

Psychological Safety as a Mediator of Relational Coordination in Interdisciplinary Hospital Care Units

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PSYCHOLOGICAL SAFETY AS A MEDIATOR OF RELATIONAL
COORDINATION IN INTERDISCIPLINARY
HOSPITAL CARE UNITS

by

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ABSTRACT
PSYCHOLOGICAL SAFETY AS A MEDIATOR OF RELATIONAL
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Barry C. Henrichs, B.S.

Marquette University, 2013

This thesis presents an examination of the relationship between psychological safety and relational coordination within interdisciplinary health care teams. Based on previous research, a model is proposed in which psychological safety—the perceived safety of interpersonal interaction—partially mediates the link between the relational dimensions—shared goals, shared knowledge, and mutual respect—and the communication dimensions—frequent, accurate, timely, and solution-oriented communication—of relational coordination. The proposed model was tested using multiple linear regression of survey data from 158 obstetricians, anesthesiologists, and nurses who work in the labor and delivery units at two large teaching hospitals. The findings do not support the proposed model; however, an alternative model in which psychological safety is an antecedent to rather than a consequence of relational quality is well supported. Building on these findings, the potential existence and nature of a new cluster of relationship-supporting communication dimensions is discussed.

This study also demonstrates the utility of role-level assessment of the psychological safety and relational coordination constructs. In most studies these constructs are assessed at the group level to facilitate comparisons between work groups. However, the role-based data collection and analysis applied in this study identified significant differences in the psychological safety, relational quality, and communication quality measurements with respect to various role-based subsets of the studied work groups. Additional differences were found when both the respondent's role and the role of the individual with whom the respondent was interacting were used as grouping variables. The revealed patterns of differences suggest that psychological safety and the dimensions of relational coordination are influenced by several role-oriented characteristics such as hierarchical status or control as well as a role's centrality or connectivity within an organization's social network.

The methods and findings presented in this thesis offer small steps toward the greater understanding of the dynamics of high-performance work groups. The practical application of this research includes the development of interventions designed to improve the communication, teamwork, and performance of groups in demanding environments such as hospital care units.

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Barry C. Henrichs, B.S.

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Chapter 1: Introduction

Interdisciplinary work groups are both essential and problematic structures in many organizations. By incorporating the expertise of multiple disciplines, these groups are able to accomplish work that would often be impossible in a more homogenous collective. However, group members from different disciplines often approach their work with different relational and functional understandings and expectations. This variety can create significant challenges when close coordination is required across discipline boundaries.

The teams of health care providers working in hospital care units exemplify the challenging but essential nature of interdisciplinary work groups. Physicians, nurses, and other care providers must function cooperatively in interdisciplinary work groups; however, effective coordination of efforts is quite difficult in this environment. Many patient care activities are tightly coupled or mutually interdependent across disciplines, so task coordination requires ongoing and effective interdisciplinary communication. Furthermore, this coordination must occur in an environment characterized by high stakes, a high level of uncertainty, and constrained time.

The theory of relational coordination provides an explanation for why some interdisciplinary work groups perform better than others, especially in demanding environments such as hospital units (Gittell, 2000, 2011a). Relational coordination describes the highly-effective management of interdependent tasks that occurs in work groups characterized by a particular set of relational qualities and communication behaviors. The relational coordination model and its association with work group outcomes has been validated in a variety of environments including health care (Bond &

Gittell, 2010; Gittell, 2000, 2003; Gittell et al., 2000; Weinberg, Lusenhop, Gittell, & Kautz, 2007) and has been applied in a wide array of related studies (see Gittell, 2011b, pp. 9-13 for a bibliography of related work).

Given the strong evidence supporting the value of relational coordination in health care units and similar environments, the identification and examination of factors that contribute to relational coordination is warranted. Previous studies of such factors have focused on organizational structures or leadership behaviors that enhance the relational and communication dimensions defined by the theory (e.g., Gittell, 2001, 2009). An alternative approach is to examine the mechanisms by which these dimensions are related and reinforced. The psychological safety concept appears to provide such a mechanism.

Psychological safety describes an individual's belief that interactions with others are unlikely to result in negative consequences such as a loss of reputation or respect (Edmondson, 1999; Kahn, 1990). Thus, a high level of psychological safety is presumably a precondition for much of the communication that enables effective coordination within work groups, such as asking questions, providing feedback, requesting help, or admitting mistakes. Previous studies have demonstrated a connection between psychological safety and communication behaviors related to organizational learning and learning from failures (Carmeli & Gittell, 2009; Edmondson, 1996, 1999; Tucker & Edmondson, 2003). A generalization of these findings supports the supposition that psychological safety is a precondition of high-quality communication as defined by the theory of relational coordination.

Previous studies have also connected psychological safety with the relational qualities associated with relational coordination. In two studies, Carmeli and Gittell (2009) found strong evidence for a model in which high-quality relationships, as defined by the theory of relational coordination, functioned as an antecedent to psychological safety. The combination of this link from relational quality to psychological safety with the expected link from psychological safety to communication quality suggests that psychological safety mediates the link connecting the relational dimensions of relational coordination to the communication dimensions. If this is the case, incorporation of the psychological safety variable into the relational coordination model may improve the explanatory power and utility of the theory.

This thesis examines the proposed mediation relationship between relational coordination and psychological safety. The expected relationship is tested using data from a survey of 158 physicians and nurses at two large teaching hospitals. Based on the survey results, a revised model of the relationship is discussed and additional variables that may enhance the model are suggested. Finally, practical applications of this line of research are considered.

Chapter 2: Literature Review and Hypotheses

The Theory of Relational Coordination

The theory of relational coordination was proposed by Gittell (2000, 2011a) as a result of her studies of team effectiveness among front-line workers in highly demanding service settings such as health care and airline operations. Drawing on prior research and her own studies, Gittell developed the concept of relational coordination to describe characteristics found in highly effective work groups within such settings.

The theory defines relational coordination as the relational process which supports the coordination of interdependent tasks in an organization. This process is most effective when the interdisciplinary relationships within the organization are characterized by shared goals, shared knowledge, and mutual respect. These relational dimensions are strongly associated with communication that is characterized as frequent, accurate, timely, and focused on problem-solving rather than blaming. The relational and communication dimensions are mutually reinforcing; thus, high-quality relationships support high-quality communication and vice versa. According to the theory, the seven dimensions are essential to the tightly-coupled interaction required to accomplish reciprocally interdependent tasks, particularly when uncertainty is high and time is constrained.

Foundations of relational coordination. According to Gittell (2011a), a relational theory of coordination was first offered by Follett (1949, as cited by Gittell, 2011a). Follett's contribution to this aspect of organizational theory was the recognition that the coordination of efforts within an organization is ongoing and relational rather

than fixed and mechanical. However, it was Thompson's (1967) typology of task interdependencies and his discussion of approaches to managing each type of interdependency that significantly informed the development of Gittell's theory (Gittell, 2000, 2006, 2011a).

In his foundational work in organizational theory, Thompson (1967) observed that the coordination of tasks that are sequentially dependent or mutually independent but require the same resources are often managed through standardized procedures and protocols. However, Thompson argued, when the dependencies between the tasks are reciprocal in nature, they require a more complex and resource-intensive approach that he described as "mutual adjustment" (p. 56). According to Gittell (2000, 2006, 2011a), it is this process of mutual adjustment that is enabled and facilitated by relational coordination.

Coordination by mutual adjustment requires workers to both share and react to information created during the performance of interdependent processes. Galbraith (1972) theorized that this need for information sharing increases with uncertainty, which is defined as the extent to which the available information is insufficient for the completion of a task. In a study of the impact of uncertainty on coordination efforts in hospital emergency departments, Argote (1982) demonstrated this connection—as uncertainty increased, so did the requirement for information exchange among workers. The challenges of mutual adjustment are further compounded when the tolerances on successful coordination are compressed by time constraints, as demonstrated by Adler (1995) in a study of innovative problem-solving in the auto industry. Building on these studies, Gittell (2000, 2006, 2011a) argued that task coordination is most difficult when

mutual adjustment is required in the context of high uncertainty and constrained time and that the relational approach to coordination is most valuable in such contexts.

Seven dimensions of relational coordination. To identify features of effective coordination in environments characterized by mutually interdependent tasks, high levels of uncertainty, and significant time constraints, Gittell (2000, 2001, 2003, 2006) observed and interviewed front-line workers in various roles in the flight departure process for several major airlines. Based on these studies, Gittell identified several relational and communication characteristics strongly associated with effective coordination and high-performing operations. Gittell et al. (2000) further refined and validated these dimensions in a study of operating room physicians and nurses in nine hospitals.

Drawing on these and other early studies, Gittell (2011a, 2011b) identified three relational dimensions and four communication dimensions that are fundamental to relational coordination. These two sets of dimensions are closely linked and mutually reinforcing.

Relational dimensions. Relational coordination is associated with three relational dimensions: shared goals, shared knowledge, and mutual respect. Shared goals define a unifying purpose for the efforts of the work group and consequently promote optimal use of time and resources. In the absence of shared goals, effort may be directed toward function-level sub-goals rather than group-level goals. Shared knowledge of the role-based responsibilities and capabilities of work group members enables workers to understand their own role and to interact efficiently and appropriately with other roles. Finally, mutual respect among workers demonstrates that the contributions of each role are appreciated and valued, thus promoting interaction and cooperation.

Communication dimensions. Relational coordination supporting relationships both reinforce and are reinforced by communication characterized by four dimensions: frequency, timeliness, accuracy, and a focus on problem solving. Frequent communication provides workers with the information they need to continuously adjust their efforts in response to changes in the status of related processes. In addition to occurring frequently, coordination-enabling communication must be timely—providing information in a timeframe that allows others to respond effectively—and accurate—allowing others to base their decisions on correct information. Finally, when problems with cross-functional implications occur, communication directed at solving the problem enables the coordinated resolution of the issues and the continuation of cooperative involvement. Conversely, communication directed at assigning blame neither leads to problem resolutions nor encourages future cooperation.

Role-based relationships. The role-based approach of relational coordination sets it apart from concepts that focus on interpersonal relationships within work groups (Gittell, 2011b). Relational coordination requires individuals to respect and share goals and knowledge with collaborators based on the roles being performed rather than personal ties or shared experiences. High-quality role-level relationships enable consistently high-quality communication in tasks where the participants are interchangeable. Thus, this model is well suited for the dynamically constructed work groups that occur within hospital units.

Empirical support. Empirical studies conducted in health care and other fields have demonstrated strong associations between relational coordination and outcome measures of both quality and efficiency (Gittell, 2011a). Within the health care field, this

research has included studies of surgical performance across nine hospitals (Gittell et al., 2000), physician-nurse coordination (Havens, Vasey, Gittell, & Lin, 2010), staff and patient satisfaction across 15 nursing homes (Gittell, Weinberg, Pfefferle, & Bishop, 2008), outcomes of hospitalist versus traditional physician job designs (Gittell, Weinberg, Bennett, & Miller, 2008), and preparation of informal caregivers to provide home care (Weinberg et al., 2007). The connection between relational coordination and organizational performance has also been found in contexts such as airlines' flight departure preparations (Gittell, 2001) and interagency coordination in the criminal justice system (Bond & Gittell, 2010). Numerous additional studies in health care and other fields have further validated the theory (see Gittell, 2011b, pp. 9-13 for a bibliography of related work).

Psychological Safety

Within the organizational behavior literature, the psychological safety construct is grounded in Kahn's (1990) analysis of psychological factors that contribute to employee engagement. Based on qualitative studies conducted in two organizations, Kahn identified three psychological conditions that were associated with employees' personal engagement or disengagement. Engaged workers perceived their work as personally meaningful and worthwhile. These workers also exhibited psychological availability, i.e., freedom from excessive preoccupation or distractions. Finally, engaged workers exhibited a condition that Kahn labeled "psychological safety." This condition "was experienced as feeling able to show and employ one's self without fear of negative consequences to self-image, status, or career" (p. 708). In other words, employees demonstrated engagement at work when they felt that it was safe to do so.

Kahn (1990) identified four factors that contributed to the psychological safety condition. First, employees experienced greater psychological safety within interpersonal relationships characterized by supportiveness, mutual trust, acceptance of risk and failure, similar organizational status, and constructive criticism. Second, psychological safety was influenced by group dynamics that evolved from group histories, hidden sub-contexts, informal roles, and internal relations. Third, groups with leadership that was supportive of creativity and risk taking, tolerant of failure, flexible, and consistent were associated with higher psychological safety. Finally, individuals working outside the safety boundaries set by organizational norms felt less safe than those who generally conformed to the norms.

The psychological safety construct described by Kahn (1990) has been operationalized and applied in various quantitative studies of communication behavior within work environments. For example, Tynan (2005) found that psychological safety was positively associated with both the likelihood that employees would express self-criticism when dealing with supportive supervisors and the likelihood that employees would express disagreement or criticism when dealing with sensitive or supportive supervisors. Siemsen, Roth, Balasubramanian, and Anand (2009) found that employees' motivation to share knowledge with a coworker was positively correlated with psychological safety and that this relationship was strongest when employees lacked confidence in the knowledge to be shared. These studies corroborate Kahn's observations and demonstrate the value of the psychological safety construct in models of communication behavior within work groups.

A variation of the psychological safety concept was provided by Edmondson (1999) in the definition of “team psychological safety” as “a shared belief that the team is safe for interpersonal risk taking” (p. 354). Edmondson explained that this shared belief is predominantly tacit and further described it as “a sense of confidence that the team will not embarrass, reject, or punish someone for speaking up” (p. 354). This definition is unique in that it describes psychological safety as an attribute of the team as a whole rather than a condition in individual relationships between employees or employees and supervisors. In this way, team-based construction of psychological safety is similar to the role-based nature of relational coordination—in both cases, the constructs describe traits that are shared by tight-knit groups of workers.

Psychological safety and organizational learning. Edmondson and others have applied the team construction of psychological safety in a number of studies, particularly with respect to team learning behavior. Team learning behavior supports organizational learning and is defined as “an ongoing process of asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions” (Edmondson, 1999, p. 353).

In a study of the rates of and responses to medication errors in eight nursing units, Edmondson (1996) found significant positive relationships among the perceived openness of unit leaders, the unit members’ willingness to report errors, and the unit’s error detection rates. In a subsequent study of 51 work teams in a manufacturing company, Edmondson (1999) defined the team psychological safety and team learning behavior constructs and demonstrated that team psychological safety was a strong

predictor of team learning behavior. Furthermore, team psychological safety was positively linked through team learning behavior to team performance outcomes.

The implications of psychological safety on learning behavior were further explored by Tucker and Edmondson (2003) in an observational study of problem-solving behaviors in nursing units in nine hospitals. The authors reported that the demands and the culture of the units motivated nurses to respond to most problems with first-order problem solving, resolving immediate issues independently without addressing underlying causes. However, organizational learning requires second-order problem solving, which entails taking steps to resolve the root causes of a problem. The authors observed that the second-order approach frequently required nurses to request the involvement or assistance of others, and these are risky interpersonal behaviors in a culture that values independence and self-sufficiency. Thus, organizational learning depends on second-order problem solving which depends on psychological safety.

Edmondson (2004) incorporated the findings of the medication error (Edmondson, 1996) and problem-solving (Tucker & Edmondson, 2003) studies reported above in an assessment of the opportunities and barriers to organizational learning in hospitals. She argued that communication about minor problems and errors is essential to enabling organizations to discover and address significant underlying causes of patient safety issues. As demonstrated in earlier studies, such communication is impeded by organizational dynamics that diminish the psychological safety felt by employees. Therefore, Edmondson argued, establishing an organizational environment characterized by psychological safety is essential for health care organizations that wish to learn from failures and thus improve patient safety.

Connecting Relational Coordination and Psychological Safety

The theory of relational coordination provides a model of work group performance based on the quality of the relationships and communication within the group. Psychological safety describes a condition in which the relational context of a work group supports the communication of information and feedback. These concepts appear to intersect with respect to both relationships and communication, with high-quality relationships as an antecedent to psychological safety and psychological safety as a precondition of high-quality communication.

Linking relational quality to psychological safety. According to the theory of relational coordination, high-quality relationships are characterized by shared goals, shared knowledge, and mutual respect. Each of these characteristics would presumably improve an individual's psychological safety. In a group that is clearly organized around shared goals, group members are more likely to be accepting and appreciative of information that supports the accomplishment of those goals, even if that information is critical or disconfirming. When group members share knowledge of each other's capabilities and responsibilities, they are likely to have greater confidence regarding when it is safe and appropriate to communicate challenging information. Finally, mutual respect among group members should reduce both the real and the perceived risk of losing face as the result of well-intentioned communication.

The link between relational quality and psychological safety was tested by Carmeli and Gittell (2009) in two survey-based studies. In the first study current employees from a variety of organizations were surveyed. The results showed that psychological safety partially mediated the link between relational quality and learning

from failures in the organizations. The second study used a more controlled approach to survey graduate students with prior experience in various business sectors. This study found that psychological safety fully mediated the same link. Both studies operationalized relational quality and psychological safety at the organization level, with relational quality operationalized using the three characteristics described in the theory of relational coordination—shared goals, shared knowledge, and mutual respect.

The following is a restatement of the second hypothesis tested and supported by Carmeli and Gittell (2009). Given the strong conceptual relationship between the constructs, strong support of this hypothesis is expected.

Hypothesis 1 (H1): Relational quality is positively associated with psychological safety.

Linking psychological safety to communication quality. In addition to linking relational quality to psychological safety, Carmeli and Gittell (2009) found a strong link between psychological safety and learning from failure. The authors defined learning from failure as “speaking up about errors and concerns” (p. 712) for the purpose of second-order problem solving. This construct was operationalized using survey items that describe communication behaviors in which employees “inform,” “talk,” and “question” with respect to identified failures (p. 715). Psychological safety is an intuitive precondition for these behaviors, and the findings of this study confirm this intuition. Similar findings have been reported in other studies of learning from failure, specifically with respect to health care units (Edmondson, 1996; Tucker & Edmondson, 2003).

The communication associated with learning from failure can be viewed as an example of high-quality communication as defined by the theory of relational coordination. Learning from failure requires frequent, accurate, timely, and problem-

solving communication but only with respect to errors, concerns, or problems that negatively impact productivity. By generalizing from the findings connecting psychological safety to learning from failure, it is conceivable that psychological safety is a precondition for the broader set of communication behaviors associated with relational coordination.

This connection between psychological safety and communication quality as defined by relational coordination is conceptually reasonable. If individuals feel that it is safe to communicate, then presumably they will be more likely to share rather than suppress their thoughts. Therefore, individuals who experience greater psychological safety are expected to communicate more frequently and in a more timely manner. These individuals are also expected to engage in less self-protective behavior such as withholding or obfuscating details, thus their communication is expected to be more accurate. Finally, individuals who feel safe to communicate are expected to engage in more of the issue identification and idea generation behaviors associated with problem solving, while individuals who perceive a lack of safety are expected to engage in more defensive behaviors such as blaming others. Therefore, the following is hypothesized:

Hypothesis 2 (H2): Psychological safety is positively associated with communication quality.

Psychological safety as a mediator of relational coordination. A strong positive association between relational quality and communication quality has been established in theory and supported by research regarding relational coordination (Gittell, 2000, 2003, 2006, 2011a; Gittell et al., 2000). Nonetheless, conceptual space remains between the constructs. Gittell (2011a) argued that shared knowledge directly enables accurate and timely communication and shared goals directly motivate group members to

engage in high-quality communication and problem-solving. Regarding mutual respect, Gittell argued that it “increases the likelihood that participants will be *receptive* to communication from their colleagues in other functions, irrespective of their relative status” (Gittell, 2011a, p. 401, emphasis added). Thus, respect as a trait of the *receiver* is expected to diminish the negative impact of status differences on communication quality. However, when considered carefully, none of the relational dimensions directly address the potential for perceived risk from sources such as status differences to negatively impact the quality of communication generated by the *sender*.

Psychological safety may provide a bridge that addresses this conceptual gap between the relational and communication dimensions of relational coordination. Particularly in situations in which communication could result in negative consequences for the sender, high-quality relationships alone may not be sufficient to support high-quality communication. The additional condition needed to support high-quality communication may be a high level of psychological safety. If this is the case and if psychological safety depends on relational quality as expected, then psychological safety should function as a mediator in the relationship between relational quality and communication quality. However, since not all communication entails an appreciable risk of negative consequences, psychological safety would probably not be important to every interaction. Thus, psychological safety is expected to be a partial mediator of the relationship between the relational coordination dimensions. This partial mediation relationship is presented graphically in Figure 1.

Hypothesis 3 (H3): Psychological safety partially mediates the link between relational quality and communication quality.

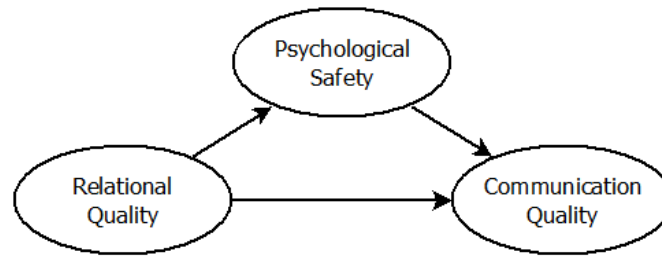


Figure 1. A model of psychological safety as a partial mediator of the relational coordination dimensions.

Differences Among Professional Roles

The hypotheses stated above assume that assessments of the relational coordination and psychological safety of a work group as a whole will reveal the expected relationships among the constructs. This work group-level analysis is explicitly supported by the theory of relational coordination (Gittell, 2011b) and is largely consistent with the team-level analysis of psychological safety described by Edmondson (1999). However, in work groups such as the health care units studied for this paper, individuals' group identities may be more strongly associated with their professional roles than with the care unit in which they work. If so, significant differences in the relational coordination and psychological safety constructs are expected to occur between the role-based groups. Furthermore, examination of the relationships between the constructs using data for specific roles or role interactions may provide stronger evidence for the proposed mediation model.

Role-level analysis of psychological safety. Edmondson (1999) proposed and validated the team-level construction of psychological safety based on the assumption that experiences shared among team members will lead to convergence of members'

individual assessments of psychological safety within the team. The underlying assumption is that team members have a sufficient base of shared experiences when making this assessment. This underlying assumption is partially expressed in Edmondson's definition of work teams as groups that "have clearly defined membership and share responsibility for a team product or service" (p. 351).

Team-level assessments of psychological safety have been applied to the study of well-defined work groups in health care; for example, Edmondson, Bohmer, and Pisano (2001) used the construct in the analysis of highly specialized surgical teams. However, the dynamically constructed work groups found in many hospital units, such as the labor and delivery units studied for this paper, have only a passing resemblance to work teams as described by Edmondson (1999). In these units relatively small groups of physicians and nurses are on duty at any given time, but the membership of the groups changes frequently as providers come and go on a variety of schedules. Applying a team model to these work groups is further challenged by the relatively large and dynamic pools of practitioners from which the active group membership is drawn. This situation is amplified in large teaching hospitals, such as the ones studied in this paper, in which the resident physician pool for a unit rotates every few weeks.

Given the dynamic composition of their work groups, practitioners on these units have limited opportunities to develop the histories of shared experiences required for team-level convergence of assessments of psychological safety. In the absence of a well-defined team with which to identify, practitioners may develop stronger group identities based on their professional roles. This role-based approach to group identification provides practitioners with a smaller pool of same-group associates, and while their

shared experiences may be limited, they likely share a large set of very similar experiences.

This type of role-based grouping was applied by Nembhard and Edmondson (2006) in a study of 23 neonatal intensive care units. In this study, physicians, nurses, and respiratory therapists were treated as separate groups to examine how psychological safety was related to each group's role-based status. As predicted by the professional status hierarchy, physicians experienced significantly greater psychological safety than did nurses, and nurses experienced significantly greater psychological safety than did respiratory therapists. While this study was focused on the status associated with professional role, it provides an example of role-level convergence of psychological safety assessments.

The study reported in this paper includes assessments of psychological safety from members of five provider roles: nurses, attending anesthesiologists, attending obstetricians, resident anesthesiologists, and resident obstetricians. The work groups in which these providers interact are loosely defined and dynamically composed from members of the five roles; thus, within the studied hospital units, role-based identification is expected to be stronger than unit-level identification. As such, role-based differences in psychological safety are expected.

Hypothesis 4 (H4): Within the studied work groups, overall psychological safety differs among individuals from different professional roles.

The existence of clearly defined and differentiated roles within the studied organizations is also expected to differentiate the providers' psychological safety with respect to each of the roles.

Hypothesis 5 (H5): Within the studied work groups, psychological safety differs based on the professional role of the other participant in an interaction.

Finally, psychological safety is expected to differ based on the combination of the provider's own role and the role of the other provider in an interaction.

Hypothesis 6 (H6): For each role-based subgroup of individuals within the studied work groups, psychological safety differs based on the professional role of the other participant in an interaction.

Role-level analysis of relational coordination. The theory of relational coordination defines the three relational dimensions and the four communication dimensions as meaningful at both the organization level and the role level and provides specifications for assessing and analyzing the dimensions at each level (Gittell, 2011b; Relational Coordination Research Collaborative, 2012). The study reported in this paper follows these specifications for evaluation and analysis with one exception—instead of aggregating all of the dimensions into a single relational coordination score, the dimensions will be aggregated into separate scores for relational quality and communication quality.

As in the case of psychological safety, role-based differences in relational quality and communication quality are expected due to the relatively strong role-based identification and relatively weak unit-based identification of the practitioners in this study. The following hypotheses restate H4, H5, and H6 for relational quality and then for communication quality.

Hypothesis 7 (H7): Within the studied work groups, overall relational quality differs among individuals from different professional roles.

Hypothesis 8 (H8): Within the studied work groups, relational quality differs based on the professional role of the other participant in an interaction.

Hypothesis 9 (H9): For each role-based subgroup of individuals within the studied work groups, relational quality differs based on the professional role of the other participant in an interaction.

Hypothesis 10 (H10): Within the studied work groups, overall communication quality differs among individuals from different professional roles.

Hypothesis 11 (H11): Within the studied work groups, communication quality differs based on the professional role of the other participant in an interaction.

Hypothesis 12 (H12): For each role-based subgroup of individuals within the studied work groups, communication quality differs based on the professional role of the other participant in an interaction.

Role-Level Relationship Between Relational Coordination and Psychological Safety

Given that psychological safety, relational quality, and communication quality are expected to differ based on the professional roles of both participants in an interaction, the relationships among these constructs may also differ for specific role interactions.

Thus the following research question is posed:

Research Question 1 (RQ1): When evaluated at the level of role-specific interactions, how do the relationships among psychological safety, relational quality, and communication quality compare with the relationships observed for the work group as a whole?

If the role-level relationships among the psychological safety, relational quality, and communication quality constructs are found to be similar to those at the group level, then the validity of the model connecting these constructs will be supported. However, if the role-level relationships among the constructs are found to be substantially different than the work group-level relationships, this information may indicate the presence of unique role-level dynamics worthy of further study.

Chapter 3: Methods

The dataset used for this study was extracted from data collected in an online survey of the physicians and nurses who work in the labor and delivery units at two large teaching hospitals. These data were collected as part of a larger pilot study of survey techniques to be used in the analysis of an interdisciplinary resident education program¹.

The study was reviewed by the Institutional Review Board (IRB) at the sponsoring medical school and exempted from IRB oversight. The IRBs at the study sites and at Marquette University deferred to the medical school's IRB. Additional approvals were obtained from the Associate Dean for Graduate Medical Education and from the research and compliance offices of the involved hospitals.

Participants

The target populations for this study were the registered nurses, residents, and attending physicians (attendings) who had recent experience working in the labor and delivery units at either of two hospitals associated with the sponsoring medical school. Survey invitations were sent to all registered nurses currently employed by the units, all obstetrics and gynecology (OB/Gyn) and anesthesiology residents who had worked on the units in the past year, and all OB/Gyn and anesthesiology attendings who were identified by the hospitals as providers for the units. Information in the invitations and in the survey instructions advised the potential respondents that the results of this survey

¹ The survey described in this thesis was conducted as a pilot for future research efforts at the sponsoring medical school. Other researchers assisted with the overall concept, design, and administration of this survey; however, the author identified the core theories, wrote the survey protocol, constructed the survey instruments, managed the online survey, and conducted the analysis reported in this thesis. The survey results were used with permission from the principal investigator of the encompassing research project.

would be used to guide the development of a new curriculum for residents during their rotations on the labor and delivery unit.

The nurses and most of the attending physicians in the respondent pools were clearly affiliated with one of the two study sites and were invited to respond for the appropriate site. Nine attending anesthesiologists were identified as having significant work experience at both sites. Due to the low total number of individuals in the anesthesia attending role as well as anecdotal reports of significant differences in their experiences at the two sites, the nine attendings were invited to respond to the survey twice—once for each site. Since the primary focus of the pilot study was Site 1, these attendings were initially invited to respond to the survey based on their experience at that site. At the close of the 24-day response period for the main survey, the nine attendings received new invitations and a 14-day window to submit the survey based on their experience at Site 2.

All of the surveyed residents had experience working at Site 1, and many had experience at Site 2 as well. However, to minimize confusion and survey burden for this group and because the primary focus of the pilot study was Site 1, residents were invited to respond for Site 1 only.

Table 1 shows the number of invitations sent, the number of completed responses to the survey, and the response rates for each group. Three recipients of survey invitations indicated that they had no recent experience on either of the labor and delivery units and thus were excluded from the invitation count. The response counts and the data used in this study include all completed surveys submitted via the online survey (N = 153) or an alternative paper survey form (N = 5).

Table 1

Response Counts and Rates by Site and Professional Role

Site	Professional Role	Invited	Complete Responses	Response Rate
Site 1	Attending			
	Anesthesia ^a	16	15	94%
	Obstetrics	35	14	40%
	Resident			
	Anesthesia	44	28	64%
	Obstetrics	30	20	67%
	Nurse	46	26	57%
Site 2	Attending			
	Anesthesia ^a	22	14	64%
	Obstetrics	22	16	73%
	Resident ^b	-	-	-
	Nurse	39	25	64%
Totals		254	158	62%

^aNine anesthesia attendings were invited to respond twice, once for each site. ^bResidents were invited to respond for Site 1 only.

The high response rate (94%) for attending anesthesiologists at Site 1 is likely due to heightened awareness of the study because the principal investigator is from this group. The low response rate (40%) for attending obstetricians at Site 1 is likely due to a larger portion of physicians who are not exclusively affiliated with this hospital and therefore rarely work in its labor and delivery unit.

Excluded Data

The online and paper form surveys yielded a total of 158 responses with complete information for all variables and scales used in this analysis. All incomplete surveys were excluded from analysis because they did not include data for the psychological safety

scale². Also, due to inconsistencies in the responses to the relational coordination items with respect to the target roles of Midwife, Surgical Technician, and NICU Staff, all data regarding these groups were excluded³. Thus, all of the reported results regarding relational quality, communication quality, and psychological safety are based on five target roles: Anesthesia Attendings, OB/Gyn Attendings, Anesthesia Residents, OB/Gyn Residents, and Registered Nurses.

Survey Components

The findings reported in this thesis used data from four segments of the larger pilot survey: the relational coordination assessment, the psychological safety scale, the job satisfaction elements, and the professional experience elements.

Relational coordination assessment. The relational coordination assessment used in this survey was constructed and phrased following the guidelines and examples provided by Gittell (2011b) and the Relational Coordination Research Collaborative (2012). For this assessment, respondents were asked to answer seven questions for each of eight different professional roles involved in providing care on labor and delivery units. Thus, 56 responses were collected in this section—eight role-specific responses for each question. The questions and roles are listed in Table 2.

² The online survey system required respondents to answer all items on a page prior to advancing to the next page; thus, respondents could not skip individual items either accidentally or intentionally. Missing data only occurred when respondents did not complete the survey. Because the final element in the survey was the psychological safety assessment central to this analysis, all incomplete survey responses were excluded from analysis.

³ In addition to the five target roles used in this analysis, the relational coordination assessment on the survey included response items for three secondary roles: Midwife, Surgical Technician, and NICU Staff. However, unlike the response items for the five primary roles, respondents were given the option to select “N/A” when responding to questions with respect to the secondary roles. Respondents who did not have experience interacting with one or more of the secondary roles were expected to answer “N/A” to all of the questions with respect to the role. In practice, many respondents answered “N/A” to some, but not all, of the questions for the secondary roles. Due to the ambiguous meaning of these responses, all data for the Midwife, Surgical Technician, and NICU Staff roles were excluded from analysis.

During review and pretesting of this section, it became apparent that some physicians and nurses had little or no experience interacting with three of the roles—midwives, surgical technicians, and neonatal intensive care unit (NICU) staff—and consequently were unable to answer questions regarding these roles. Since the online survey technology did not allow respondents to skip the questions, an “N/A” response option was added to each question for each of the three roles.

Psychological safety assessment. The psychological safety assessment used in this survey is based on items used previously in studies of the prevalence and handling of medication errors by patient care teams (Edmondson, 1996), the learning behavior of manufacturing teams (Edmondson, 1999), and the adoption of new technology by surgery teams (Edmondson, 2003). Six items from these studies were selected and modified to fit the context and the role-oriented approach of this study. The survey presented each item as a stem statement, as shown in Table 3, that was completed for each of the five roles being studied: “the OB/Gyn Attendings,” “the OB/Gyn Residents,” “the Anesthesia Attendings,” “the Anesthesia Residents,” and “the Nurses.” Thus, 30 items were constructed—six stems completed for each of the five roles. Respondents were asked to rate the 30 items on a Likert-type scale that provided five response categories: “Strongly agree,” “Agree,” “Neither agree nor disagree,” “Disagree,” and “Strongly disagree.”

Table 2

Relational Coordination Assessment Items

Communication Dimensions

1. How frequently do people in each of these groups communicate with you about obstetrics patients?
Options: Not nearly enough, Not enough, Just the right amount, Too often, Much too often
2. Do people in each of these groups communicate with you in a timely way about obstetrics patients?
Options: Never, Rarely, Sometimes, Often, Always
3. Do people in each of these groups communicate with you accurately about obstetrics patients?
Options: Never, Rarely, Sometimes, Often, Always
4. When problems occur in the care of obstetrics patients, do people in each of these groups respond by blaming others or do they try to work with you to solve the problem?
Options: Always blame, Mostly blame, Neither blame nor solve, Mostly solve, Always solve

Relational Dimensions

5. How much do people in each of these groups share your goals for the care of obstetrics patients?
Options: Not at all, A little, Somewhat, A lot, Completely
6. How much do people in each of these groups know about the work you do in caring for obstetrics patients?
Options: Nothing, Little, Some, A lot, Everything
7. How much do people in each of these groups respect your work or role in caring for obstetrics patients?
Options: Not at all, A little, Somewhat, A lot, Completely

Response Groups

Each question above was asked for each of the following groups:

1. Anesthesia Residents
2. OB/Gyn Residents
3. Anesthesia Attendings
4. OB/Gyn Attendings
5. Labor and Delivery Nurses (i.e., registered nurses)
6. Certified Nurse Midwives^a
7. Surgical Technicians^a
8. NICU Team (i.e., physicians or nurses from the neonatal intensive care unit)^a

Note. Survey items adapted from *Measuring relational coordination, 2012*, Relational Coordination Research Collaborative, retrieved July 27, 2012 from <http://rcrc.brandeis.edu/survey/measuring.html>.

^aAn "N/A" option was added to the response options for each item for response groups 6, 7, and 8.

Table 3

Psychological Safety Assessment Item Stems

-
1. If I make a mistake ... will often hold it against me (*Reverse scored*)
 2. My opinions are valued and respected by ...
 3. It is difficult to ask for help from ... (*Reverse scored*)
 4. I can safely share my concerns or complaints about work with ...
 5. When learning or performing a task that is new to me, I can count on support from ...
 6. If I don't understand a decision, I am comfortable asking for an explanation from ...
-

Note. Survey items 1 and 3 adapted from "Psychological safety and learning behavior in work teams," by A. C. Edmondson, 1999, *Administrative Science Quarterly*, 44, p. 382.

Job satisfaction covariant. Previous studies have found that overall job satisfaction is correlated with relational coordination and that job satisfaction is a partial mediator between relational coordination and job performance (Gittell, 2009; Gittell, Weinberg, Pfefferle, et al., 2008). In order to assess and control for the influence of this variable on the relationships between relational quality, psychological safety, and communication quality, a simple measure of job satisfaction was included in the survey used for this study.

The studies referenced above measured job satisfaction using a single item, asking respondents to rate their overall job satisfaction on a five point scale from "very dissatisfied" to "very satisfied." In the present study, the nurses were asked to report their overall job satisfaction as most of the surveyed nurses only work on the studied units. However, since most physicians work in multiple environments, they were asked specifically about their satisfaction with working on the labor and delivery unit.

Control variables. Work site, professional role, sex, and professional experience information was recorded for each survey respondent. Respondents provided different information about their work experience depending on their role. Nurses and attendings

reported the total number of years they had been practicing. The response options were grouped into five-year blocks to reduce the potential for re-identification of respondents based on these data. Residents reported the total number of weeks they had spent working in the labor and delivery unit at Site 1. A common experience index was created by standardizing the experience data collected for each of the five target roles.

Scale Construction

Two sets of scales—composite scales and role-specific scales—were constructed using items from the relational coordination and psychological safety assessments. The composite scales aggregate a respondent’s answers for all five target roles⁴ and were developed to test the first three hypotheses. The remaining hypotheses were tested using role-specific scales that provide separate scores for a respondent’s answers regarding each target role.

The data from the relational dimensions and the communication dimensions of the relational coordination assessment were separated to produce discrete relational quality and communication quality subscales. Gittell (2011b) defined three standard approaches to aggregating data from the relational coordination assessment into summated scales: by averaging responses for each dimension across all roles, by averaging responses for each role across all dimensions, or by averaging all dimensions for all roles to create a single, group-level score. The scales constructed for this thesis use a hybrid of these approaches to generate the relational quality and communication quality subscales required to test the hypotheses.

⁴ The five target roles are: anesthesia attending, OB/Gyn attending, anesthesia resident, OB/Gyn resident, and registered nurse.

Composite Scales. The composite scales for relational quality, communication quality, and psychological safety are composed of the respondent's answers to a set of relational coordination or psychological safety items for all five target roles.

Composite relational quality (CRQ) scale. The composite relational quality (CRQ) scale comprises 15 survey items that address the relational dimensions of the relational coordination assessment (i.e., three relational dimensions evaluated for each of five target roles). For the 158 complete responses to this section, Cronbach's alpha for the 15 items was .80. The CRQ scale was constructed by calculating a respondent's mean score for each of the three relational dimensions, standardizing these scores, and then calculating the mean of the respondent's three standardized scores to arrive at the respondent's CRQ score. A higher score on this scale indicates higher relational quality.

Composite communication quality (CCQ) scale. The composite communication quality (CCQ) scale comprises 20 survey items that address the communication dimensions of the relational coordination assessment (four communication dimensions evaluated for each of five target roles). For the 158 complete responses to this section, Cronbach's alpha for the 20 items was .85. The CCQ scale was constructed by calculating a respondent's mean score for each of the four communication dimensions, standardizing these scores, and then calculating the mean of the respondent's four standardized scores to arrive at the respondent's CCQ score. A higher score on this scale indicates higher communication quality.

Composite psychological safety (CPS) scale. The composite psychological safety (CPS) scale comprises all 30 survey items from the psychological safety assessment (six question stems for each of five target roles). For the 158 complete responses to this

section, Cronbach's alpha for the 30 items was .90. The CPS scale was constructed by calculating a respondent's mean score for each of the six question stems, standardizing these scores, and then calculating the mean of the respondent's six standardized scores to arrive at the respondent's CPS score. A higher score on this scale indicates a higher level of psychological safety.

Role-Specific Scales. The role-specific scales aggregate a respondent's answers to the questions associated with a given construct for a single target role, for example, a respondent's answers to the three relational quality questions with respect to attending anesthesiologists. Thus, for each construct, each respondent was assigned five role-specific scores, one for each of the five target roles. Also, since each of the 158 survey responses contains five instances of each role-specific scale—one for each target role—the sample size for reliability testing is 790.

Role-specific relational quality (RQ-R) scale. The role-specific relational quality (RQ-R) scale aggregates a respondent's answers to the three relational quality items in the relational coordination assessment with respect to a single target role. Across all cases, the scale had a Cronbach's alpha of .85. A respondent's RQ-R score for a given target role is the mean of the standardized values of the respondent's answers to the three relational quality items for the given role. A higher score on this scale indicates a higher level of relational quality.

Role-specific communication quality (CQ-R) scale. The role-specific communication quality (CQ-R) scale aggregates a respondent's answers to the four communication quality items in the relational coordination assessment with respect to a single target role. Across all cases, the scale had a Cronbach's alpha of .77. A

respondent's CQ-R score for a given target role is the mean of the standardized values of the respondent's answers to the four communication quality items for the given role. A higher score on this scale indicates a higher level of communication quality.

Role-specific psychological safety (PS-R) scale. The role-specific psychological safety (PS-R) scale aggregates a respondent's answers to the six questions in the psychological safety assessment with respect to a single target role. Across all cases, the scale had a Cronbach's alpha of .86. A respondent's PS-R score for a given target role is the mean of the standardized values of the respondent's answers to the six items on the psychological safety assessment for the given role. A higher score on this scale indicates a higher level of psychological safety.

Preliminary Review and Testing of the Survey

A preliminary version of the survey was developed in consultation with five attending physicians including program directors for the anesthesiology and the obstetrics and gynecology residency programs at the sponsoring institution. This survey was then reviewed by a biostatistician affiliated with the sponsoring institution and revised slightly. The revised version of the survey was then administered via the online survey system to five attending physicians from the anesthesiology and the obstetrics and gynecology groups at a teaching hospital not affiliated with the sponsoring institution or the study sites. No major issues were identified during this review; however, feedback from the reviewers did lead to minor clarifications and enhancements of the survey text.

Survey Administration

The primary mode of delivery of the survey was via the Opinio online survey system hosted at Marquette University. The full survey included up to 139 response items and required up to 15 minutes to complete, depending on the respondent's professional role. Accommodation for respondents who preferred not to use the online system was provided upon request in the form of paper surveys with return mail envelopes.

Prior to the distribution of survey invitations, leaders known to the target populations notified the potential respondents that a survey invitation would be forthcoming and encouraged participation. Care was taken to communicate that responses would be confidential and that participation was voluntary and would not be linked to professional or academic evaluations.

Invitations to complete the survey were automatically generated by the online survey system and emailed to every individual in the target populations. Three reminders were automatically generated and emailed to non-responders during the 24-day period in which electronic responses were collected.

Each invitation and reminder contained a uniquely coded hyperlink to the online survey system. The use of unique invitation codes enabled respondents to return to the survey if they were interrupted, ensured that each respondent could submit only one set of answers, enabled targeted reminder messages, and allowed for respondent-specific information to be associated with the responses. All personally identifying information was removed from the response data prior to analysis.

Chapter 4: Results

Regression Models Using Composite Scales

Table 4 shows three linear regression models in which psychological safety, measured on the CPS scale, is the dependent variable. Model 1A shows that the combination of the work site, sex, role, and experience control variables describe a small but significant part of the variation in psychological safety, adjusted $R^2 = .06$, $F(11, 146) = 1.96$, $p \leq .05$. Model 1B shows that the model is substantially improved when job satisfaction is added to the set of control variables, adjusted $R^2 = .20$, $F(12, 145) = 4.17$, $p \leq .001$. Finally, Model 1C shows that the model is further improved by the inclusion of relation quality, measured on the CRQ scale, adjusted $R^2 = .39$, $F(13, 144) = 8.87$, $p \leq .001$. Model 1C also shows that relational quality has a significant and strong influence on psychological safety, $\beta = .51$, $p \leq .001$. Thus, H1 is supported.

Table 5 shows a set of linear regression models in which communication quality, measured on the CCQ scale, is the dependent variable. Model 2A shows that the combination of the work site, sex, role, and experience control variables describe a small but significant part of the variation in communication quality, adjusted $R^2 = .10$, $F(11, 146) = 2.62$, $p \leq .05$. Model 2B shows that the model is substantially improved when job satisfaction is added to the set of control variables, adjusted $R^2 = .18$, $F(12, 145) = 3.79$, $p \leq .001$. Model 2C shows that the model is further improved by the inclusion of psychological safety, measured on the CPS scale, adjusted $R^2 = .26$, $F(13, 144) = 5.18$, $p \leq .001$. Model 2C also shows that psychological safety has a significant and moderate positive influence on communication quality, $\beta = .33$, $p \leq .001$. Thus, H2 is supported.

Table 4

Regression Models of Relational Quality, Job Satisfaction, and Control Variables Acting on Psychological Safety

Variable	Model 1A β	Model 1B β	Model 1C β
Site ^a	-.17	.02	.07
Sex ^a	.09	.06	.00
Role ^a			
Anesth. Att.	.14	.19	.20
OB Att.	.40*	.43*	.54***
Anesth. Res.	-.12	-.13	-.06
OB Res.	.16	.17	.24
Nurse ^b	.00	.00	.00
Experience			
Anesth. Att.	.08	.11	.11
OB Att.	.00	-.03	-.21
Anesth. Res.	.16	.21	.18
OB Res.	.03	.01	-.08
Nurse	.25*	.21	.27**
Job Satisfaction		.41***	.23**
Relational Quality (CRQ Scale)			.51***
R ²	.13	.26	.45
Adjusted R ²	.06	.20	.39
ANOVA	F(11,146) = 1.96*	F(12,145) = 4.17***	F(13,144) = 8.87***

Note. $N = 158$. Dependent variable is Psychological Safety (CPS Scale).

^aDummy variable. ^bThe *Nurse* parameter of the *Role* dummy variable is zero because it is represented in the model when all other parameters of *Role* are zero.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Table 5

Regression Models of Relational Quality, Psychological Safety, Job Satisfaction, and Control Variables Acting on Communication Quality

Variable	Model 2A β	Model 2B β	Model 2C β	Model 3 β	Model 4 β
Site ^a	-.29**	-.15	-.16	-.09	-.09
Sex ^a	.01	-.02	-.03	-.08	-.08
Role ^a					
Anesth. Att.	-.29	-.26	-.32*	-.24*	-.24*
OB Att.	-.39*	-.37*	-.51***	-.23	-.24
Anesth. Res.	-.44	-.45	-.40	-.36	-.36
OB Res.	-.09	-.08	-.13	.01	.00
Nurse ^b	.00	.00	.00	.00	.00
Experience					
Anesth. Att.	.01	.03	.00	.03	.03
OB Att.	.33*	.31*	.32*	.08	.08
Anesth. Res.	.21	.25	.18	.21	.21
OB Res.	-.02	-.04	-.04	-.15	-.15
Nurse	-.08	-.10	-.17	-.03	-.04
Job Satisfaction		.31***	.18*	.09	.08
Psychological Safety (CPS Scale)			.33***		.02
Relational Quality (CRQ Scale)				.63***	.63***
R ²	.17	.24	.32	.53	.53
Adjusted R ²	.10	.18	.26	.49	.49
ANOVA	F(11,146) = 2.62*	F(12,145) = 3.79***	F(13,144) = 5.18***	F(13,144) = 12.69***	F(14,143) = 11.70***

Note. $N = 158$. Dependent variable is Communication Quality (CCQ Scale).

^aDummy variable. ^bThe *Nurse* parameter of the *Role* dummy variable is zero because it is represented in the model when all other parameters of *Role* are zero.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

Mediation test. H3 states that psychological safety mediates the relationship between relational quality and communication quality. Baron and Kenny (1986) state that the following conditions indicate that a third variable mediates the relationship between an independent and a dependent variable: (a) variation in the third variable is significantly accounted for by the independent variable, (b) variation in the dependent variable is significantly accounted for by the third variable, (c) when the influence of the third variable is not controlled, variation in the dependent variable is significantly accounted for by independent variable, and (d) when the influence of the third variable is controlled, the relationship between the independent and dependent variables becomes non-significant.

The first condition in the mediation test is a generalization of H1 and is satisfied by Model 1C. The second condition is a generalization of H2 and is satisfied by Model 2C. The third condition is satisfied by Model 3 which shows that relational quality, measured on the CRQ scale, has a significant and strong influence on communication quality, $\beta = .63, p \leq .001$.

The fourth condition of the mediation test was evaluated by comparing the significance of relational quality in Model 3, which does not control for psychological safety, with the significance of relational quality in Model 4, which does control for psychological safety. The significance and influence of relational quality is unchanged between the two models, $\beta = .63, p \leq .001$. Therefore, the fourth condition of the mediation test is not satisfied, and H3 is not supported.

Control variables. The data used in the regression models were controlled for differences in respondents' study site, sex, professional role, and experience in that role.

Study site. A dummy variable was used to represent the two study sites: Site 1 = 0 and Site 2 = 1. In Model 2A, the influence of site was significant, $\beta = -.29, p \leq .01$. However, when job satisfaction was added in Model 2B, the influence of site was reduced and the site variable became non-significant, $\beta = -.15, p = .11$.

A similar change in the influence of the site variable was observed between Model 1A and Model 1B. Site did not achieve statistical significance in either model; however, the variable went from being moderately non-significant in Model 1A, $\beta = -.17, p = .07$, to definitively irrelevant when job satisfaction is introduced in Model 1B, $\beta = .02, p = .87$.

This pattern suggests that the effect of site was picked up by consistent variation in job satisfaction between the two sites. This is consistent with the large and significant difference in mean job satisfaction between the sites, $M_{\text{site1}} = 4.38, SD_{\text{site1}} = .72, M_{\text{site2}} = 3.56, SD_{\text{site2}} = .94, t(88.26) = 5.63, p \leq .001, d = .98$.⁵

Sex. A dummy variable was used to represent respondent sex: female = 0 and male = 1. Sex was not significant in any of the study models.

Professional role. Four dummy variables were used to represent the five respondent roles, with the Nurse role providing the default condition in the models.⁶ All three variations of Model 1 show that membership in the OB/Gyn Attending role has a strong positive influence on psychological safety, most notably in Model 1C, $\beta = .54, p \leq .001$. Conversely, all three variations of Model 2 show that membership in the OB/Gyn

⁵ Independent samples t-test. Cohen's d calculated using $d = M_1 - M_2 / \sigma_{\text{pooled}}$ where $\sigma_{\text{pooled}} = \sqrt{[(\sigma_1^2 + \sigma_2^2)/2]}$ (Rosnow & Rosenthal, 1996). Cohen (1988) defined $d \geq .80$ as a large effect size.

⁶ In linear regression models, categorical information can be represented by $N - 1$ dummy variables, where N is the number of categories. The N th category becomes the default condition for the model, with the beta of each dummy variable representing a shift in the intercept of the partial regression equation for cases of the represented category (Agresti & Finlay, 2009).

Attending role has a strong negative influence on communication quality, most notably in Model 2C, $\beta = -.51, p \leq .001$. Likewise, membership in the Anesthesia Attending role is shown to have a moderate negative influence on communication quality in Model 2C, $\beta = -.32, p \leq .05$; Model 3, $\beta = -.24, p \leq .05$; and Model 4, $\beta = -.24, p \leq .05$.

Experience. The models show that experience is not significantly related to psychological safety or communication quality in most cases. Exceptions occur in Model 1A and Model 1C, which show that nurse experience was significantly and positively associated with psychological safety (Model 1A: $\beta = .25, p \leq .05$; Model 1C: $\beta = .27, p \leq .01$), and in the three versions of Model 2, which show that OB/Gyn attending experience was significantly and positively associated with communication quality (Model 2A: $\beta = .33, p \leq .05$; Model 2B: $\beta = .31, p \leq .05$; Model 2C: $\beta = .32, p \leq .05$).

Job satisfaction covariant. The addition of job satisfaction to the control variables significantly improved the variance accounted for in Model 1 and Model 2. The addition of job satisfaction in Model 1B increased the adjusted R^2 value for Model 1 from .06 to .20. Job satisfaction became less important but remained significant when relational quality was added in Model 1C (Model 1B: $\beta = .41, p \leq .001$; Model 1C: $\beta = .23, p \leq .01$).

The same pattern was found in Model 2. The addition of job satisfaction in Model 2B increased the adjusted R^2 value of Model 2 from .10 to .18, and the job satisfaction variable remained significant but less important when psychological safety was added in Model 2C (Model 2B: $\beta = .31, p \leq .001$; Model 2C: $\beta = .18, p \leq .05$). However, Model 3 and Model 4 show that job satisfaction becomes non-significant in models of

communication quality that include relational quality as an independent variable (Model 3: $\beta = .09$, ns; Model 4: $\beta = 08$, ns).

Differences Based on Respondent Role

Table 6 presents mean scores for the composite scales of psychological safety, relational quality, and communication quality, separated by study site and respondents' professional role. Each of the means shown on this table is an assessment of how the members of the specified professional role at the given site rated the psychological safety, relational quality, or communication quality in their work group.

For each study site, one-way analysis of variance (ANOVA) tests were used to identify significant differences in the mean scores. The Bonferroni multiple comparisons procedure was then applied to identify significant pair-wise differences among the means. An exception to this approach occurred in the case of CCQ scores at Site 1, because Levene's test of this case indicated a violation of the assumption of homoscedasticity. For this case the Brown-Forsythe and Welch tests were applied to confirm the ANOVA finding, and the Games-Howell test was used for post-hoc comparisons.

Respondent role and psychological safety. At Site 1, CPS scores for the five respondent roles did not differ significantly, $F(4, 98) = 1.71$, ns. CPS scores for the three respondent roles surveyed at Site 2 did differ significantly, $F(2, 52) = 3.63$, $p = .03$, with OB/Gyn Attendings reporting significantly higher levels of psychological safety ($M = .28$) than did Registered Nurses ($M = -.33$). In this case, respondent's role had a medium-sized effect on CPS, $\eta^2 = .12$. Since a significant difference in psychological safety was found between role-based subgroups in one of the two work groups studied, H4 is supported but not replicated across both groups.

Table 6

Mean Composite Scores of Psychological Safety, Relational Quality, and Communication Quality, Based on Respondent's Professional Role

Scale	Site	Respondent's Professional Role (Cells show mean score on scale)					ANOVA statistic with estimate of effect size			
		RN	AR	OR	AA	OA	<i>F</i>	<i>df</i>	<i>p</i>	η^2
Composite Psychological Safety (CPS)	1	.01 <i>n</i> =26	-.17 <i>n</i> =28	.09 <i>n</i> =20	.12 <i>n</i> =15	.41 <i>n</i> =14	1.71	4, 98	ns	.07
	2	-.33^b <i>n</i> =25	–	–	-.16 <i>n</i> =14	.28^a <i>n</i> =16	3.63	2, 52	.03	.12
Composite Relational Quality (CRQ)	1	.08 <i>n</i> =26	.11 <i>n</i> =28	.32 <i>n</i> =20	.10 <i>n</i> =15	.47 <i>n</i> =14	.91	4, 98	ns	.04
	2	-.40 <i>n</i> =25	–	–	-.37 <i>n</i> =14	.01 <i>n</i> =16	.90	2, 52	ns	.03
Composite Communication Quality (CCQ)	1 [†]	.51^c <i>n</i> =26	.00 <i>n</i> =28	.23 <i>n</i> =20	-.08^d <i>n</i> =15	.07 <i>n</i> =14	2.63	4, 98	.04	.10
	2	-.24 <i>n</i> =25	–	–	-.56 <i>n</i> =14	-.04 <i>n</i> =16	1.53	2, 52	ns	.06

Note. Means with significant differences are in boldface. RN = Registered Nurse; AR = Anesthesia Resident; OR = OB/Gyn Resident; AA = Anesthesia Attending; OA = OB/Gyn Attending. A respondent's composite score for a construct is the mean of the respondent's standardized scores for that construct for each of five target roles.

^{a,b} Within row, "a" is significantly greater than "b" (Bonferroni post-hoc test). ^{c,d} Within row, "c" is significantly greater than "d" (Games-Howell post-hoc test). [†] Levene's test for equality of variances was significant for this case, $F(4, 98) = 2.43, p = .05$. The ANOVA finding of significant differences in means was supported by the Brown-Forsythe statistic, $F(4, 63.99) = 2.66, p = .04$, and the Welch statistic, $F(4, 42.05) = 4.59, p = .01$.

Respondent role and relational quality. CRQ scores did not differ significantly among respondent roles at either Site 1 or Site 2, $F_{\text{Site 1}}(4, 98) = .91, ns$, $F_{\text{Site 2}}(2, 52) = .90, ns$. Thus, relational quality was not found to differ among role-based subgroups, and H7 is not supported.

Respondent role and communication quality. CCQ scores for the five respondent roles at Site 1 did differ significantly, Brown-Forsythe $F(4, 63.99) = 2.66, p =$

.04, Welch $F(4, 42.05) = 4.59, p = .01$, with Registered Nurses reporting significantly higher quality of work group communication ($M = .51$) than was reported by Attending Anesthesiologists ($M = -.08$). In this case, the effect of respondent role on CCQ was moderate, $\eta^2 = .10$. CCQ scores among respondent roles at Site 2 did not differ significantly, ANOVA $F(2, 52) = 1.53, ns$. Thus, in one of the two work groups studied a significant difference was found in the communication quality reported by two role-based subgroups, so H10 is supported but not replicated across both groups.

Differences Based on Professional Role of Other Participant

Table 7 presents mean scores for the PS-R, RQ-R, and CQ-R scales with respect to each of the five studied provider roles, separated by study site. Each of the means shown on this table indicates how all of the respondents from a given site rated psychological safety, relational quality, or communication quality with respect to one of five professional roles.

For each study site, one-way ANOVA tests were used to identify significant differences in the mean scores. The Bonferroni multiple comparisons procedure was then applied to identify significant pair-wise differences among the means. Exceptions to this approach occurred in the cases of the Site 2 RQ-R scores and the Site 1 CQ-R scores. In both cases, Levene's test indicated violations of the assumption of homoscedasticity. For these cases, the Brown-Forsythe and Welch tests were applied to confirm the ANOVA findings, and the Games-Howell test was used for post-hoc comparisons.

Table 7

Mean Scores of Psychological Safety, Relational Quality, and Communication Quality Reported by All Respondents with Respect to the Members of Five Professional Roles

Scale	Site	Professional Role of Other in Interaction (Cells show mean score on scale)					ANOVA statistic with estimate of effect size			
		RN	AR	OR	AA	OA	F	df	p	η^2
Psychological Safety with Role (PS-R)	1	.03^a <i>n</i> =103	.19^a <i>n</i> =103	.07^a <i>n</i> =103	.21^a <i>n</i> =103	-.32^b <i>n</i> =103	9.07	4, 510	.001	.07
	2	.08 <i>n</i> =55	-.16 <i>n</i> =55	.07 <i>n</i> =55	-.28 <i>n</i> =55	-.06 <i>n</i> =55	2.01	4, 270	ns	.03
Relational Quality with Role (RQ-R)	1	.13 <i>n</i> =103	.08 <i>n</i> =103	.00^b <i>n</i> =103	.35^a <i>n</i> =103	-.08^b <i>n</i> =103	4.50	4, 510	.001	.03
	2 [†]	.16^a <i>n</i> =55	-.47^b <i>n</i> =55	-.20 <i>n</i> =55	-.33 <i>n</i> =55	-.07 <i>n</i> =55	3.33	4, 270	.01	.05
Communication Quality with Role (CQ-R)	1 [†]	.20^a <i>n</i> =103	.13^a <i>n</i> =103	-.04^d <i>n</i> =103	.35^{a,c} <i>n</i> =103	-.16^b <i>n</i> =103	8.47	4, 510	.001	.06
	2	-.01 <i>n</i> =55	-.26 <i>n</i> =55	-.17 <i>n</i> =55	-.32 <i>n</i> =55	-.16 <i>n</i> =55	1.13	4, 270	ns	.02

Note. Means with significant differences are in boldface. RN = Registered Nurse; AR = Anesthesia Resident; OR = OB/Gyn Resident; AA = Anesthesia Attending; OA = OB/Gyn Attending. Differences for PS-R and RQ-R at Site 1 identified with Bonferroni post-hoc test. Differences for CQ-R at Site 1 and RQ-R at Site 2 identified with Games-Howell post-hoc test.

^{a,b} Within row, "a" is significantly greater than "b". ^{c,d} Within row, "c" is significantly greater than "d".

[†] Levene's test for equality of variances was significant for this case, $F(4, 270) = 2.41, p = .05$. The ANOVA finding of significant differences in means was supported by the Brown-Forsythe statistic, $F(4, 256.16) = 3.33, p = .01$, and the Welch statistic, $F(4, 134.66) = 3.38, p = .01$. [‡] Levene's test for equality of variances was significant for this case, $F(4, 510) = 2.62, p = .03$. The ANOVA finding of significant differences in means was supported by the Brown-Forsythe statistic, $F(4, 486.77) = 8.47, p < .001$, and the Welch statistic, $F(4, 253.89) = 9.08, p < .001$.

Other participant's role and psychological safety. For Site 1, respondents

reported significantly lower psychological safety when interacting with OB/Gyn

Attendings ($M = -.32$) than with any other group ($M_{RN} = .03, M_{AR} = .19, M_{OR} = .07, M_{AA} = .21$), $F(4, 510) = 9.07, p \leq .001$. For this site, the other participant's role had a medium-sized effect on PS-R, $\eta^2 = .07$. However, no significant differences in PS-R scores were

found for Site 2, $F(4, 270) = 2.01$, ns. Thus, in one of the two work groups studied psychological safety was found to differ based on the professional role of the other participant in the interaction, so H5 is supported but not replicated across both groups.

Other participant's role and relational quality. Respondents from Site 1 reported significantly higher relational quality with Anesthesia Attendings ($M = .35$) than with OB/Gyn Residents ($M = .00$) or OB/Gyn Attendings ($M = -.08$), $F(4, 510) = 4.50$, $p \leq .001$; however, the effect size was small, $\eta^2 = .03$. A significant difference among mean RQ-R scores was also found for Site 2, Brown-Forsythe $F(4, 256.16) = 3.33$, $p = .01$, Welch $F(4, 134.66) = 3.38$, $p = .01$. In this case, respondents reported superior relational quality with Registered Nurses ($M = .16$) than with Anesthesia Residents ($M = -.47$). The effect size for this case was also small, $\eta^2 = .05$. Thus, in both of the work groups studied relational quality was found to differ based on the professional role of the other participant in the interaction; however, the effect size of the other participant's role was small. Therefore, H8 is weakly supported.

Other participant's role and communication quality. Respondents from Site 1 reported significantly lower communication quality with OB/Gyn Attendings ($M = -.16$) than with the nurses or anesthesiologists ($M_{RN} = .20$, $M_{AR} = .13$, $M_{AA} = .35$) as well as significantly lower quality communication with OB/Gyn Residents ($M = -.04$) than with Attending Anesthesiologists ($M = .35$), Brown-Forsythe $F(4, 486.77) = 8.47$, $p \leq .001$, Welch $F(4, 253.89) = 9.08$, $p \leq .001$. For Site 1, the size of the effect of the other participant's role on CQ-R was moderate, $\eta^2 = .06$. No significant differences in CQ-R scores were found for Site 2, $F(4, 270) = 1.13$, ns. Since communication quality was found to differ based on the professional role of the other participant in the interaction in

one of the two work groups studied, H11 is supported but not replicated across both groups.

Interaction of Respondent Role and the Role of Other Participant

Tables 8, 9, and 10 present mean scores for the PS-R, RQ-R, and CQ-R scales, respectively, with respect to each of the five studied work group roles, separated by respondent's professional role and study site. Each of the means shown in the tables indicates how respondents from a specified role-based subgroup at a given site rated the psychological safety, relational quality, or communication quality of the members of one of five professional roles.

For each respondent role at each study site, one-way ANOVA tests were used to identify significant differences in the mean scores. The Bonferroni multiple comparisons procedure was then applied to identify significant pair-wise differences among the means. Exceptions to this approach occurred in several cases and are noted in Tables 8, 9, and 10. In each of these cases, Levene's test indicated violations of the assumption of homoscedasticity. Consequently, the Brown-Forsythe and Welch tests were applied to confirm the ANOVA findings for the cases, and the Games-Howell test was used for post-hoc comparisons.

Table 8

Mean Scores of Psychological Safety Reported by All Respondents with Respect to the Members of Five Professional Roles, Grouped by Respondent Role

Scale	Site	Own Role	Professional Role of Other in Encounter (Cells show mean score on scale)					ANOVA statistic with estimate of effect size			
			RN	AR	OR	AA	OA	F	df	p	η^2
Psychological Safety with Role (PS-R)	1	RN	.44 a n=26	-.27 b n=26	.20 n=26	-.12 n=26	-.22 b n=26	4.10	4, 125	.01	.12
		AR	-.50 b,d n=28	.62 a n=28	-.35 b,d n=28	.45 c n=28	-.76 b,d n=28	21.48	4, 135	.001	.39
		OR	.04 b n=20	-.02 b n=20	.53 a n=20	-.05 b n=20	-.22 b n=20	6.45	4, 95	.001	.21
		AA	.02 b n=15	.53 c n=15	-.25 b,d n=15	.59 a n=15	-.41 b,d n=15	11.98	4, 70	.001	.41
		OA	.35 n=14	.15 n=14	.33 n=14	.28 n=14	.32 n=14	.24	4, 65	ns	.01
	2	RN [†]	.52 a n=25	-.52 b,d n=25	.11 c n=25	-.91 b,d n=25	.30 b n=25	16.15	4, 120	.001	.35
		AA	-.69 b,d n=14	.46 a n=14	-.35 b n=14	.31 c n=14	-.26 n=14	6.32	4, 65	.001	.28
		OA	.08 n=16	-.13 n=16	.37 n=16	.20 n=16	.50 n=16	2.22	4, 75	ns	.11

Note. Means with significant differences are in boldface. Letter pairs (a-b, c-d) show significant differences within a row: a > b; c > d. Differences identified by Bonferroni post-hoc test except for the RN group at Site 2, for which the Games-Howell post-hoc test was applied.

[†]Levene's test for equality of variances was significant for this case, $F(4, 120) = 2.53, p = .04$. The ANOVA finding of significant differences in means was supported by the Brown-Forsythe statistic, $F(4, 102.10) = 16.15, p < .001$, and the Welch statistic, $F(4, 59.39) = 16.75, p < .001$.

Table 9

Mean Scores of Relational Quality Reported by All Respondents with Respect to the Members of Five Professional Roles, Grouped by Respondent Role

Scale	Site	Own Role	Professional Role of Other in Encounter (Cells show mean score on scale)					ANOVA statistic with estimate of effect size			
			RN	AR	OR	AA	OA	F	df	p	η^2
Relational Quality with Role (RQ-R)	1	RN	.65 a n=26	-.62 b,d,f,h n=26	.18 c n=26	-.12 b,e n=26	.04 b,g n=26	14.41	4, 125	.001	.32
		AR [†]	-.41 b,d n=28	.90 a n=28	-.47 b,d n=28	.77 c n=28	-.49 b,d n=28	23.98	4, 135	.001	.42
		OR	.15 b n=20	-.29 b n=20	.78 a n=20	.01 b n=20	.17 b n=20	8.73	4, 95	.001	.30
		AA	-.05 b,d,e n=15	.52 c n=15	-.70 b,d,e n=15	.95 a n=15	-.53 b,d,e n=15	37.94	4, 70	.001	.68
		OA	.38 n=14	-.18 b n=14	.25 n=14	.22 n=14	.66 a n=14	4.72	4, 65	.01	.23
	2	RN [‡]	.77 a n=25	-.85 b,d n=25	.02 b,c n=25	-1.01 b,d n=25	-.23 b n=25	16.17	4, 120	.001	.35
		AA [§]	-.99 b,d n=14	.45 c n=14	-.99 b,d n=14	.81 a n=14	-.45 b,d n=14	27.36	4, 65	.001	.63
		OA	.21 c n=16	-.69 b,d,f n=16	.15 e n=16	-.26 n=16	.51 a n=16	5.36	4, 75	.001	.22

Note. Means with significant differences are in boldface. Letter pairs (a-b, c-d, e-f, g-h) show significant differences within a row: a > b; c > d; e > f; g > h. Differences identified by Bonferroni post-hoc test except for the AR group at Site 1 and the RN and AA groups at Site 2, for which the Games-Howell post-hoc test was applied. Levene's test for equality of variances was significant for the flagged cases.

[†]Levene statistic: $F(4, 135) = 4.56, p < .01$. Significant differences of means were confirmed using: Brown-Forsythe test, $F(4, 100.50) = 23.98, p < .001$, and Welch test, $F(4, 65.02) = 31.78, p < .001$. [‡]Levene statistic: $F(4, 120) = 3.54, p < .01$. Significant differences of means were confirmed using: Brown-Forsythe test, $F(4, 99.91) = 16.17, p < .001$, and Welch test, $F(4, 57.90) = 24.30, p < .001$. [§]Levene statistic: $F(4, 65) = 2.89, p = .03$. Significant differences of means were confirmed using: Brown-Forsythe test, $F(4, 46.05) = 27.36, p < .001$, and Welch test, $F(4, 32.09) = 31.41, p < .001$.

Table 10

Mean Scores of Communication Quality Reported by All Respondents with Respect to the Members of Five Professional Roles, Grouped by Respondent Role

Scale	Site	Own Role	Professional Role of Other in Encounter (Cells show mean score on scale)					ANOVA statistic with estimate of effect size			
			RN	AR	OR	AA	OA	F	df	p	η^2
Communication Quality with Role (RQ-R)	1	RN	.55 a n=26	.03 b n=26	.33 n=26	.34 n=26	.30 n=26	4.58	4, 125	.01	.13
		AR [†]	-.16 b,d n=28	.54 a n=28	-.39 b,d n=28	.56 c n=28	-.61 b,d n=28	12.14	4, 135	.001	.27
		OR [†]	.23 n=20	-.17 b n=20	.37 a n=20	.13 n=20	.09 n=20	3.06	4, 95	.02	.11
		AA	.06 e n=15	.34 c n=15	-.66 b,d,f n=15	.57 a n=15	-.63 b,d,f n=15	17.90	4, 70	.001	.51
		OA	.40 n=14	-.29 n=14	.05 n=14	.02 n=14	.06 n=14	1.55	4, 65	ns	.09
	2	RN [§]	.46 a n=25	-.34 b n=25	.14 c n=25	-.79 b,d n=25	-.31 b n=25	11.70	4, 120	.001	.28
		AA	-1.14 b,d n=14	.24 c n=14	-.88 b,d n=14	.34 a n=14	-.44 n=14	11.47	4, 65	.001	.41
		OA	.25 c n=16	-.58 b,d n=16	-.02 n=16	-.18 n=16	.32 a n=16	3.99	4, 75	.01	.18

Note. Means with significant differences are in boldface. Letter pairs (a-b, c-d, e-f) show significant differences within a row: a > b; c > d; e > f. Differences identified by Bonferroni post-hoc test except for the AR and OR groups at Site 1 and the RN group at Site 2, for which the Games-Howell post-hoc test was applied. Levene's test for equality of variances was significant for the flagged cases.

[†]Levene statistic: $F(4, 135) = 3.68, p = .01$. Significant differences of means were confirmed using: Brown-Forsythe test, $F(4, 103.18) = 12.14, p < .001$, and Welch test, $F(4, 65.61) = 15.11, p < .001$. [‡]Levene statistic: $F(4, 95) = 3.40, p = .01$. Significant differences of means were confirmed using: Brown-Forsythe test, $F(4, 83.35) = 3.06, p = .02$, and Welch test, $F(4, 47.19) = 2.78, p = .04$. [§]Levene statistic: $F(4, 120) = 5.01, p = .001$. Significant differences of means were confirmed using: Brown-Forsythe test, $F(4, 90.38) = 11.70, p < .001$, and Welch test, $F(4, 58.65) = 13.94, p < .001$.

Respondent's role, other's role, and psychological safety. As shown in Table 8, numerous significant differences among mean PS-R scores arise from the interaction of the respondent's role and the other participant's role. The Registered Nurse, Anesthesia Resident, OB/Gyn Resident, and Anesthesia Attending subgroups at Site 1 and the Registered Nurse and Anesthesia Attending subgroups at Site 2 each demonstrated unique patterns of statistically significant differences among the mean PS-R scores with respect to the five target roles (see Table 8 for results of statistical tests). For five of these six subgroups (excepting the Site 1 Registered Nurse subgroup) the p values for the tests of differences of means are less than or equal to .001, and the effect size is large to very large, with η^2 values ranging from .21 for Site 1 Obstetrics Residents to .41 for Site 1 Anesthesia Attendings. These findings provide strong support for H6.

Respondent's role, other's role, and relational quality. As shown in Table 9, numerous significant differences among mean RQ-R scores arise from the interaction of the respondent's role and the other participant's role. All five role-based subgroups at Site 1 and all three role-based subgroups at Site 2 demonstrated unique patterns of statistically significant differences among the mean RQ-R scores with respect to the five target roles (see Table 9 for results of statistical tests). The p values for the tests of differences of means are less than or equal to .001 for seven of the eight subgroups ($p = .01$ for Site 1 OB/Gyn Attendings), and the effect sizes are large to very large for all eight cases, with η^2 values ranging from .22 for Site 2 Obstetrics Attendings to .68 for Site 1 Anesthesia Attendings. These findings provide strong support for H9.

Respondent's role, other's role, and relational quality. As shown in Table 10, numerous significant differences among mean CQ-R scores arise from the interaction of

the respondent's role and the other participant's role. The Registered Nurse, Anesthesia Resident, OB/Gyn Resident, and Anesthesia Attending subgroups at Site 1 and all three role-based subgroups at Site 2 demonstrate unique patterns of statistically significant differences among the mean CQ-R scores with respect to the five target roles (see Table 10 for results of statistical tests). For the Site 1 Anesthesia Resident and Anesthesia Attending subgroups and the Site 2 Registered Nurse and Anesthesia Attending subgroups, the p values for the tests of differences of means are less than or equal to .001, and the effect sizes are large to very large, with η^2 values ranging from .27 for Site 1 Anesthesia Residents to .51 for Site 1 Anesthesia Attendings. In addition, the Site 1 Registered Nurse subgroup and the Site 2 Obstetric Anesthesia subgroup have p values of .01 or less, with η^2 values of .13 and .18, respectively, indicating moderate effect sizes. As a whole, these findings provide strong support for H12.

Regression Models of Role-Level Interactions

Two sets of regression models were constructed to address RQ1, which asks how psychological safety, relational quality, and communication quality are related when they are evaluated based on the interactions between role-based subgroups within a work group. The two sets of models use different datasets in order to examine the potential for different outcomes depending on whether the role-based interactions exhibit higher or lower levels of relational quality.

The datasets for the two sets of regression models were constructed as follows: For each role-based subgroup of respondents from each site, one corresponding target role was selected based on the mean relational quality (RQ-R) reported by the subgroup members with respect to the target role. (These means are shown in Table 9.) For each

respondent in the subgroup a case was added to the dataset containing the PS-R, RQ-R, and CQ-R scores for the selected target role. Thus, for each respondent, the dataset contains one case and that case contains the PS-R, RQ-R, and CQ-R scores from the target role selected based on the respondent's role.

High relational quality dataset. The first dataset contains the respondent role/target role pairings with the highest mean relational quality, i.e. RQ-R score. For each role-based subgroup at each site, a single target role stood out as having higher relational quality than the other target roles. (In most cases, the RQ-R score for the selected role was significantly higher than the scores for most or all of the other target roles.) The first dataset was constructed using these target roles. In each case the target role happened to be the same as the respondent's role. That is, Registered Nurses reported the highest relational quality with other Registered Nurses, Anesthesia Attendings reported the highest relational quality with other Anesthesia Attendings, and so on.

Table 11 shows a set of linear regression models derived from the high relational quality dataset. The available control variables are not included because they did not significantly or meaningfully influence the models. Model 5 shows that relational quality has a significant and moderate positive influence on psychological safety, $\beta = .51, p \leq .001, R^2 = .26, F(1, 156) = 55.93, p \leq .001$. Model 6 shows that psychological safety has a small but significant positive influence on communication quality, $\beta = .17, p \leq .05, R^2 = .03, F(1, 156) = 4.65, p \leq .05$. Model 7 shows that relational quality has a significant and moderate positive influence on communication quality, $\beta = .42, p \leq .001, R^2 = .17, F(1, 156) = 32.82, p \leq .001$. Finally, Model 8 shows that when psychological safety and relational quality are considered simultaneously, relational quality continues to

demonstrate a significant and moderate influence on communication quality, $\beta = .45$, $p \leq .001$, while psychological safety becomes irrelevant, $\beta = -.06$, ns, $R^2 = .18$, $F(2, 155) = 16.60$, $p \leq .001$. Taken together, this set of models describes a pattern of relationships that is very similar to the pattern found in the earlier analyses using the composite scales.

Table 11

Regression Models of Relationships Among Relational Quality, Communication Quality, and Psychological Safety for Role Pairings with High Mean Relational Quality

Variable	Psychological Safety ^a		Communication Quality ^c	
	Model 5 β	Model 6 β	Model 7 β	Model 8 β
Psychological Safety ^a		.17*		-.06
Relational Quality ^b	.51***		.42***	.45***
R ²	.26	.03	.17	.18
Adjusted R ²	.26	.02	.17	.17
ANOVA	F(1,156) = 55.93***	F(1,156) = 4.65*	F(1,156) = 32.82***	F(2,155) = 16.60***

Note. $N = 158$. The following cases are included in this analysis (respondent's role \rightarrow evaluated role): Site 1: RN \rightarrow RN, AR \rightarrow AR, OR \rightarrow OR, AA \rightarrow AA, and OA \rightarrow OA; Site 2: RN \rightarrow RN, AA \rightarrow AA, and OA \rightarrow OA.

^a PS-R scale; ^b RQ-R scale; ^c CQ-R scale.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Low relational quality dataset. The second dataset contains the role pairings with the lowest mean RQ-R scores. For each role-based subgroup at each site, the lowest mean RQ-R score for a target role was significantly lower than the mean score for the target role selected for the first dataset. Thus, the second dataset contains cases that, on

the average, reflect a significantly lower quality of relationship than did the first dataset.

The selected role pairings are listed at the bottom of Table 12.

Table 12

Regression Models of Relationships Among Relational Quality, Communication Quality, and Psychological Safety for Role Pairings with Low Mean Relational Quality

Variable	Psychological Safety ^a		Communication Quality ^c	
	Model 9 β	Model 10 β	Model 11 β	Model 12 β
Psychological Safety ^a		.52 ^{***}		.12
Relational Quality ^b	.62 ^{***}		.72 ^{***}	.65 ^{***}
R ²	.38	.27	.52	.53
Adjusted R ²	.38	.26	.52	.52
ANOVA	F(1,156) = 96.23 ^{***}	F(1,156) = 56.99 ^{***}	F(1,156) = 170.54 ^{***}	F(2,155) = 87.53 ^{***}

Note. $N = 158$. The following cases are included in this analysis (respondent's role \rightarrow evaluated role): Site 1: RN \rightarrow AR, AR \rightarrow OA, OR \rightarrow AR, AA \rightarrow OR, and OA \rightarrow AR; Site 2: RN \rightarrow AA, AA \rightarrow OR, and OA \rightarrow AR.

^a PS-R scale; ^b RQ-R scale; ^c CQ-R scale.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Table 12 shows a set of linear regression models derived from the low relational quality dataset. As above, the available control variables are not included because they did not significantly or meaningfully influence the models. Model 9 shows that relational quality has a significant and large positive influence on psychological safety, $\beta = .62$, $p \leq .001$, $R^2 = .38$, $F(1, 156) = 96.23$, $p \leq .001$. Model 10 shows that psychological safety has a significant and moderate positive influence on communication quality, $\beta = .52$, $p \leq .001$, $R^2 = .27$, $F(1, 156) = 56.99$, $p \leq .001$. Model 11 shows that relational quality has a significant and large positive influence on communication quality, $\beta = .72$, $p \leq .001$, $R^2 =$

.52, $F(1, 156) = 170.54, p \leq .001$. Finally, Model 12 shows that when psychological safety and relational quality are considered simultaneously, relational quality continues to demonstrate a significant and large influence on communication quality, $\beta = .65, p \leq .001$, while psychological safety again becomes non-significant, $\beta = .12, ns, R^2 = .53, F(2, 155) = 87.53, p \leq .001$.

Chapter 5: Discussion

Mediation Model

The partial mediation model proposed in this thesis suggests that psychological safety (PS) accounts for a significant part of the relationship between relational quality (RQ) and communication quality (CQ). The study data did not support this model. Regression analysis using both work group-level and role-level assessments of the model's variables showed that the relationship between RQ and CQ was not significantly influenced by the respondent's PS. This indicates that a different model is needed to account for the relationships among PS, RQ, and CQ.

Work group-level evaluation. The composite scales used to test the first three hypotheses (CPS, CRQ, and CCQ) were designed to indicate a respondent's relative levels of PS, RQ, and CQ with respect to the work group as a whole. The regression models shown in Tables 4 and 5 used these scales to examine the associations between the three variables. Models 1, 2, and 3 support the premises that PS is dependent on RQ, CQ is dependent on PS, and CQ is dependent on RQ, respectively. These three links appear to set up the triangle of associations shown in Figure 2a. However, if PS was in fact mediating the relationship between RQ and CQ, then Model 4, shown in Table 5, would indicate that, when considered simultaneously, the influence of PS on CQ would be significant while the influence of RQ on CQ would be diminished (indicating partial mediation) or eliminated (indicating full mediation). Instead, Model 4 shows that when considered simultaneously, PS has no influence on CQ while the influence of RQ on CQ

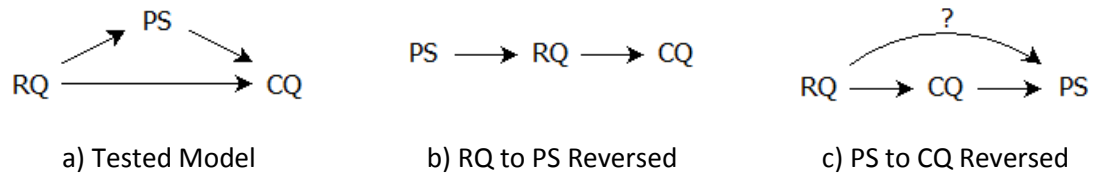


Figure 2. Representation of the tested mediation model (a), an alternative model in which the direction of the RQ to PS link is reversed and the PS to RQ link is removed (b), and an alternative model in which the direction of the PS to CQ link is reversed (c). RQ = relational quality; PS = psychological safety; CQ = communication quality.

remains unchanged from that found in Model 3. Thus, the work group-level findings provide no support for the proposed mediation model.

Role-level evaluation. The role-specific scales used to indicate a respondent's relative levels of PS, RQ, and CQ with respect to each of the five different roles (PS-R, RQ-R, and CQ-R) provided an alternative means of evaluating the relationships among the three variables in the proposed mediation model. Significant differences in each of the three variables were found for each respondent role based on the role of the other participant in an interaction. The existence of these role-level differences suggested that the relationships among the model variables might be different under different conditions. To examine this possibility, the proposed model was tested using two subsets of the role-level data.

The first subset of data contained cases in which the average RQ between the respondent's role and the role being related to was high. As in the group-level evaluation, the regression models using this high-RQ dataset, shown in Table 11, support most of the mediation model premises: PS depends on RQ, CQ depends on PS (though weakly), and CQ depends on RQ. However, as with the group-level evaluation, when considered simultaneously, the influence of PS on CQ disappears while the influence of RQ on CQ persists.

The second subset of data contained cases in which the average RQ between the respondent's role and role being related to was significantly lower than in the high-RQ dataset. The regression models using this low-RQ dataset are shown in Table 12. These models show the same pattern of associations found in the group-level and high-RQ evaluations—the mediation model is initially supported, but the influence of PS disappears when considered along with RQ. The only noteworthy difference between the low-RQ and high-RQ evaluations is in the goodness of fit. For each model, the variance accounted for in the low-RQ dataset is substantially higher than for the high-RQ dataset. Possible explanations for this difference will be considered later in this discussion.

To address research question 1 (RQ1), the relationships among PS, RQ, and CQ for role-specific interactions are consistent with the relationships observed for the workgroup as a whole. This suggests that a common model that describes the relationships at both the work group and role-specific levels may exist. However, the proposed mediation model does not fit at either level.

Different assumptions, different models. By definition, regression analysis evaluates the influence of independent variables on the variation of a dependent variable. However, a significant association between an independent variable and the dependent variable in a regression model will often remain significant if the model is reversed. This fact allows for speculation regarding better models for the relationships observed among PS, RQ, and CQ.

Psychological safety as a contributor to relational coordination. If the strong relationship between RC and PS found in Models 1, 5, and 9 is reversed such that RQ depends on PS, then the mediation model is changed such that RQ mediates the

relationship between PS and CQ. This revised model fits the data well. It also satisfies the conditions for full mediation defined by Baron and Kenny (1986); thus, the direct link from PS to CQ is eliminated in this model. A diagram of the resulting chain relationship is shown in Figure 2b. In this model psychological safety is a predecessor to relational coordination, influencing communication quality through relational quality.

This revised model does not address the question of why the RQ and CQ dimensions of the relational coordination construct are connected. Nevertheless, it does provide a reasonable model that connects PS to relational coordination and is consistent with the definition of psychological safety as a predecessor to communication in work groups. The revised model raises new research questions with practical applications: Does improving PS facilitate the development of RQ, and if so, why? Answering these questions could lead to new insights regarding practical approaches to improving the relational coordination and thus the performance of work groups.

The validation and examination of the revised model are challenges for future study, but the following speculation is offered: The revised model indicates that individuals are more likely to establish relationships characterized by shared knowledge, shared goals, and mutual respect if they feel able to engage in interpersonal risk taking without fear of negative consequences. This suggests that safer environments uniquely support or even promote some type of interpersonally-risky relationship-building communication. This type of communication may have characteristics different than those that define communication quality within relational coordination. For example, characteristics such as openness, self-disclosure, information seeking, and interpersonal engagement would be more likely in an environment of psychological safety and would

presumably promote relational quality. Thus, there may exist a second cluster of communication dimensions that are correlated with and conditions for relational coordination. The identification of such a cluster would strongly support the proposed link from PS to RQ, and it would provide new insight into methods for promoting relational coordination within work groups.

Psychological safety as a consequence of relational coordination. Two recent publications describe interaction models that are inconsistent with the revised model discussed above. In two studies conducted by Carmeli and Gittell (2009), PS was found to depend on RQ, mediating the relationship between RQ and learning from failure. The results of the first study appear to be equally consistent with a model in which RQ is the mediating variable; however, the second study provided clear evidence supporting Carmeli and Gittell's proposed model. In an unrelated study, Siemsen et al. (2009) presented and validated a model in which PS is dependent on the communication frequency dimension of CQ. Neither of these publications considered PS, RQ, and CQ together, but they both present support for models in which PS is dependent on at least one dimension of relational coordination.

To be consistent with this earlier work and with the empirical findings reported here, the mediation model tested in this thesis could be adjusted such that PS depends on CQ. In this alternative model, shown in Figure 2c, CQ mediates the relationship between RQ and PS, and psychological safety is modeled as a consequence of relational coordination rather than a contributor to it.

This model is consistent with the analysis presented in this thesis, but further regression tests using PS as the dependent variable would be required to fully determine

if this model fits the data. However, since the PS to CQ association is the weakest link in all three tests of the proposed mediation model, this alternative formulation of the model seems unlikely to provide a better fit than the revised model discussed above.

Furthermore, a model that suggests that relational coordination is entirely independent of psychological safety is fundamentally inconsistent with the definition of psychological safety as a condition that enables individuals to engage in group work.

Enhancing the Model

In addition to suggesting revisions to the structure of the proposed mediation model, the analysis presented in this thesis identified several additional variables worthy of consideration in the design of a more complete model.

Aspects of role membership. Much of the existing research regarding psychological safety or relational coordination has used work group- or team-level aggregation of results when testing models or comparing organizations. This thesis expands on earlier work by measuring and analyzing these constructs and their interaction at the role level. Several significant findings from this role-based examination point to role-related characteristics worthy of future study.

In the first set of regression models, shown in Tables 4 and 5, the betas for the OB/Gyn Attending role stand out as both significant and interesting. In Model 1C, membership in this role is associated with significantly higher PS relative to RQ. However, Model 2C shows that membership in the same role is associated with significantly lower levels of CQ relative to PS. Finally, Model 3 shows that membership in this role does not significantly impact CQ relative to RQ. Together, these findings indicate that membership in a particular role can push PS significantly higher, but this

bump in PS may not be reflected by a significant increase in CQ. This case suggests that some aspect of a respondent's role can have a significant impact on the magnitude of the associations among PS, RQ, and CQ.

The potential significance of role-related variables is further supported by the comparisons of means shown in Table 6. While most of the role-based differences in PS, RQ, and CQ did not rise to the level of statistical significance, the two that are significant present an interesting contradiction. The Registered Nurses at Site 2 reported significantly *lower PS* than did the OB/Gyn Attendings. A similar though not statistically significant difference in PS was found between the same groups at Site 1. Following from the study of role-based hierarchy and psychological safety conducted by Nembhard and Edmondson (2006), these differences might be construed as a reflection of status or control: the high-level attending physicians reported feeling safer than did the relatively low-level nurses.

Conversely, at Site 1 the Registered Nurses reported significantly *higher CQ* than did the Anesthesia Attendings. It may be that status or control is a disadvantage with respect to CQ; however, it seems more likely that another aspect of role membership led to this difference. As with the professional roles found in many work groups, the differences between physicians and nurses are far more complex than status and control hierarchies. For example, the nurses at the study sites tend to have significantly more opportunities to interact with other members of the team, whereas the physicians are limited with respect to team interactions. Thus, perhaps social network variables such as connectedness, homophily, or centrality converge at the role-level and are critical to understanding how PS, RQ, and CQ interact with role membership.

These findings suggest that models of PS, RQ, and CQ will likely be improved by the additional consideration not only of an individual's professional role, but also of the relational characteristics associated with role differences. These characteristics may include differences in status or control as well as social network variables. Identifying the key characteristics is a challenge for future work.

Job satisfaction. Job Satisfaction stood out as a key variable in some but not all of the analyzed regression models, suggesting an important and potentially complex interaction with the PS, RQ, and CQ variables. Inclusion of Job Satisfaction significantly improved the fit of Model 1 (PS regressed on RQ) and Model 2 (CQ regressed on PS). However, the beta for Job Satisfaction was non-significant in Models 3 and 4, both of which include the regression of CQ on RQ. Thus, job satisfaction appears to have minimal influence on the relationship between the relational coordination dimensions, but it may be an important third variable in the relationship between relational coordination and psychological safety.

The influence of the Job Satisfaction variable was also noteworthy with respect to its interaction with the Site variable. In both Models 1 and 2 the addition of Job Satisfaction substantially reduced the p value of Site. That is, for both PS and CQ, when the variance due to differences in job satisfaction was accounted for, the variance between the sites was substantially diminished. This finding is far from conclusive, but it suggests that organizational differences that affect job satisfaction have an indirect but significant impact on both psychological safety and communication quality.

Assessing Model Variables for Role Interactions

In addition to detecting potential role-related third variables that may enhance a model that connects psychological safety and relational coordination, the role-level findings reported in this thesis suggest that the variables should be measured and evaluated with respect to specific role interactions within a work group.

PS, RQ, and CQ with respect to respondent role. As shown in Table 6, when separate PS, RQ, and CQ scores were calculated for each role-based group of survey respondents, significant group differences were found in the PS scores reported at Site 2 and also in the CQ scores reported at Site 1. The findings do not explain why the differences exist—as discussed earlier, this determination is a challenge for future research. Nonetheless, the presence of these significant differences challenges the notion that the levels of and perhaps even the relationships among PS, RQ, and CQ can be generalized across a work group.

PS, RQ, and CQ with respect to the role of the other. The role of the other participant in an interaction was also found to be an important consideration when assessing PS, RQ, and CQ. Table 7 shows that at Site 1 the respondents reported significantly different level of PS, RQ, and CQ with respect to different role-based groups of their colleagues. The same was found for RQ at Site 2. Again, the reasons for the differences are not identified by this analysis; however, the existence of the differences signals a potential hazard to work group-level generalization.

Interaction of respondent's role and other's role. The strongest support for role-level assessment of PS, RQ, and CQ is provided by the results shown in Tables 8, 9, and 10, in which the study findings are broken down by both the role of the respondent

and the role being evaluated. Six of the eight role-based groups of survey respondents reported significantly different PS, RQ, and CQ with respect to different role-based groups of colleagues. The other two groups reported significant differences for at least one of the variables. Furthermore, in most cases, the estimated effect size of the differences ranged from large to very large. Finally, the pattern of significantly higher and lower values was different for each role-based group of respondents, demonstrating that the differences were not consistent across respondent roles.

The significant, substantial, and varied findings of these analyses indicate that potentially important differences may be found in PS, RQ, and CQ when they are measured and analyzed with respect to the interaction between a respondent's own role and the roles of the respondent's colleagues. Thus, if differences related to role interactions are not measured or if measured differences are obscured by aggregation, the role-related variation may introduce misleading error into work group-level analyses. Therefore, it seems prudent to measure and analyze role-level interactions when studying work group constructs such as psychological safety and relational coordination. This observation seems particularly relevant for environments such as health care, where workers have clearly defined and differentiated roles.

Evaluating the mediation model for specific role interactions. The proposed mediation model was tested using two sets of role interaction data. As discussed above, the high-RQ evaluation used data from the respondent-role/other-role pairs with the highest relational quality, and the low-RQ evaluation used data from the pairs with the lowest relational quality. Both the high-RQ and low-RQ findings regarding the proposed mediation model were consistent with the work group-level findings. However, the

regression models of the high-RQ and low-RQ datasets differed substantially with respect to the strength of the associations among the PS, RQ, and CQ variables. In this way, the role-level evaluations provided additional information not available in the group-level analysis.

The low-RQ regression models, shown in Table 12, fit the data very well with R^2 values ranging from .27 to .53, and significant betas ranging from .52 to .72. These numbers indicate strong associations between the variables. In contrast, the same associations in the high-RQ regression models were substantially weaker, with R^2 values ranging from .03 to .26, and betas ranging from .17 to .51. The reason for the differences is not apparent in the available data; however, the findings suggest the presence of a third variable that moderates the strength of the relationships between the PS, RQ, and CQ variables. That the moderation effect appears to be negatively related to the magnitude of RQ is puzzling and somewhat concerning with respect to the practical applications of this research. If the strength of the associations among PS, RQ, and CQ is diminished as RQ increases, then the effectiveness of efforts to improve CQ by improving RQ may diminish as a result of their own success. To address this concern, future examination of this apparent moderation effect is needed.

Limitations

The validity of the findings reported in this thesis may be limited due to constraints imposed by the study environment. The small size of the studied populations necessitated the use of a census approach in lieu of sampling. However, since responses were not received from the entire population, the representativeness of the study data cannot be verified. The census approach also contributed to the statistically large

variation in the number of responses received from the role-based subgroups, and this variation likely contributed to the unequal variances found in some cases among the role-based scores on the PS, RQ, and CQ scales.

With respect to generalizability, it should be noted that the workers in the studied environment belong to clearly defined and differentiated roles with limited overlap in duties and responsibilities. Thus, the findings of the study may exaggerate the significance of role-level differences that would be found in more integrated and homogenous environments. Also, several of the Anesthesia Attendings provided responses for both sites, so the mean scores for that role may be skewed toward the extremes due to the respondents' comparative rather than absolute ratings of the sites.

Assumed causality. The alternative model presented in this discussion describes causal relationships from PS to RQ and from RQ to CQ. However, the analysis of data from a single point in time is not sufficient to demonstrate causality, so the possibility of spurious relationships cannot be discounted. The results of the mediation tests discussed above are equally consistent with a model in which PS and CQ are mutually independent and both depend on RQ. Without longitudinal data, it is impossible to test the direction of causality between the variables and thus demonstrate the dependence of RQ on PS.

Psychological safety assessment. The assessment of psychological safety was based on survey items validated in previous studies; however, the novel instrumentation used in this study was somewhat problematic. First, regarding the structure of the survey items, respondents were asked to indicate their level of agreement or disagreement regarding a set of items, with two of the six items being semantically reversed. While this is a common survey design, a better practice would have been to ask direct questions with

item-specific response options (Saris, Revilla, Krosnick, & Shaeffer, 2010). While the impact on overall reliability appears to have been small, a few respondents were clearly confused by the reversed items and others may have been as well.

A conceptual problem arose from the difference in perspective between the relational coordination assessment and some of the psychological safety items. The relational coordination assessment consistently asked respondents to report the behaviors of others from each of the target roles. Some items of the psychological safety assessment were structured this way as well, e.g. “If I make a mistake ... with often hold it against me.” However, other items asked respondents to report their own behavior, e.g. “It is difficult for me to ask for help from ...” While the scales derived from the psychological safety items were found to be highly reliable, the perspective from which the construct was assessed is not clear. Thus, the psychological safety assessments and the relational coordination assessments may not have been conceptually parallel.

Future Directions

The study reported in this thesis confirmed the expectation that significant relationships exist between psychological safety and the dimensions of relational coordination. However, ascertaining the structure of these relationships will require further investigation. Additional studies are needed to determine if the revised model in which RQ mediates the link between PS and CQ provides a valid and consistent representation of the relationships among the constructs.

Future exploration is also needed to identify and integrate additional variables to develop a more complete model of factors that support interdisciplinary coordination. Job satisfaction will likely be an important component in this model, but additional research

is needed to determine how this variable is linked to others. A number of role-related variables were suggested for consideration in the discussion above, with role-level assessments of status, control, and social network metrics offered as strong candidates. Finally, the apparent moderating effect of relational quality on the strength of the relationships within the model is a curiosity worthy of further study.

The practical applications of this research include informing the development of programs intended to improve communication within interdisciplinary work groups. An example of this type of program is currently being implemented at the medical school where this study was conducted. The overarching goal of that program is to improve the residents' interdisciplinary communication; however, previous research has shown mixed results for improvement programs that target communication directly.

Applying prior research and the findings reported in this thesis, a research team has developed an educational program that brings residents from different specialties together to work on case studies in a facilitated, low-risk environment. The direct objectives of this program include the promotion of residents' psychological safety with respect to providers from other roles and the development of the quality of the relationships among the roles. Research conducted in conjunction with this program will assess the efficacy of this indirect approach to improving interdisciplinary communication.

Conclusion

The mediation model proposed in this thesis, in which psychological safety mediates the relationship between key dimensions of relational coordination, was not supported in this study of hospital care units. However, the results of the study did

indicate that the psychological safety, relational quality, and communication quality constructs are connected by significant and strong relationships. Furthermore, the findings supported a revised model of these relationships that appears to have a good fit and face validity. Thus, this research provides both clear disconfirming evidence for one possible model and strong support for an alternative model for integrating these constructs.

This research also proposed and supported the value of conducting assessment and analysis of psychological safety and relational coordination at the role interaction level, at least in environments with clearly differentiated roles. This role-level approach was essential to the identification of several role-related variables that appear to affect the relationships between the main constructs. The significant differences in the mean construct scores found among many own-role/other-role combinations also indicates the importance of conducting studies at this level.

At a high level, the goal of this research was to apply and attempt to connect two well-developed theories that focus on interdisciplinary collaboration within work groups. From this perspective, this research project was very successful. Independently, the relational coordination and psychological safety assessments each provided statistically significant and contextually meaningful information about the studied work groups. Taken together, the assessments revealed a strong but unexpected connection. A number of opportunities for future work were identified, and this research is already being applied in the development of an educational program for physicians.

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