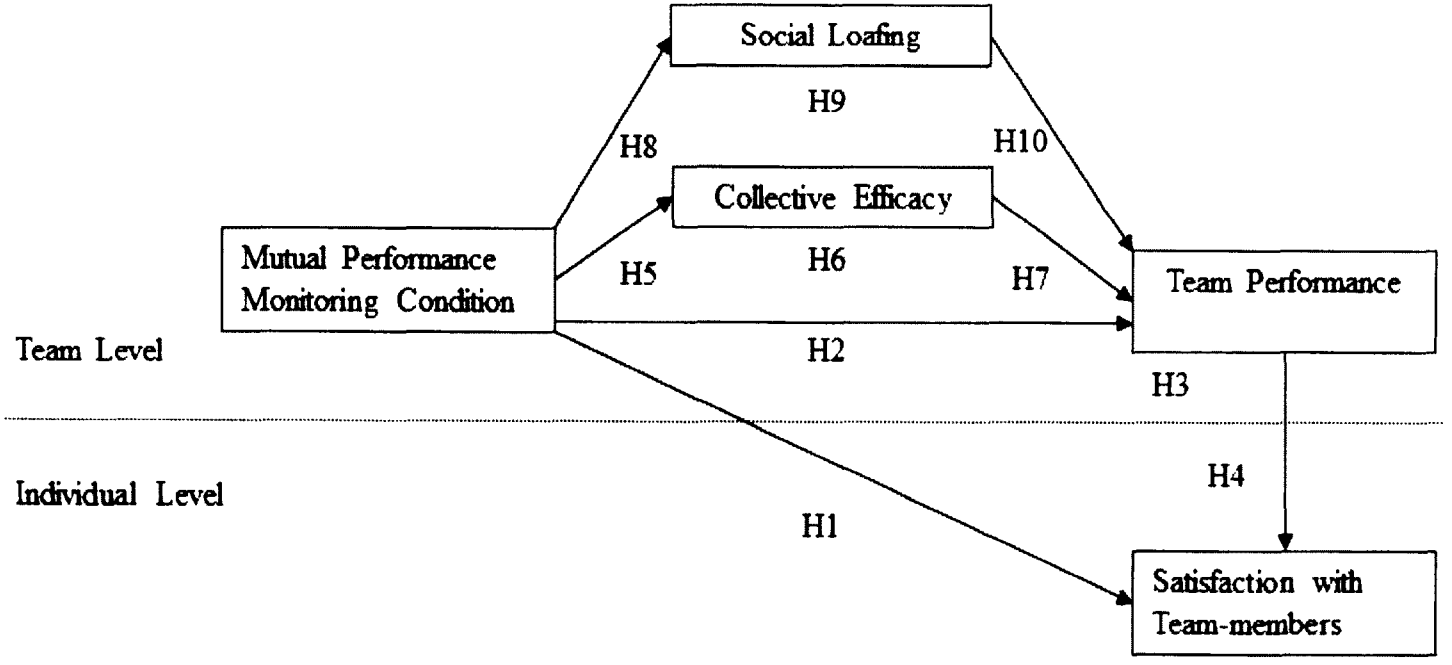

Figure 2. Research model of mutual performance monitoring within virtual teams.

Affective outcomes of mutual performance monitoring have not been examined. Although research on performance monitoring by supervisors has found predominantly negative outcomes for subordinates (e.g., decreased job satisfaction in Irving, Higgins, & Safayeni, 1986), this may not be the case for team monitoring. Research indicates that individual perceptions of performance monitoring are important (Chalykoff & Kochan, 1989) and vary based on the monitoring source, such as supervisor or team member (Stanton, 2000). In teams, mutual performance monitoring occurs among team members, so perceptions of satisfaction may differ from monitoring by supervisors. To examine an affective outcome associated with mutual performance monitoring, satisfaction with team members was assessed in this research.

Satisfaction with team members is an important affective outcome in teams. When teams perform mutual performance monitoring, they are demonstrating interest in team members and their performance. While in some cases mutual performance monitoring has the potential to be seen as intrusive, it is theorized that in most cases it is seen as an indicator of team attentiveness and participation. Teams that engage in mutual performance monitoring over time develop an implicit psychological contract that monitoring is instrumental to team performance and thus becomes an accepted team norm (McIntyre & Salas, 1995).

> *Hypothesis 1:* Mutual performance monitoring will be positively related to satisfaction with team members, such that participants in condition two (high mutual performance monitoring) will demonstrate higher satisfaction with team members than participants in condition one (low mutual performance monitoring).

Team-level Outcomes

Team performance. Mutual performance monitoring is an important antecedent to team effectiveness (Cannon-Bowers et al., 1995; Dickinson & McIntyre, 1997; Hackman, 1990; Marks et al., 2001; Salas et al., 2005; Salas, Sims, & Klein, 2004). Mutual performance monitoring leads to improvements in team performance through the timely identification of performance lapses and subsequent feedback and backup behaviors. Mutual performance monitoring is especially important in occupations where the consequences of an error are high (e.g., medical response teams; Baker, Day, & Salas, 2006).

Using the team monitoring and backup factor from Marks et al. (2001), a meta-analysis by LePine et al. (2008) found monitoring predicted team performance ($p = .30$). Task interdependence and team size were found to be significant moderators between team process and team performance. That is, team process becomes more important as task interdependence and team size increase. Jehn and Shah (1997) examined task monitoring in collocated teams and found positive relationships to team motor performance ($r = .28$) and team cognitive performance ($r = .26$). Task monitoring of teams in this study was seen to improve performance through the synchronization of effort and staying on schedule with task deadlines. In a study of undergraduate and graduate student teams working on simple building tasks ($N = 40$), performance monitoring was found to be a significant predictor of team performance (Weldon et al., 1991). Marks and Panzer (2004) studied mutual performance monitoring in collocated teams and found that it was related to coordination ($r = .42$), feedback ($r = .43$),

and performance (r = .55). While there have been several studies of monitoring and team performance in collocated teams, no research was found reporting the examination of mutual performance monitoring in virtual teams.

Mutual performance monitoring is more difficult in virtual teams than collocated teams (Martins et al., 2004). Collocated team members share a physical space in which they can easily monitor actions of their team members. For virtual teams, maintaining an awareness of member actions and performance is more difficult as they often cannot see each other and must rely on technology for interactions. Virtual teams often rely heavily on electronic resources that range in synchronicity and fidelity (e.g., email is asynchronous with low fidelity while webcam interaction is synchronous with high fidelity). This can lead to potential process losses in virtual teams due to the lack of coordinated efforts. Based on the review of the empirical research on mutual performance monitoring, it is hypothesized to be an important antecedent to team performance in virtual teams.

> *Hypothesis 2:* Mutual performance monitoring will be positively related to team performance, such that participants in condition two (high mutual performance monitoring) will demonstrate higher team performance than participants in condition one (low mutual performance monitoring).

Team performance may be important for satisfaction with team members as it is related to satisfaction (e.g., Pearsall & Ellis, 2006; Rockmann & Northcraft, 2010). Individuals are more satisfied with their team members when they perform better as a team. The relationship between mutual performance monitoring and satisfaction with team members is hypothesized to be partially mediated by the team's performance.

Hypothesis 3 and 4: Team performance will partially mediate the relationship between mutual performance monitoring and satisfaction with team members. In addition, this mediation implies a direct effect of team performance on satisfaction with team members, which is hypothesized to be positive.

Collective efficacy. An important characteristic of members in virtual teams is their belief that they are effective when performing tasks as a team. Similar to the conceptualization of individual self-efficacy from Bandura (1997), collective efficacy refers to the "sense of collective competence shared among individuals when allocating, coordinating, and integrating their resources in a successful concerted response to specific situational demands" (Zaccaro, Blair, Peterson, & Zazanis, 1995, p. 309). Collective efficacy refers to shared efficacy beliefs for a specific task, not general efficacy beliefs. Collective efficacy has been conceptualized in several ways by researchers when compared with the similar, yet distinct concept of group potency (for a review see Stajkovic, Lee, & Nyberg, 2009). Group potency refers to global efficacy beliefs while collective efficacy refers to task-specific efficacy beliefs.

Collective efficacy is important as it influences team motivation, persistence, perseverance, goal difficulty, and subsequent performance (Zaccaro et al., 1995). Developing collective efficacy in teams has been suggested as an important function of leadership (e.g., Chen & Bliese, 2002). In virtual teams, developing collective efficacy quickly and effectively is important as virtual teams are often deployed quickly and have discrete lifecycles, especially when completing complex tasks (Bell & Kozlowski, 2002).

In a study of collocated teams, combination of action processes including mutual performance monitoring, was found related to collective efficacy (r = .46; Chen, Thomas, & Wallace, 2005). Efficacy beliefs in individuals and teams are theorized to emerge primarily from four sources: enactive mastery experience (history of performance success), vicarious learning (observation of team member performance), social influences (encouragement and feedback), and physiological and affective states (team arousal levels; Bandura, 1997; Goddard, Hoy, & Hoy, 2004). Mutual performance monitoring may influence the development of collective efficacy through the routes of vicarious learning and social persuasion. Teams performing mutual performance monitoring are better able to observe team members successfully performing their tasks and have more opportunities for feedback, which may result in increased collective efficacy.

Hypothesis 5: Mutual performance monitoring will be positively related to collective efficacy, such that participants in condition two (high mutual performance monitoring) will demonstrate higher collective efficacy than participants in condition one (low mutual performance monitoring).

Collective efficacy is a motivational construct important for team effectiveness. In a meta-analysis, collective efficacy was found to predict team performance (p = .35; Stajkovic et al., 2009). Collective efficacy influences performance through determining the direction, intensity, and perseverance of actions (Stajkovic et al., 2009). Collective efficacy is hypothesized to be a mediator of mutual performance monitoring and team performance.

Hypothesis 6 and 7: Collective efficacy will partially mediate the relationship between mutual performance monitoring and team performance. In addition, this mediation implies a direct effect of collective efficacy on team performance, which is hypothesized to be positive.

Social loafing. Social loafing is a social phenomenon where individuals exert less effort when working collectively than individually (Latane, Williams, & Harkins, 1979). Social loafing is an important behavioral issue in teams (Karau & Williams, 1993). Sustaining individual performance levels regardless of context (e.g., in a team) is important for organizational effectiveness.

Social loafing occurs from motivation losses when working collectively. While there are several explanations for why these motivation losses occur, perceived dispensability of efforts is an explanation that has received considerable empirical support (Harkins & Petty, 1982; Kerr & Bruun, 1983; Price, Harrison, & Gavin, 2006). When individuals work collectively, they may feel that their actions are redundant. Individuals exert less effort in situations where they feel their contributions have little effect on team outcomes. Perceived dispensability may be a product of coordination losses. Team members with an awareness of their team's performance are more likely to coordinate actions, resulting in decreased redundancy and perceived dispensability of efforts.

Mutual performance monitoring is a potential way to reduce social loafing in teams. When team members monitor each other's performance, perceived dispensability of effort is reduced. Social loafing behaviors are also more easily recognizable by teammates and thus discouraged.

Hypothesis 8: Mutual performance monitoring will be negatively related to social loafing, such that participants in condition two (high mutual performance monitoring) will display lower social loafing than participants in condition one (low mutual performance monitoring).

When certain team members do not contribute, team performance can suffer. In teams with high amounts of social loafing, performance becomes dependent on a subset of the team, which on average, results in decreased team performance. Social loafing may therefore be an important mediator in the relationship between mutual performance monitoring and team performance.

Hypothesis 9 and 10: Social loafing will partially mediate the relationship between mutual performance monitoring and team performance. In addition, this mediation implies a direct effect of social loafing on team performance, which is hypothesized to be negative.

CHAPTER 2

METHOD

Participants

Participants were recruited from a Mid-Atlantic university through an undergraduate research participation system. Participants were required to be at least 18 years of age and have access to a computer with a reliable Internet connection. Participants received extra credit points for their courses as a reward for participation in this experiment. An additional incentive of a $10 gift card to the six highest-performing teams was used as a way to increase effort. This project received human subjects research authorization (ID# 012-013-008). A total of 161 participants completed the experiment, yielding 47 teams. Of those, 114 (70.81%) were female. The average age of participants was 23.56 (SD = 7.61). For self-reported ethnicity, there were 65 (40.37%) Caucasians, 51 (31.68%) African Americans, 12 (7.45%) Latinos or Hispanics, 7 (4.35%) Asians, 2 (1.24%) Native Americans, and 14 (8.70%) participants who reported ethnicity as "Other." The average team size was 3.43 members (SD = 0.62). The rate for individuals who signed-up for the study but did not attend was 20% in this study.

Power Analysis

Power analyses were performed prior to conducting the study. Given the small number of previous studies examining the relationships between mutual performance monitoring and variables in this study, several effect size estimates were used to calculate required sample size. Moreover, there were no studies on mutual performance monitoring in virtual teams, so only effect sizes from studies examining collocated teams could be used.

Optimal Design (Raudenbush, Spybrook, Congdon, Liu, & Martinez, 2011) was used to estimate the power to test team-level predictors on an individual-level outcome. The power analysis used a critical alpha value of .05, team size of 4, effect sizes that were small ($d = 0.30$), medium ($d = 0.50$), and large ($d = 0.80$), and percent of individual-level variance explained by between team differences of .10. To achieve a power of .80, 19 teams are needed for a large effect size, 43 teams are needed for a medium effect size, and 115 teams are needed for a small effect size.

It was not possible to estimate effect sizes for all team-level relationships because previous research did not exist. There are several studies that have examined mutual performance monitoring and team performance. With the general construct of team monitoring in a meta-analysis, LePine et al. (2008) found a medium effect size ($d = 0.69$) on team performance. In the examination of student teams completing simulations of similar length to this study, Marks and Panzer (2004) found a large effect size ($d = 1.32$) and Porter et al. (2010) found medium effect sizes of .56 and .75 for mutual performance monitoring and team performance.

Power analyses for team-level effects were conducted in GPower 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007) using an alpha of .05, three predictors, power of .80, and effect sizes of small ($d = 0.30$), medium ($d = 0.50$), and large ($d = 0.80$). Thirteen teams are needed for a large effect size, 21 teams are needed for a medium effect size, and 38 teams are needed for a small effect size. Based on these estimates, the sample of 47 teams used in this study was large enough to detect medium cross-level effects and large team-level effects with power of .80.

Task

Virtual teams often work on tasks where an electronic environment does not impede performance, such as idea generation, decision-making, and planning (Furst, Blackburn, & Rosen, 1999). A decision-making task was created to measure team performance in this study. The experimental task required team members to work together in the creation of a budget and rationale for their decisions. The experimental task is included as Appendix A.

Participants were presented task instructions identifying seven strategic objectives of the fictional university, a budget template, and definitions of the budget expenditure areas. The required team outcomes were a balanced budget and a written report describing how the budget meets each of the seven strategic objectives.

The task was created to ensure that there was a degree of interdependence as represented in several team definitions (Cohen & Bailey, 1997; Guzzo & Dickson, 1996; Hackman, 1987; Kozlowski & Bell, 2003; Saavedra, Earley, & Van Dyne, 1993). Team members had to work together to finish the task in a timely and proficient manner. Participants were given 75 minutes to complete the task and produce the required outcomes.

Experimental Conditions

The technology available to virtual teams is vast and organizations vary in the amount of resources they choose to invest in communication technology. In this project, electronic communication was restricted to two common forms, email and instant messaging. Individuals were recruited and randomly assigned to teams, which were then randomly assigned to one of two experimental conditions.

Low monitoring condition. The low monitoring condition was meant to represent virtual teams with limited capabilities for mutual performance monitoring. Participants had access to their own documents only. Work was completed independently and combined at appropriate stages of the project task. Team members were not able to directly monitor each other's work but were able to indirectly monitor (e.g., requesting or offering performance updates). They received no instructions for mutual performance monitoring. This condition was intended to represent the manner in which many virtual teams work together today.

High monitoring condition. The high monitoring condition was meant to represent virtual teams that have the ability to monitor team members and are expected to do so. Condition two varied from the low monitoring condition in two ways to increase monitoring. First, participants in the high monitoring condition were able to view and edit team members' documents in real-time using Google Drive. This provided an enhanced opportunity for team members to monitor the behaviors and task progress of individuals in their team. An example of a document being viewed and edited by all team members is presented in Appendix B. Second, the high monitoring condition was provided with instructions that described effective mutual performance monitoring, how individuals are able to perform it in this project, and the benefits of doing so (see Appendix C).

Measures

Individuals were presented with three surveys throughout this experiment. These surveys measured variables related to individual self-perceptions and experiences of working together. The measures presented in the survey are included as Appendix D.

Mutual performance monitoring. Mutual performance monitoring is the degree to which team members observe and are aware of each other's performance. The scale was adapted from the nine-item scale from Rosenstein (1994). An example question is "Team members are aware of other team members' performance." Items were answered using a frequency-based response scale from 1 (*almost never*) to 5 (*almost always*).

Before the study, the wording of three items was simplified in an attempt to increase the reliability of the measure based on analyses from Rosenstein (1994). An analysis of the data in this research study revealed one item that should be removed. Item two, "Team members are concerned with the performance of the team members with whom they interact closely," differed from the other items. The inter-item correlations were small with a range of .06 to .31. The item also had a low, corrected item-total correlation of .29. Additionally, the removal of the item increased Cronbach's alpha from .86 to .88. This suggested the item may belong to another factor or was problematic (e.g., confusing to participants). There was no theoretical basis to retain the item or examine it as another factor, so it was removed from further analysis. The mutual performance monitoring scale therefore contained eight items with a Cronbach's alpha of .88.

An exploratory factor analysis was performed on this scale to examine the factor structure after removing the item. Maximum likelihood extraction was used to estimate the factor structure. Based on the examination of the Eigenvalues and scree plot, one factor was retained that explained 56% of the variance. Factor loadings ranged from .62-.80.

Satisfaction with team members. Satisfaction with team members is the degree individuals are satisfied with the members of their team. The scale consisted of four items

from Shaw et al. (2011) who adapted items from a measure of job satisfaction (Cammann, Fichman, Jenkins, & Klesh, 1983) by using a team referent. An example item is "I am satisfied with the way I was treated by my team members." Items were answered using an agreement-based response scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's alpha for the four-item scale was .83.

Team performance. Team performance was assessed by rating teams' responses on timeliness of submission, budget accuracy, and answer completeness and quality. Timeliness was worth 10%, budget accuracy was worth 30%, and response completeness and quality were worth 60% based on the dimensions assessed importance to the team project. The scores for dimensions of team performance were combined and that value was standardized across teams for analyses. Two graduate-level students rated the performance of teams based on their submitted responses. A scoring sheet was used to rate performance (see Appendix E). The raters first assessed the teams in a pilot study. They met and discussed any disagreements or difficulties with the scoring sheet. The raters then provided scores for all teams' performance. Based on 47 teams and across 15 ratings per team, rater agreement was 91%. All rating disagreements were discussed until consensus was reached. All rating disagreements came from the quality dimension.

Collective efficacy. Collective efficacy is the degree individuals believe their team is effective at a certain task. The scale consisted of seven items from Riggs, Warka, Babasa, Betancourt, and Hooker (1994). An example item is "The members of this team are excellent at this task." Items were answered using an agreement-based response scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's alpha for the seven-item scale was .90.

Social loafing. Social loafing is the degree team members did not contribute to the task equally. The scale consisted of four-items from Mulvey and Klein (1998). An example item is "Members of my team tried as hard as they could." Items were answered using an agreement-based response scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's alpha for the four-item scale was .83.

Exploratory variables. There were two variables included in which formal hypotheses were not made, satisfaction with monitoring and perceptions of spying. These measures were added as potential important outcomes for mutual performance monitoring in virtual teams. Satisfaction with monitoring describes the degree individuals are satisfied with the monitoring by their teammates. The scale was adapted from a measure of satisfaction with computer-aided monitoring (Chalykoff & Kochan, 1989). An example item is "I am satisfied with amount of feedback I received from my team members." Items were answered using an agreement-based response scale from 1 (*strongly disagree*) to 7 (*strongly agree*).

An exploratory factor analysis was performed on this scale to examine the factor structure after changes to the scale. Maximum likelihood extraction was used to estimate the factor structure. Based on the examination of the Eigenvalues and scree plot, one factor was retained that explained 71% of the variance. Factor loadings ranged from .58-.93. Cronbach's alpha for the four-item scale was .87.

A single item was included to measure perceptions of spying. Individuals were asked to respond to the statement, "I felt spied on by my team members." This item used an agreement based response scale from 1 (*strongly disagree*) to 7 (*strongly agree*). A summary of all measures in this study is presented as Table 2.

Table 2
Summary of Measurements

Variable	Items	α	Example item	Source
Mutual Performance Monitoring	8	.88	Team members notice the actions of other team members.	Rosenstein (1994)
Satisfaction with Team Members	4	.83	I am satisfied with the way I was treated by my team members.	Shaw et al. (2011)
Team Performance	-	.91[a]	Combination of timeliness, budget accuracy, answers completeness, and quality.	-
Collective Efficacy	7	.90	The members of this team are excellent at this task.	Riggs et al. (1994)
Social Loafing	4	.83	Members of my team tried as hard as they could.	Mulvey & Klein (1998)
Satisfaction with Monitoring	4	.87	I am satisfied with the frequency of feedback by team members.	Chalykoff & Kochan (1989)
Spying	1	-	I felt spied on by my team members.	-

[a] percent rater agreement

Pilot Test

Before beginning the experiment, six teams and 21 individuals went through a pilot test. One team was removed for not following directions correctly, resulting in five teams with 17 individuals. The results indicated that the manipulation induced a small mean difference in mutual performance monitoring between the low ($M = 3.68$, $SD = 0.01$) and high conditions ($M = 4.02$, $SD = 0.23$). The results were used to refine the components of the task, such as increasing the instructions and timing of the task, in addition to replacing the measure of collective efficacy and updating the measure of team performance to better reflect variability in team task answers.

Procedure

Figure 3 displays the order and timing of the research protocol. Participants were recruited through a research participation system at the university. Interested individuals followed a link to a webpage with the study description and a form to complete for availability. Participants were randomly assigned to teams of four based on the pool of available participants. Teams of four were used so participants could still be tested as a team if one participant did not show up. Individuals were sent invitations to the experiment at a specific date and time. They were sent two-day and one-day reminders. At the beginning of the experiment, participants were emailed a set of instructions. They first completed a survey and then were directed to a short training on Google Drive, Gmail, and Gmail chat. A copy of the training was available to participants throughout the experiment. After the training, participants were instructed to log into Gmail using the credentials provided. Team members were assigned a gender-neutral alias that appeared in communications with other team members to protect their identity.

When all team members were in Gmail, they were sent task instructions. The instructions included a ten-minute window in which they were instructed to submit their completed report. Halfway through the task, they were sent a link to the measure of collective efficacy. This was measured in the middle of the task because it provided a balance between experience working with team members and knowledge of the team's performance outcome. The collective efficacy measure was short and thought to have minimal disruption on team performance.

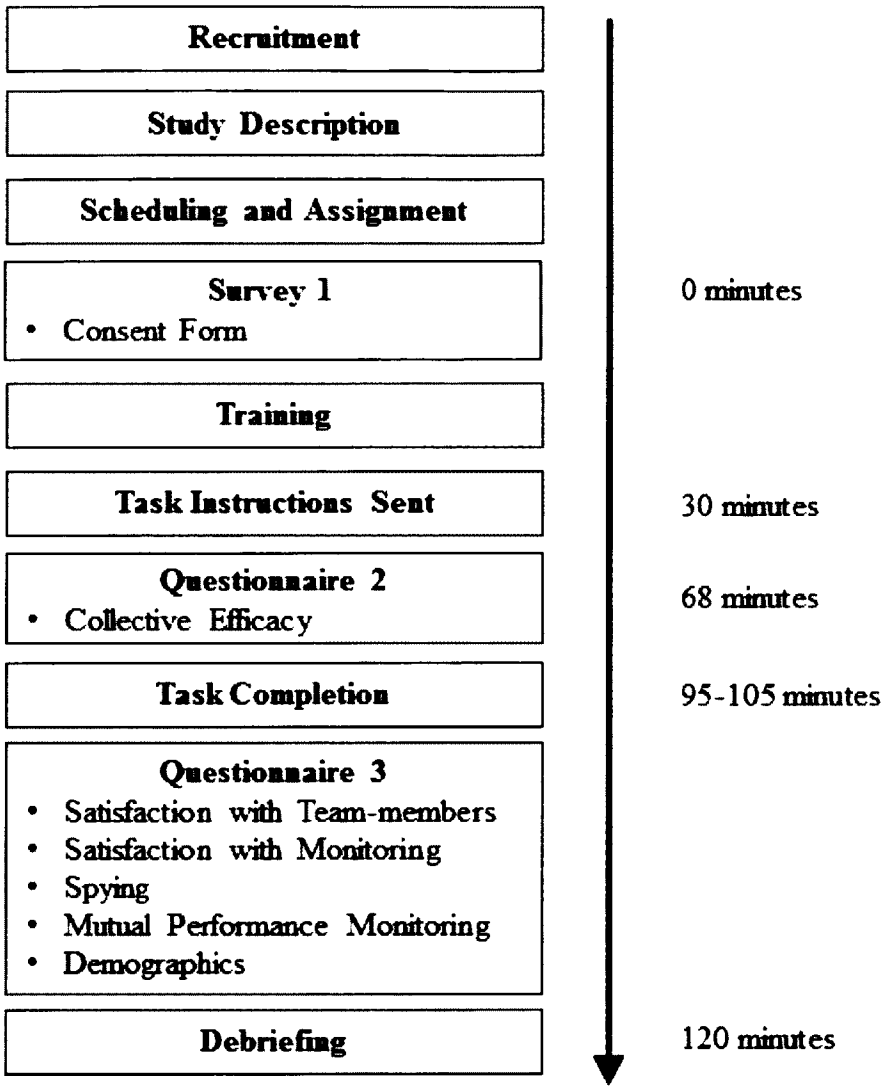

Figure 3. Diagram of the research procedure.

After task completion, a survey link was sent to participants containing the remaining measures. The measures included satisfaction with team members, satisfaction with monitoring, perceptions of spying, mutual performance monitoring, social loafing, and a demographic form. After completion of the surveys, a link to a debriefing form was provided that could be saved or printed.

CHAPTER 3

RESULTS

Data were first examined for indicators of careless responding and missing response patterns. Second, agreement and reliability statistics were examined for deciding whether to aggregate individual responses to team-level variables. Third, the equivalence of the experimental conditions and efficacy of manipulation were examined. Fourth, hierarchical linear modeling (HLM) and structural equation modeling (SEM) were used to examine the hypotheses.

Careless Responder Analysis

Due to concerns with response quality of undergraduate samples, analyses to identify careless responders were performed (Meade & Craig, 2012). The maximum number of identical, consecutive responses and response times were calculated for participants on each survey. The purpose of the identical, consecutive response analysis was to identify individuals with an unusually high number of identical responses. The purpose of the response time analysis was to identify individuals with unusually quick response times. Quick response times may indicate careless responding such that individuals provide an answer without reading the question.

Table 3 presents descriptive statistics for the length of identical, consecutive responses and response times for each of the three surveys. Based on the careless responder analysis, four individuals were identified as having unusually high identical, consecutive responses. For the response time analysis, it was difficult to determine what would be considered responding too quickly. While difficult to examine alone, in combination with the other analysis, the response time analysis supported the

identification of four individuals as careless responders. Those four individuals responded with identical responses to nearly all survey questions and had short response times of between one and three minutes for each survey. The four participants were removed from further analysis.

Table 3
Descriptive Statistics for Careless Responder Analysis

Survey	Minimum	Maximum	Median
	Consecutive Identical Responses Length		
First	2	39	4
Second	1	7	2
Third	2	10	6
	Response Times (in minutes)		
First	1	17	6
Second	1	40	2
Third	1	149	4

Missing Data

Missing data were identified by looking at frequencies of individual responses to items. Frequencies were calculated based on survey scales (i.e., average across multiple items) to represent the nature of missing data as there were no missing responses to individual items within a survey, only entire surveys. Missing data for scales ranged from 3.1 to 6.2 percent (see Table 4). Eight individuals failed to respond to either the second or third survey.

Table 4
Missing Data Analysis for Scales

Measure	*N*	Count	Percent
Satisfaction with Team members	161	10	6.2
Satisfaction with Monitoring	161	10	6.2
Spying	161	10	6.2
Mutual Performance Monitoring	161	10	6.2
Collective Efficacy	161	5	3.1
Social Loafing	161	10	6.2

The first step was to determine if there was a pattern of missing data, such that missingness is related to another variable. There are three types of missing data: missing completely at random (MCAR), missing at random (MAR), and missing not at random (MNAR; Little & Rubin, 1989). MCAR means that missingness results from a random process. MAR means missingness results from processes reflected by variables in the dataset. MNAR means that missingness results from unmeasured processes. MCAR was tested using Little's MCAR test and was found to be non-significant, $\chi^2(205) = 212.48$, $p = .345$. This suggests that missing data can be assumed to be missing as a result of random processes (i.e., MCAR).

For team level variables, aggregation was completed using scores from individuals without missing data. This yielded all but one team with at least two responses, which is the least number of responses within a team needed for calculating aggregation statistics. For the individual-level variable, satisfaction with team members, listwise deletion was used. Listwise deletion was used as when data are MCAR, analyses with listwise deletion yield unbiased estimates (Graham, Cumsille, & Elek-Fisk, 2003).

Team-level Aggregation

Collective efficacy, social loafing, and mutual performance monitoring were measured as individual responses but conceptualized as team-level phenomena. To support aggregation, theoretical and empirical evidence must be provided. These team-level variables represent a reference-shift consensus model, in which individuals provide ratings in reference to a higher-level construct (Chan, 1998). The within-unit ratings are then averaged to become a score for the higher-level construct.

Collective efficacy, social loafing, and mutual performance monitoring were conceptualized as team-level variables but measured at the individual-level with self-reported perceptions. The wording for items on each of these scales used a team-level referent. In addition, these measures had been used previously in the literature and were supported to be team-level phenomena.

To justify aggregation empirically, within-group agreement statistics were calculated. Agreement is essential to establishing a higher-level construct using a referent-shift consensus model. The scales included multiple items, so $r_{wg(j)}$ was used to calculate agreement (James, Demaree, & Wolf, 1984). The $r_{wg(j)}$ metric examines the variance of team member ratings relative to a baseline null distribution. Higher scores for $r_{wg(j)}$ represent higher agreement, or a smaller relationship to the null distribution. A $r_{wg(j)}$ score is calculated for each team and the median or mean across teams is used to support aggregation.

The most common null distribution is rectangular, where the chance of responding to each response scale is identical. Although this is commonly reported, it is suggested that additional null distributions are analyzed (James et al., 1984). A triangular

null distribution was also used in this study to calculate $r_{wg(j)}$. The triangular null distribution reflects higher likelihoods responding to the center of the scale than the ends. Whereas $r_{wg(j)}$ is often compared to a .70 rule of thumb, there is questionable grounds for this comparison and it is probably too lenient a cutoff (Harvey & Hollander, 2004). Team size also has an influence on $r_{wg(j)}$ values, such that small team sizes (e.g., fewer than 10) can result in inaccurately low values as disagreement has a larger in smaller team sizes (Lindell, Brandt, & Whitney, 1999).

Intraclass correlations (ICCs) were calculated to examine the reliability of team means. ICC(1) is the proportion of variance that can be explained by team-level variables. ICC(2) is a measure of reliability for team means and related to ICC(1) as a function of team size. ICC(2) increases as the size of the team or ICC(1) increase. A one-way ANOVA with random-effects is used to calculate ICC(1) and ICC(2) where the independent variable is team identity and dependent variable is the individuals' score for the construct.

Table 5 presents agreement and reliability statistics for collective efficacy, social loafing, and mutual performance monitoring. The agreement statistics of $r_{wg(j)}$ between .82 and .90 would support aggregation of the team-level constructs, with some central tendency for collective efficacy and mutual performance monitoring. For collective efficacy, the ICC(1) was not statistically significant, $F(46, 151) = 1.36$, $p = .099$. For social loafing, the ICC(1) was statistically significant, $F(46, 104) = 1.51$, $p = .044$. For mutual performance monitoring, the ICC was not statistically significant, $F(46, 109) = .89$, $p = .668$.

Table 5
Agreement and Reliability of Team-level Variables

	Median $r_{wg(j)}$				
Variable	Rectangular	Triangular	ICC(1)	*p*	ICC(2)
Collective Efficacy	.90	.76	.10	.099	.27
Social Loafing	.82	.57	.13	.044	.34
Mutual Performance Monitoring	.83	.39	.00	.678	.00

The team-level variables had strong agreement but low reliability, providing mixed support for aggregation. The non-significant ICC(1)s for collective efficacy and mutual performance monitoring reflect low variance in team means. The low ICC(2)s are a result of small ICC(1) values and small team sizes.

Agreement and reliability describe different aspects of the data. Agreement statistics measure the degree to which team member ratings of the team-level construct are equivalent in value (i.e., absolute agreement). ICC(1) and ICC(2) statistics describe the reliability of team means by describing the degree to which team member rankings are equivalent. ICC(1) can be interpreted as an effect size estimate of the degree to which ratings were affected by team membership. Although evidence from both are preferred to support aggregation, this is not always possible and it is not rare for aggregation support to be mixed (LeBreton & Senter, 2008). There can be high absolute agreement with low reliability (e.g., ranking equivalence). Based on the agreement statistics, individual ratings of collective efficacy, social loafing, and mutual performance monitoring were aggregated to create team-level scales operationalized as emergent, team-level constructs.

Descriptive Statistics

Means, standard deviations, and correlations for individual-level variables are presented as Table 6 and team-level variables as Table 7. Individual-level correlations are based on a sample size of at least 151 and team-level correlations are based on a sample size of 47.

Check for Equivalence of Experimental Condition after Random Assignment

Teams were randomly assigned to the two experimental conditions. Participant characteristics were compared to verify equivalence across both conditions. There was no statistically significant difference in the age of participants between conditions, $t(149) = 1.46$, $p = .478$. Cross-tabulations showed little difference by condition in frequencies for gender, ethnicity, and year in school. Examinations of the short quiz at the end of training displayed similar performance for each group, with 91% accuracy for the low monitoring condition and 93% accuracy for the high monitoring condition. The average team size for each condition was similar in the low monitoring condition ($M = 3.33$, $SD = 0.70$) and the high monitoring condition ($M = 3.52$, $SD = 0.51$), $t(45) = 1.05$, $p = .300$.

Table 6

Descriptive Statistics for Individual-level Variables

Variable	*N*	*M*	*SD*	1	2	3	4	5	6	7
1. Satisfaction with Team Members	151	5.91	1.00							
2. Satisfaction with Monitoring	151	5.62	1.24	.70**						
3. Spying	151	2.20	1.68	-.17*	-.31**					
4. Condition	161	-	-	.14	.09	-.04				
5. Mutual Performance Monitoring	151	3.64	0.86	.37**	.43**	-.08	.01			
6. Collective Efficacy	156	4.99	1.24	.65**	.55**	-.16	.00	.31**		
7. Social Loafing	151	2.49	1.21	-.66	-.63**	.14	-.10	-.39**	-.62**	

*$p<.05$, **$p<.01$

Table 7

Descriptive Statistics for Team-level Variables

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1. Satisfaction with Team Members	5.91	0.57								
2. Satisfaction with Monitoring	5.64	0.71	.60**							
3. Spying	2.16	1.35	-.16	-.59**						
4. Condition	-	-	.21	.16	-.05					
5. Mutual Performance Monitoring	3.63	0.47	.32*	.28	.01	.07				
6. Collective Efficacy	4.98	0.75	.66**	.49**	-.12	-.01	.37*			
7. Social Loafing	2.50	0.81	-.48**	-.51**	.08	-.17	-.51**	-.56**		
8. Team Performance	0.00	1.00	.32*	.28	-.17	.32**	-.03	.16	-.11	

Note: $N = 47$. Team performance was standardized.

*$p<.05$, **$p<.01$

Manipulation check. The manipulation check was an analysis of the eight-item scale of mutual performance monitoring. To verify the manipulation elicited greater mutual performance monitoring in the high monitoring condition than the low monitoring condition, an independent samples t-test was conducted. Levene's test for homogeneity of variance was not statistically significant, $p = .556$. Participants in the high monitoring condition reported higher levels of mutual performance monitoring ($M = 3.67$, $SD = 0.46$) than did participants in the low monitoring condition ($M = 3.60$, $SD = 0.48$), as was expected by the manipulation, but this difference was small and not statistically significant, $t(45) = 0.49$, $p = .629$. These results indicate that the manipulation was ineffective and that participants in both conditions experienced similar amounts of mutual performance monitoring. Based on this finding, the measure of mutual performance monitoring was examined in a correlational design with condition as a control variable.

Outlier Analyses

Univariate outliers were examined by looking at boxplots and calculating distance from the mean at both the individual-level and the team-level. Cases that were outside three times the inter-quartile range were considered univariate outliers. No participants or teams were identified as univariate outliers.

Multivariate outliers were examined by calculating leverage, discrepancy, and influence statistics before each analysis. Leverage was examined with Mahalanobis distance, which measures the distance between a case and the centroid of the predictors. Discrepancy was examined using externally deleted residuals, which measures the difference between the predicted and observed values, taking into account the precision of the estimate and removing the case when calculating the regression line. Influence was

examined with DFBETAS, which examines the difference between regression coefficients with or without the case included. In the analysis of cross-level effects with HLM, one team was identified as a multivariate outlier. Given the small sample size, the team was retained. Analyses with and without the multivariate outlier were identical in their conclusions.

Multicollinearity of the predictors on the outcome variables was examined. The variance inflation factor (VIF) was calculated, which measures the variance increase of a regression coefficient relative to a hypothetical condition where predictors are uncorrelated. Tolerance was examined which describes the amount of variance in a predictor that is independent of other variables. Multicollinearity statistics were all found to be below the cutoff of 10 for VIF and larger than the cutoff of .10 for tolerance.

Hypothesis Tests

HLM is a statistical analysis method that handles data that violate the independence assumption in regression. In these cases, data are hierarchical and must be modeled as such for accurate estimates. HLM allows partitioning of variance and covariance for different levels of analysis, improves the estimation of effects within units, and provides more accurate standard error estimates (Raudenbush & Bryk, 2002). In the current research, individuals were nested within teams and therefore there was likely an influence of responses among members.

HLM assumptions. HLM makes several assumptions about the nature of the data and relationships. First, the relationships between the predictors and outcomes are assumed to be linear. To examine this assumption, scatterplots for each predictor and satisfaction with team members were examined. It was determined that this assumption

was met based on visual inspections. Second, the predictors are assumed to have a multivariate normal distribution. This was analyzed by examining the Q-Q plots for each variable. It was determined that this assumption was met. Third, homogeneity of variance in the predictors is assumed. This was analyzed by examining the relationship between the residuals and each variable. It was determined that this assumption was met. Fourth, teams are assumed to be independent of each other. Based on the design of the experiment, teams did not have an influence on each other and therefore the assumption of independence is reasonable.

Missing data are a concern for both levels in HLM. There was no missing data for level-2 variables, therefore no corrections needed to be made. Missing data at level-1 was handled automatically by the HLM software through listwise deletion during analysis.

Centering is a concern when testing a model in HLM. Condition was indicated through dummy coding so no centering was used. Mutual performance monitoring, team performance, collective efficacy, and social loafing were added to the equation using grand-mean centering to reduce potential multicollinearity and help with interpretation. Estimation of random and fixed effects was completed using restricted maximum likelihood.

The basic HLM model is a one-way ANOVA with random-effects. It does not include any predictors and provides an ICC(1) estimate. The equations for this model were:

Level 1: $SatTM_{ij} = \beta_{0j} + r_{ij}$
Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

where:

β_{0j} = SatTM mean for team j
γ_{00} = grand mean SatTM
Var $(r_{ij}) = \sigma^2$ = within group variance

$\text{Var}(u_{0j}) = \tau_{00}$ = between group variance
$\text{Var}(\text{SatTM}_{ij}) = \text{Var}(u_{0j} + r_{ij}) = \tau_{00}$
$\text{ICC}(1) = \tau_{00}/(\tau_{00} + \sigma^2)$
SatTM = Satisfaction with team members

The variance of the level-1 random effect was 0.99 and of the level-2 random effect was 0.00, which was not statistically significant, χ^2 (46, N = 151) = 48.23, p = .383. The ICC(1) was .00, meaning that 0% of the variance in satisfaction with team members is attributed to differences between teams. This essentially means that there is no meaningful variance in satisfaction with team members at the team-level. Based on this finding, hypotheses were tested using SEM at the individual-level. For team performance, individuals were given their team score as performance was not measured at the individual-level. SEM is advantageous because it allows for the testing of multiple relationships simultaneously, corrections for unreliability in measurement, and affords increased power to test hypothesized relationships.

Hypotheses were tested with maximum likelihood estimation in SEM using EQS (Multivariate Software, 2013). The assumptions for SEM were first analyzed. Collinearity was examined with tolerance and VIF values, univariate outliers were examined using the cutoff of three times the inter-quartile range, linearity of relationships was examined with scatterplots, and the homoscedasticity of residuals was examined with Q-Q plots. Model fit was assessed using model chi-square, comparative fit index (CFI), standardized root mean square residual (SRMR), and root mean square of approximation (RMSEA) with cutoff values from Hoyle (2012). Model chi-square describes the degree of misfit between the sample covariance matrix and model-implied covariance matrix and should have a significance value above .05. CFI assesses improvement in model fit of the specified model to the independence model with a cutoff of value .95. SRMR is the mean

absolute correlation residual and should be below .08. RMSEA is a parsimony-adjusted badness-of-fit index and should be less than .06.

The SEM analysis followed a two-stage approach as recommended by Anderson and Gerbing (1988). The first step was to examine the measurement model. The initial measurement model used 300 covariances and variances to estimate 57 parameters. Based on the confirmatory factor analysis (CFA) results, the fit was considered poor, χ^2 (243, N = 151) = 494.27, p < .001, CFI = .88, SRMR = 0.08, RMSEA = 0.08 (90% CI [0.07, 0.09]).

Based on an examination of modification indices, several changes were made to the measurement model. For mutual performance monitoring, three items were removed due to cross-loadings. Modification indices suggested the item "Team members notice performance errors of other team members" loaded on collective efficacy (16.24), social loafing (17.11), and satisfaction with team members (12.41). Modification indices suggested the item "Team members recognize when a team member makes a mistake," loaded on collective efficacy (11.69) and social loafing (18.89). Modification indices suggested that the item "Team members recognize when a team member performs correctly" loaded on collective efficacy (11.35), social loafing (15.73), and satisfaction with team members (11.35). Modification indices suggested correlated error terms for two items in the mutual performance monitoring scale (14.37). The items, "Team members make sure other team members are performing appropriately" and "Team members watch other team members to ensure they are meeting the requirements of the task being worked on" seem to capture an aspect of monitoring similar to surveillance behaviors so the items' errors were allowed to correlate. Modification indices suggested

correlated error terms for two items in the collective efficacy scale (37.60). The items, "Some members of this team should not be in the team due to lack of ability" and "Some members in this team cannot do their jobs well," seem to capture assessments of team member competence or ability more generally so the items' errors were allowed to correlate. Modification indices suggested correlated error terms for two items in the satisfaction with team members scale (29.52). The items, "I am satisfied with the way I was treated by my team members" and "I am satisfied with the friendliness of my team members," are similar is wording and content so the items' error terms were allowed to correlate. The final measurement model used 231 covariances and variances to estimate 54 parameters. This measurement model was better fitting than the initial measurement model and met most of the recommended cutoffs, χ^2 (177, N = 151) = 247.01, $p < .001$, CFI = .96, SRMR = 0.06, RMSEA = 0.05 (90% CI [0.04, 0.07]). This measurement model, presented in Figure 4, was used in the structural model.

The second step was to estimate the structural model. The model used 231 covariances and variances to estimate 51 parameters. The correlation matrix of indicators used to test the structural model is presented in Table 8. The structural model depicted in Figure 5 did not fit the obtained data well, χ^2 (180, N = 151) = 337.95, $p < .001$, CFI = .91, SRMR = 0.09, RMSEA = 0.08 (90% CI [0.06, 0.09]). The Mardia's normalized estimate for multivariate kurtosis was 22.26, indicating potential for inflated chi-square and standard error estimates. Bootstrapping was therefore used to estimate the model again and parameter estimates following recommendations for when multivariate normality cannot be assumed (Nevitt & Hancock, 2001). Based on 1,000 resamples, the bootstrapping analysis revealed a better fitting model, χ^2 (180, N = 151) = 220.88, p =

.020, CFI = .97, SRMR = 0.05, RMSEA = 0.03 (90% CI [0.02, 0.05]). Path coefficients and standard errors for the model tested with bootstrapping are presented in Table 9.

Hypothesis 1 predicted a positive relationship between mutual performance monitoring and satisfaction with team members. The path between mutual performance monitoring and satisfaction with team members was positive and statistically significant. Thus, hypothesis 1 was supported by the data.

Hypothesis 2 predicted a positive relationship between mutual performance monitoring and team performance. The results indicated a negative relationship between these variables that was not statistically significant. Thus, hypothesis 2 was not supported. Hypothesis 3 predicted that the team performance mediates the relationship between mutual performance monitoring and satisfaction with team members. There was no statistically significant path between mutual performance monitoring and team performance, therefore the mediating relationship could not be tested and its hypothesis was not supported.

Hypothesis 4 predicted that there would be a positive relationship between team performance and satisfaction with team members. This relationship was found to be statistically significant. Thus, hypothesis 4 was supported by the data.

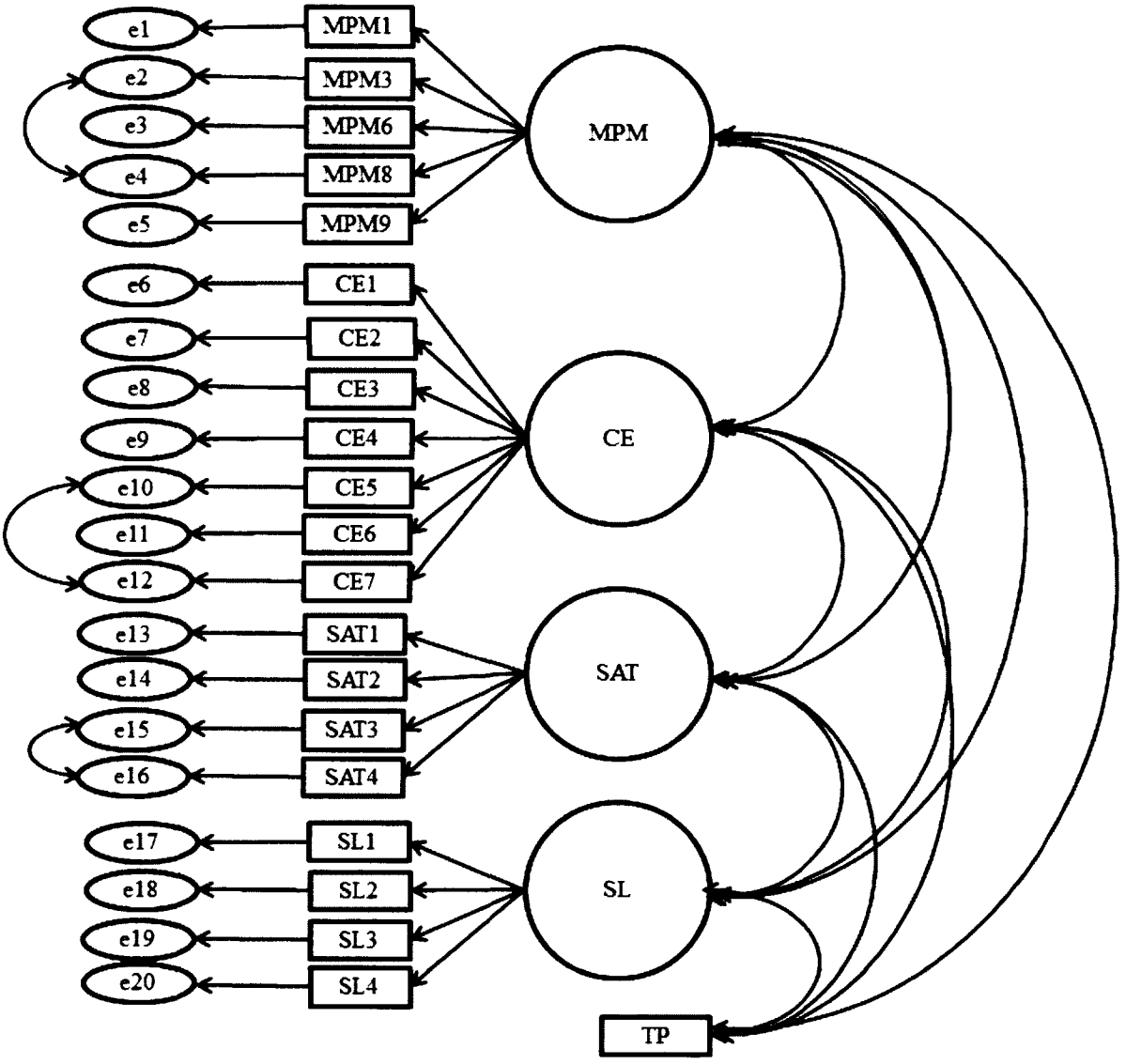

Figure 4. Measurement model. MPM = mutual performance monitoring; CE = collective efficacy; SAT = satisfaction with team members; SL = social loafing; TP = team performance. Model χ^2 (177, N = 151) = 247.01, $p < .001$, CFI = .96, SRMR = 0.06, RMSEA = 0.05 (90% CI [0.04, 0.07]). CFI = comparative fit index; SRMR = standardized root mean square residual; RMSEA = root mean square error of approximation.

Table 8

Means, Standard Deviations, and Correlations for Indicators

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. MPM1	3.89	1.12									
2. MPM3	3.46	1.19	.47**								
3. MPM6	4.09	0.87	.55**	.55**							
4. MPM8	3.39	1.32	.39**	.63**	.44**						
5. MPM9	3.76	1.11	.43**	.49**	.56**	.54**					
6. SL1	2.22	1.30	-.35**	-.31**	-.44**	-.32**	-.41**				
7. SL2	2.65	1.58	-.29**	-.22**	-.33**	-.15	-.28**	.52**			
8. SL3	2.78	1.63	-.34**	-.21*	-.33**	-.13	-.32**	.51**	.57**		
9. SL4	2.29	1.42	-.27**	-.20*	-.28**	-.21*	-.31**	.64**	.55**	.50**	
10. CE1	4.81	1.49	.36**	.30**	.29**	.19*	.35**	-.47**	-.24**	-.36**	-.34**
11. CE2	5.05	1.42	.31**	.16	.28**	.18*	.28**	-.48**	-.37**	-.39**	-.43**
12. CE3	5.03	1.57	.35**	.13	.28**	.12	.36**	-.51**	-.41**	-.54**	-.45**
13. CE4	4.85	1.53	.30**	.24**	.26**	.12	.30**	-.54**	-.35**	-.43**	-.43**
14. CE5	5.11	1.68	.25**	.13	.22**	.10	.15	-.32**	-.34**	-.31**	-.29**
15. CE6	5.12	1.62	.31**	.13	.26**	.09	.27**	-.51**	-.34**	-.45**	-.41**
16. CE7	5.00	1.64	.25**	.14	.21**	.05	.17*	-.37**	-.48**	-.46**	-.35**
17. SAT1	5.65	1.46	.38**	.30**	.34**	.21*	.38**	-.55**	-.49**	-.53**	-.60**
18. SAT2	5.83	1.37	.33**	.22**	.26**	.17*	.31**	-.45**	-.46**	-.55**	-.53**
19. SAT3	6.00	1.11	.27**	.17*	.29**	.11	.33**	-.30**	-.26**	-.38**	-.25**
20. SAT4	6.18	0.89	.31**	.19*	.36**	.17*	.31**	-.34**	-.34**	-.44**	-.31**
21. TP	-0.03	1.02	.07	-.14	.01	-.06	.03	.00	-.15	-.07	-.10

Variable	10	11	12	13	14	15	16	17	18	19	20	21
1. MPM1												
2. MPM3												
3. MPM6												
4. MPM8												
5. MPM9												
6. SL1												
7. SL2												
8. SL3												
9. SL4												
10. CE1												
11. CE2	.68**											
12. CE3	.56**	.66**										
13. CE4	.62**	.61**	.62**									
14. CE5	.32**	.44**	.44**	.42**								
15. CE6	.63**	.70**	.72**	.70**	.47**							
16. CE7	.50**	.59**	.49**	.52**	.67**	.60**						
17. SAT1	.44**	.51**	.52**	.50**	.26**	.54**	.45**					
18. SAT2	.49**	.56**	.57**	.48**	.40**	.61**	.56**	.81**				
19. SAT3	.24**	.34**	.35**	.26**	.30**	.38**	.33**	.41**	.44**			
20. SAT4	.20*	.34**	.44**	.34**	.35**	.38**	.39**	.56**	.51**	.64**		
21. TP	.07	.09	.08	.02	.02	.09	.07	.21*	.18*	.15	.06	

Note: N = 149-156. MPM = Mutual performance monitoring; CE = collective efficacy; SAT = satisfaction with team members; SL = social loafing; TP = team performance.

*p<.05, **p<.01

Table 9
Path Estimates and Standard Errors for Relationships in Bootstrapped Model

Path	β	*B*	95% CI for *B*
MPM → Collective Efficacy	.72	1.24*	[0.79, 1.85]
MPM → Social Loafing	-.88	-1.32*	[-1.91, -0.90]
MPM → Performance	-.21	-0.33	[-1.66, 0.69]
MPM → Satisfaction	.77	1.58*	[1.07, 2.31]
Collective Efficacy → Performance	.13	0.12	[-0.18, 0.41]
Social Loafing → Performance	-.18	-0.17	[-0.88, 0.36]
Performance → Satisfaction	.19	0.25*	[0.10, 0.40]

Note: β = standardized path estimate; *B* = unstandardized path estimate; CI = percentile confidence intervals based on 1,000 bootstrap samples; MPM = mutual performance monitoring. Model χ^2 (180, N = 151) = 220.88, p = .020, CFI = .97, SRMR = 0.05, RMSEA = 0.03 (90% CI [0.02, 0.05]). CFI = comparative fit index; SRMR = standardized root mean square residual; RMSEA = root mean square error of approximation.
*indicates statistical significance based on 95% percentile CI (α = .05).

Hypothesis 5 predicted a positive relationship between mutual performance monitoring and collective efficacy. Mutual performance monitoring was found to be a statistically significant predictor of collective efficacy. This relationship was the same after controlling for condition, B = 1.58 (95% CI [1.07, 2.31). Hypothesis 5 was supported by the data. Hypothesis 6 predicted an indirect effect of mutual performance monitoring on team performance through collective efficacy. However, mutual performance monitoring did not have an effect on team performance; therefore there was no effect to mediate. Thus, hypothesis 6 was not supported by the data. Hypothesis 7 predicted that collective efficacy had a direct effect on team performance. The effect of collective efficacy on team performance was not statistically significant. Hypothesis 7 was not supported by the data.

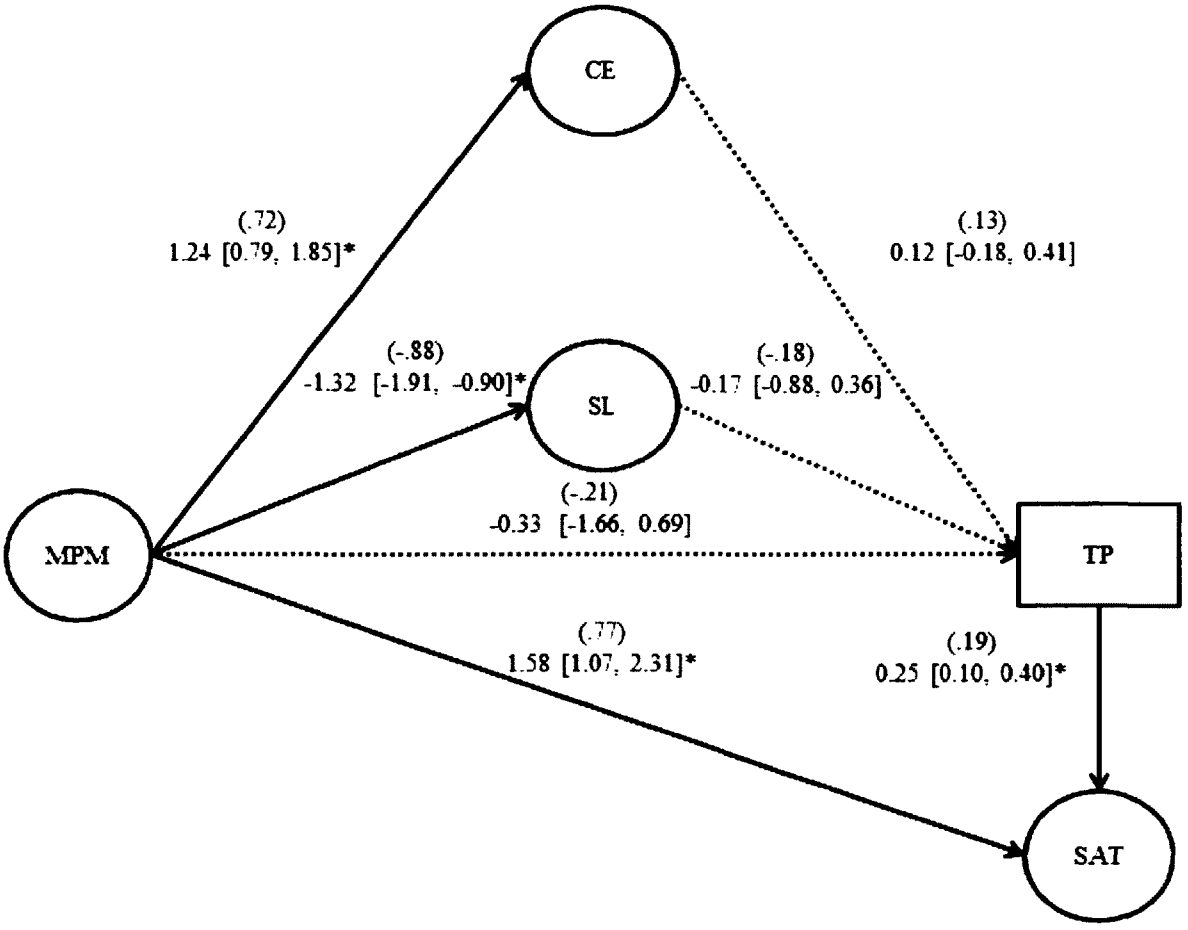

Figure 5. Structural model with bootstrap estimates. Standardized estimates are within parentheses with unstandardized estimates and 95% CI directly below. CI = percentile confidence intervals based on 1,000 bootstrap samples. MPM = Mutual performance monitoring; CE = collective efficacy; SAT = satisfaction with team members; SL = social loafing; TP = team performance. χ^2 (180, N = 151) = 220.88, p = .020, CFI = .97, SRMR = 0.05, RMSEA = 0.03 (90% CI [0.02, 0.05]). CFI = comparative fit index; SRMR = standardized root mean square residual; RMSEA = root mean square error of approximation.

*indicates statistical significance based on 95% percentile CI (α = .05).

Hypothesis 8 predicted that mutual performance monitoring would predict social loafing. Mutual performance monitoring was found to be a statistically significant predictor of social loafing. This relationship was the same after controlling for condition, B = -1.32 (95% CI [-1.91, -0.90]). Hypothesis 8 was supported by the data.

Hypothesis 9 predicted an indirect effect of mutual performance monitoring on team performance through social loafing. However, mutual performance monitoring did not have an effect on team performance; therefore there was no effect to mediate. Thus, hypothesis 9 was not supported. Hypothesis 10 predicted that social loafing had a direct effect on team performance. The effect of social loafing on team performance was not statistically significant. Hypothesis 10 was not supported by the data. Table 10 presents a summary of the support found for hypotheses in this study.

Exploratory Variable Analyses

Satisfaction with monitoring and spying were two variables explored without hypotheses. Based on individual-level correlations, satisfaction with monitoring and satisfaction with team members were strongly correlated, $r(151) = .70$, $p < .001$. Spying was negatively related to satisfaction with team members, $r(151) = -.17$, $p = .035$ and satisfaction with monitoring, $r(151) = -.31$, $p < .001$.

Table 10
Summary of Support for Hypotheses

Hypothesis	Supported?
1: Mutual performance monitoring will be positively related to satisfaction with team members.	Yes
2: Mutual performance monitoring will be positively related to team performance.	No
3: Team performance will partially mediate the relationship between mutual performance monitoring and satisfaction with team members.	No
4: Team performance will be positively related to satisfaction with team members.	Yes
5: Mutual performance monitoring will be positively related to collective efficacy.	Yes
6: Collective efficacy will partially mediate the relationship between mutual performance monitoring and team performance.	No
7: Collective efficacy will be positively related to team performance.	No
8: Mutual performance monitoring will be negatively related to social loafing.	Yes
9: Social loafing will partially mediate the relationship between mutual performance monitoring and team performance.	No
10: Social loafing will be negatively related to team performance.	No

For satisfaction with monitoring, HLM analyses were performed using a building-up approach where individual-level predictors were added before team-level predictors and only significant predictors were kept. From the one-way ANOVA with random-effects, the variance of the level-1 random effect was found to be 0.11 and the level-2 random effect was 1.43, which was not statistically significant, χ^2 (46, N = 151) =

54.33, $p = .187$. The ICC(1) was .07, meaning that 7% of the variance in satisfaction with monitoring is attributed to differences between teams. Satisfaction with team members was a statistically significant predictor ($B = 0.83$, $SE = 0.07$, $p < .001$) as was spying ($B = -0.14$, $SE = 0.04$, $p < .001$); individuals who were satisfied with their team members tended to be more satisfied with monitoring. Additionally, individuals who felt less spied upon tended to be more satisfied with monitoring. None of the team-level variables measured in this study were found to be statistically significant predictors.

For spying, HLM analyses were performed using the same building-up approach. From the one-way ANOVA with random-effects model, the variance of the level-1 random effect was found to be 1.37 and the level-2 random effect was 1.43, which was statistically significant, χ^2 (46, $N = 151$) = 205.64, $p < .001$. The ICC(1) was .51, meaning that 51% of the variance in spying was attributed to differences between teams. Satisfaction with team members and satisfaction with monitoring were not found to be statistically significant predictors of spying. None of the team-level variables were found to be statistically significant predictors.

Team performance was measured as a composite but can also be decomposed into the dimensions of timeliness, accuracy of budget calculations, objective completeness, and objective quality. The dimensions may be interesting to explore as they represent facets of performance on the task and may relate to team processes differently. Table 11 presents means, standard deviations, and t-tests for the team performance dimensions separated by condition. There was a significant effect for objective quality and near significant effects for budget completion accuracy and objective completeness. Timeliness was correlated with spying, $r(47) = .31$, $p = .037$. Budget calculation accuracy

was correlated with satisfaction with team members, $r(47) = .30, p = .040$, and satisfaction with monitoring, $r(47) = .35, p = .017$. Objective completeness was not correlated with variables outside of the performance composite. Objective quality had no additional statistically significant correlations.

Table 11
Team Performance Dimensions

	Low Monitoring Condition		High Monitoring Condition		
	M	*SD*	*M*	*SD*	*t*
Timeliness	.80	.37	.87	.31	0.78
Budget Calculation Accuracy (%)	.58	.50	.83	.39	1.85+
Objective Completeness	4.17	2.84	5.48	2.41	1.70+
Objective Quality	14.58	7.08	19.61	9.37	2.08*

$+p < .10$, $*p < .05$

CHAPTER 4

DISCUSSION

The present research examined the influence of mutual performance monitoring on team-level and individual-level outcomes within virtual teams. This research was important because mutual performance monitoring is a critical teamwork behavior (e.g., Cannon-Bowers et al., 1995; Marks et al., 2001; Salas et al., 2005). This research was the first to examine mutual performance monitoring within virtual teams, an important type of team structure to explore because of their increased use by organizations (RW-3, 2010; SHRM, 2012). Additionally, this research examined the effects of mutual performance monitoring on satisfaction with team members, collective efficacy, social loafing, and perceptions of spying. This research integrated multiple levels of analysis, which is consistent with recommendations for organizational research (e.g., Kozlowski & Klein, 2000).

Effects of Mutual Performance Monitoring

Mutual performance monitoring was hypothesized to have direct effects on satisfaction with team members (hypothesis 1), team performance (hypothesis 2), collective efficacy (hypothesis 5), and social loafing (hypothesis 8). All the hypothesized direct effects of mutual performance monitoring, except for team performance, were supported. The effects of mutual performance monitoring on collective efficacy, social loafing, and satisfaction with team members are the first to be described in the literature. Together these results indicate the importance of mutual performance monitoring for team cognitions, behaviors, and satisfaction.

Mutual performance monitoring may have contributed to the development of collective efficacy within virtual teams. The teams in this study were ad hoc, so they did not have any previous experience working together, thus they needed to develop collective efficacy quickly. Monitoring is a precursor to other behaviors, such as feedback, which is one route in the development of collective efficacy (Goddard et al., 2004).

Mutual performance monitoring may have led to decreased social loafing. When teams monitor member performance, there is an increased knowledge of contributions. Social loafing could be reduced through decreased feelings of individual contribution dispensability (Price et al., 2006). Team members would better understand the importance of their contributions to team outcomes and thus provide additional effort accordingly. Team monitoring also increases the transparency of member actions. The decreased anonymity of member actions may have led to less loafing behaviors.

The lack of relationship between mutual performance monitoring and team performance is not consistent with previous research (Bijlsma-Frankema et al., 2008; De Jong & Elfring, 2010; Marks & Panzer, 2004; Porter et al., 2010). The zero-order correlation between mutual performance monitoring and team performance was small and negative. The inconsistency with previous research for mutual performance monitoring and team performance indicates unique factors within this study may have contributed to this difference.

A possible explanation for the lack of findings between mutual performance monitoring and team performance is that the task and task environment did not allow teamwork processes to affect team performance. Condition only had a significant effect

on team performance in this study, in which condition two (real-time document sharing and instructions for monitoring) had higher team performance. The difference between the two conditions was considered to have a moderate effect size, $d = .68$. Condition one may have had a more difficult time communicating, and given the limited time to complete the task, team performance suffered as a result. To have an effect on team performance, the benefits of mutual performance monitoring may have needed more time to materialize.

Though mutual performance monitoring did not have an effect on team performance, neither did collective efficacy nor social loafing, team motivation and behavior constructs. These relationships are not consistent with previous research that has demonstrated collective efficacy and social loafing to be important for team performance (Gully, Incalcaterra, Joshi, & Beaubien, 2002; Mulvey & Klein, 1998; Stajkovic et al., 2009). This inconsistency with previous research provides support for the notion that the task or environment influenced team performance rather than team cognition, which emerges from teamwork.

Participants were provided with an open-ended question at the end of the study to report thoughts and experiences related to their participation in the study. Based on reviews of comments provided by participants, those in condition one reported more difficulties with the task and task environment than those in condition two. For condition one, eight participants commented on difficulties in information exchange using email or instant messaging. Additionally, five participants commented that they would have liked more time to complete the study. For condition two, there were no complaints about difficulties exchanging information using email or instant messaging. There were three

positive comments about how document sharing resulted in an easier or quicker time working on the task. Only three participants commented they would have liked more time to complete the study. The differences in comments provided by participants in each condition support the view that the experimental manipulation may have led to decreased performance due to constraints with the task and task environment.

Satisfaction with Team Members

Mutual performance monitoring and team performance were found to be positive predictors of satisfaction with team members. Previous research has not found variables with strong relationships to satisfaction with team members. In a study by Shaw, Duffy, and Stark (2000), several important individual and situational variables were examined and found to explain under 10% of the variance in satisfaction with team members. In subsequent analyses, the addition of relationship conflict increased the explained variance to 32% (Duffy, Shaw, & Stark, 2000). Although these results were confounded with level misspecification, they suggest variables exploring relationship quality may be important to satisfaction with team members. Additionally, measures of satisfaction with team members may capture specific dyadic relationships, such that some relationships with team members influence overall feelings of satisfaction with the team more than others.

Exploratory Variables

Satisfaction with monitoring and perceptions of spying were examined as exploratory variables. None of the individual or team-level variables in this study predicted perceptions of spying. This is interesting given that 51% of the variance in spying was at the team level.

Spying may relate to team norms and behavioral intentions for the use of member performance information. Mutual performance monitoring over time becomes a team norm (McIntyre & Salas, 1995) and may subsequently be seen less as spying. The use of information about member performance gained from monitoring may be important. When team members keep performance information within the team, such as to provide constructive feedback or backup, monitoring may be seen less as spying than if teamwork performance information is shared outside the team, such as with supervisors.

Practical Implications

The results of this study are important for organizations that use teams to organize and perform work. Mutual performance monitoring was found to be positively related to collective efficacy and negatively related to social loafing. This study supports the importance of mutual performance monitoring on motivational and behavioral team outcomes, whereas other research indicates its positive effects on team performance (LePine et al., 2008).

The largest effect was found for mutual performance monitoring on social loafing. Social loafing can lead to decreased team performance, waste organization resources, and diminish the quality of interactions within teams (Chidambaram & Tung, 2005; Liden, Wayne, Jaworski, & Bennett, 2004). The study results suggest that increasing mutual performance monitoring is one way to reduce social loafing in virtual teams.

The finding that mutual performance monitoring was related to collective efficacy has important implications for organizations as collective efficacy is important for organizational effectiveness (Gully et al., 2002; Stajkovic et al., 2009). Organizations can use training to increase monitoring behaviors in teams and can influence opportunities

and support for monitoring through technology. Decisions about technological support are critical to virtual teams' success as they rely on the technology provided by their organizations (Riopelle et al., 2003).

Limitations

This research examined mutual performance monitoring in a virtual environment using an original task. This may have led to limitations in data interpretation and generalization. The experimental conditions did not elicit the intended differences in mutual performance monitoring. The manipulation and task may have produced too few opportunities for individuals to monitor the performance of fellow team members. Individuals were required to read and understand instructions, discuss and decide on budget allocations, and coordinate actions in describing their rationale for the decisions. The task difficulty may have constrained opportunities to monitor. This would have resulted in low amounts of monitoring regardless of condition. Several individuals reported that they would have liked additional time to complete the task. Though the time teams spent together was short, this timespan was comparable to previous research (Marks & Panzer, 2004; Porter et al., 2010).

The task may have not been motivating enough for participants. To monitor, provide feedback, and backup team members, individuals must be invested in the team outcome. The task was no-stakes in that participants were rewarded with participation credit regardless of quality. A small performance-based incentive was also provided. These rewards may not have motivated participants enough to monitor.

The specific task environment may have influenced the way teamwork was conducted and subsequent relationships among team-level constructs. In the selection of

this task environment, dozens of online project management software programs tools were examined. Ultimately, Google was selected because it provided a simpler and more intuitive user experience. Many of the alternative online software programs were prohibitively expensive, whereas Gmail and Google Drive were available free of cost. Google Drive also provided a seamless way to collaborate on documents in real-time, which was not available in many other software programs. Although the environment may have unique characteristics, Gmail and Google Drive are by far the most popular. In 2012, Google reported 425 million monthly active users of Gmail, 5 million businesses that use Google Apps, and 66 of the top 100 universities have transitioned their in-house systems to Google Apps for Education (Lardinois, 2012). Therefore, Gmail and Google Drive is a task environment likely with the greatest generalizability.

The specific task used in this study limits the ability to generalize to other tasks. The budget allocation task was created to meet time and resource constraints. The task used the longest amount of time given the sample and recruitment methods. A task was created due to a lack of alternatives in the literature that would fit within the time span and could be conducted online. The decision-making task was created to represent the type of task commonly performed in virtual teams (Furst et al., 1999) and to require some level of interdependence. The timing was constrained because participants had to complete surveys, training, and the task within a two-hour timeframe. Based on feedback from participants from both conditions about the task, 10 comments were negative with participants reporting the task to be confusing and too difficult. Thirty-six comments were positive with participants reporting that the task was fun, challenging, interesting, and satisfying.

Future Research

The way in which teamwork processes manifest within virtual teams is an important area for future research. The effect of mutual performance monitoring on team performance was not found in this study, suggesting teamwork processes may need more time to influence performance. Longitudinal research in which monitoring is assessed across intervals of team performance would be able to describe the development and stability of mutual performance monitoring.

Mutual performance monitoring is a behavior in teams measured by aggregating ratings from team members. This type of rating does not indicate the degree monitoring in teams is mutual. Ratings of mutual performance monitoring may reflect the actions of a few versus an average of all team members. It would seem plausible that an individual could emerge as an informal leader and perform most of the monitoring duties. Researchers could seek ways to parse out which team members are performing monitoring and the roles individuals play in average ratings of mutual performance monitoring and subsequent outcomes.

The influence of individual differences on quantity and quality of monitoring and feedback to team members would be an important area to study. Certain individuals may be better suited to monitor team members. Individual differences, such as conscientiousness, attention, and mindfulness, may be able to explain variance in the ability of individuals to monitor team members effectively.

Future experimental research on mutual performance monitoring should explore ways in which the behavior can be manipulated in teams. Based on this study, instructions and document sharing were not enough to elicit differences in mutual

performance monitoring. Training modules or role-playing exercises with teams may be an area for future research to explore. Mutual performance monitoring is an important teamwork process and researchers should continue to research it because of its important antecedent role in other teamwork behaviors (e.g., feedback and backup) and implications to organizational effectiveness.

CHAPTER 5

CONCLUSIONS

The present study examined the teamwork process of mutual performance monitoring within virtual teams. The effects of mutual performance monitoring were examined on collective efficacy, social loafing, team performance, and satisfaction with team members through an experiment within Gmail and Google Drive.

The experimental manipulation was not able to produce group differences in mutual performance monitoring but did have an effect on team performance, suggesting the influence of task constraints on performance. Analyses indicated that mutual performance monitoring was negatively related to social loafing, positively related to collective efficacy and satisfaction with team members, and not related to team performance. The short amount of time for the task may have contributed to the lack of relationship between mutual performance monitoring and team performance. Research on mutual performance monitoring should continue, especially in understanding individual influences on monitoring and how monitoring behavior develops over time into a team norm. Mutual performance monitoring is one of the five most important teamwork behaviors (Salas et al., 2005) and research should continue on teamwork within virtual teams to better understand the needs of the future.

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APPENDIX A

EXPERIMENTAL TASK

General Instructions

This document provides a description of the task your team is being asked to perform. Individuals in the top 5 performing teams will receive $10 Amazon gift cards in addition to SONA credit, so try your best!

If you have any questions during the task, ask the Study Admin in Gmail chat.

There is a time constraint on this task. Please do your best and have a team member email the information to Study Admin. I created a timeslot for submitting the completed assignment. Please do not submit it earlier or later. The time slot for completion of this task is **[X:XX-X:XX].**

After submission, you will receive confirmation with a link to a short survey, debriefing, and SONA credit confirmation page. This study is not complete until you reach the Sona confirmation page.

The Task

You are part of a team that has been tasked with developing a budget to submit to the Director of Finance at Virginia University of Success (fictional). The university plans to receive $750,000 more funding than last year, totaling $2,500,000. You will work as a team to determine the amount of funding each budget expenditure area should receive. The university has seven strategic objectives that should guide your team's decisions. You will also be asked to defend your decision with explanations of your team's choices.

Following are documents that should help you, including one that provides the structure for the budget (you can copy and paste it into your workspace). Your performance on this task will assessed by the completeness, accuracy, and depth of your answers.

As a team, you are asked to prepare an email with two parts to submit to the Study Admin.

PART 1: A completed budget.
PART 2: Strategic plan objective descriptions: Write a description for how each strategic initiative (7 in total) will be met by your budget.

Note: Do not create a new document when submitting, just copy and paste it into an email message.
(Ctrl + C to copy and Ctrl + V to paste)

You are free to use any resources available to you (excluding individuals that are not part of your team). Please DO NOT copy and paste sources into your report, it should be original opinions by your team.

UNIVERSITY OF SUCCESS STRATEGIC OBJECTIVES

The following objectives must be considered while making budget decisions.

1.) Provide students with the tools to succeed
2.) Build strong civic and community partnerships
3.) Enrich the quality of campus life
4.) Expand international connections
5.) Gain a national reputation for student achievement
6.) Become leaders in research
7.) Provide a high-quality environment for employees

Budget

Budget Expenditure Area	2012-2013 Amount	Proposed 2014 Amount
1. Academic Salaries and Benefits	325,000	
2. Support Staff/Student Salaries	170,000	
3. Health Services	175,000	
4. Student Services	200,000	
5. Research Grants/Aid	275,000	
6. Scholarships	190,000	
7. Public Service	190,000	
8. Maintenance, Utilities, Equipment	225,000	
Total:	1,750,000	2,500,000

BUDGET EXPENDITURE AREA DESCRIPTIONS

ACADEMIC SALARIES AND BENEFITS

This category includes all salaries associated with full-time and tenured positions (e.g., teachers). This category also includes all benefits offered to employees (e.g., health and dental benefit costs, employee support programs, retirement benefits).

SUPPORT STAFF/STUDENT SALARIES

This category includes all salaries for contractual and temporary employees (e.g., janitorial). This includes student workers employed by the university.

HEALTH SERVICES

This category includes services provided to students for health and wellness. These funds support basic medical, mental health, and personal wellness services.

STUDENT SERVICES

This category includes many services available to students. Funding supports programs such as career advising, tutoring, recreation centers, activity funds, and legal services.

RESEARCH GRANTS/AID

This category includes all funds provided to university departments and students for research related activities.

STUDENT SCHOLARSHIPS

This category includes all student financial awards, including scholarships, graduate assistantships, and tuition remission.

PUBLIC SERVICE

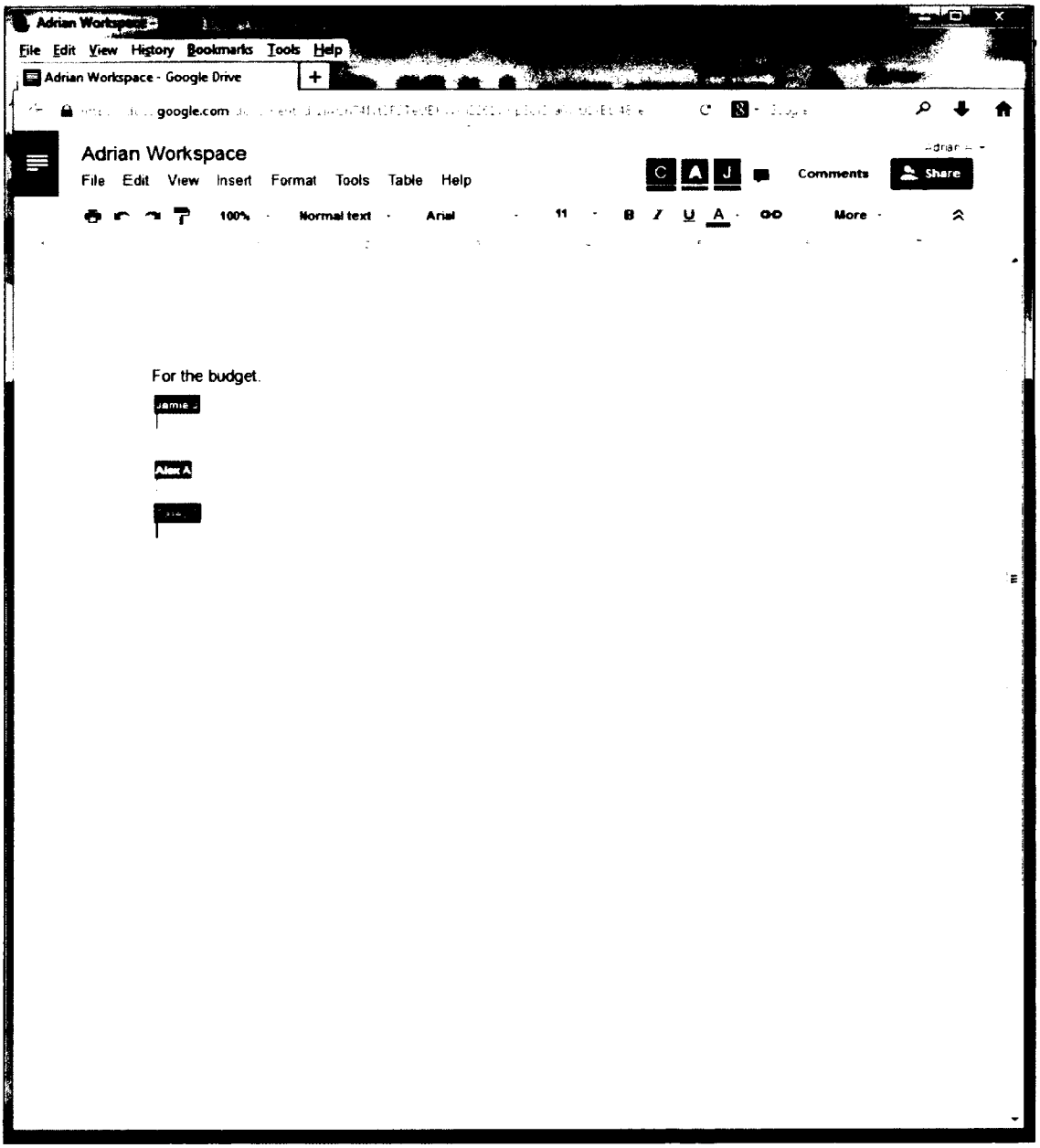
This category includes university public services funding for contributions to the well-being of the community, state, and nation.

MAINTENANCE, UTILITIES, EQUIPMENT

This category includes expenses for building maintenance (e.g., building janitorial services), utility costs and basic equipment (e.g., student classrooms, faculty offices).

APPENDIX B

REAL-TIME DOCUMENT SHARING



APPENDIX C

CONDITION TWO INSTRUCTIONS

Additional instructions will be provided to manipulation groups as described below. All groups will receive the same instructions on how the email and document management system work.

How to work together as a team

As a team works together, they are able to monitor each other's performance. When teammates monitor each other's performance, they work better as a team.

Monitoring does not mean spying on teammates. It means keeping track of how teammates are performing and at the same time completing your own work. Monitoring means being aware of your teammates' performance and recognizing when they are performing both correctly and incorrectly.

Examples of monitoring
- Observing teammates progress on a project
- Recognizing when a teammate's performance can be improved
- Asking questions such as "How are you doing on this project?"

For this task:
While you are working on this project, you are able to both communicate with your teammates and observe their performance in real-time. Effective monitoring means the regular observation of and concern with performance of teammates.

APPENDIX D

SURVEY MEASURES

Mutual Performance Monitoring

Please rate the following statements when thinking about **your team.**
Use the scale below to rate how your team worked together during the task you just completed. Rate how frequently the members of your team did each of the following things by selecting the bubble that best describes your opinion.
Team members...

1. Are aware of other team members' performance.
2. Are concerned with the performance of the team members with whom they interact closely.
3. Make sure other team members are performing appropriately.
4. Recognize when a team member makes a mistake.
5. Recognize when a team member performs correctly.
6. Notice the actions of other team members.
   6b. Notice the behavior of others. (original item)
7. Notice performance errors of other team members.
   7b. Discover errors in the performance of another team member. (original item)
8. Watch other team members to ensure they are meeting the requirements of the task being worked on.
   8b. Watch other team members to ensure that they are performing according to guidelines. (original item)
9. Notice which members are performing their tasks especially well.

Satisfaction with Team members

For the following statements, please respond with your level of agreement when thinking about **yourself.** Select the bubble that best describes your opinion.

1. All in all, I am satisfied with my team.
2. In general, I don't like my team.
3. I am satisfied with the way I was treated by my team members.
4. I am satisfied with the friendliness of my team members.

Collective Efficacy

Think about the team you are working with right now. When responding to the following items, think about the ability of your team to do the budget task you are working on. Select the bubble that best describes your opinion.

1. This team is above average at the task.
2. This team is poor compared to other teams doing similar work.
3. This team is not able to perform as well as it should.
4. The members of this team are excellent at this task.
5. Some members of this team should not be in the team due to lack of ability.
6. This team is not very effective at the task.
7. Some members in this team cannot do their jobs well.

Social Loafing

Rate your agreement with the following statements when thinking about **your team.** Select the bubble that best describes your opinion.

1. Members of my team tried as hard as they could.
2. Members of my team were "free-loaders."
3. Members of my team contributed less than I anticipated.
4. Given their abilities, my team members did the best they could.

Satisfaction with Monitoring

For the following statements, please respond with your level of agreement when thinking about **yourself.** Select the bubble that best describes your opinion.

1. I am satisfied with amount of feedback I received from my team members.
2. I am satisfied with the way feedback was shared with me by my team members.
3. I am satisfied with the constructiveness of feedback by my team members.
4. I am satisfied with the frequency of feedback by team members.

Spying

For the following statements, please respond with your level of agreement when thinking about **yourself.** Select the bubble that best describes your opinion.

1. I felt spied on by my team members.

APPENDIX E

PERFORMANCE EVALUATION RATING FORM

	Area	Dimension	Options
Part 1		Timeliness	0 = over 9 min late 3 = 6-9 min late 6 = 3-6 min late 9 = 1-3 min late 10 = on-time
Part 2	Budget	Accuracy	0 = No 1 = Yes (adds up to $2.5 million)
Part 3	Provide students with the tools to succeed	Completeness	0 = No 1 = Yes (answer provided)
		Quality	1 = No or poor description present (low quality) 3 = Description is present but not logical or detailed (moderate quality) 5 = Description is present and detailed/logical (high quality)
	Build strong civic and community partnerships	Completeness	0 = No 1 = Yes (answer provided)
		Quality	1 = No or poor description present (low quality) 3 = Description is present but not logical or detailed (moderate quality) 5 = Description is present and detailed/logical (high quality)
	Enrich the quality of campus life	Completeness	0 = No 1 = Yes (answer provided)
		Quality	1 = No or poor description present (low quality) 3 = Description is present but not logical or detailed (moderate quality) 5 = Description is present and detailed/logical (high quality)
	Expand international connections	Completeness	0 = No 1 = Yes (answer provided)
		Quality	1 = No or poor description present (low quality) 3 = Description is present but not logical or detailed (moderate quality) 5 = Description is present and detailed/logical (high quality)

	Gain a national reputation for student achievement	Completeness	0 = No 1 = Yes (answer provided)
		Quality	1 = No or poor description present (low quality) 3 = Description is present but not logical or detailed (moderate quality) 5 = Description is present and detailed/logical (high quality)
	Become leaders in research	Completeness	0 = No 1 = Yes (answer provided)
		Quality	1 = No or poor description present (low quality) 3 = Description is present but not logical or detailed (moderate quality) 5 = Description is present and detailed/logical (high quality)
	Provide a high-quality environment for employees	Completeness	0 = No 1 = Yes (answer provided)
		Quality	1 = No or poor description present (low quality) 3 = Description is present but not logical or detailed (moderate quality) 5 = Description is present and detailed/logical (high quality)

VITA

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Cognitive Neuroscience Lab (2008-2011)
University of Minnesota

- Projects on memory, confidence, and mental energy depletion and replenishment.

Eating Disorders Research Lab (2007-2008)
University of Minnesota Department of Psychiatry

- Projects on sub-threshold bulimia nervosa and mortality associated with eating disorders.

MEMBERSHIP IN PROFESSIONAL AFFILATIONS

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Academy of Management
Society for Human Resource Management