Staying Apart to Work Better Together: Team Structure in Cross-Functional Teams

Journal:	*Academy of Management Discoveries*
Manuscript ID	AMD-2020-0238.R2
Manuscript Type:	Revision
Keywords:	Communication < Interpersonal & Team Processes, Innovation < Performance & Effectiveness, Team Development & Building < Interpersonal & Team Processes, Virtual Teams < Interpersonal & Team Processes

Abstract:	Organizations often leverage cross-functional teams to create innovative solutions and products, yet collaboration across functional boundaries is inherently challenging. Research on small teams largely suggests that, to facilitate team creative outcomes, subgroups should integrate across functional boundaries by increasing communication. In contrast, research on larger cross-functional teams (e.g., multiteam systems) suggests that too much communication across knowledge domains can worsen team outcomes. Using a quasi-experimental design, we investigate the influence of these two different team structures on cross-functional team communication and subsequent innovation outcomes. Contrary to the prevailing recommendation for an integrated team structure in small teams, results illustrate that integrating teams, and the resultant extensive cross-functional communication, does not enhance team innovation outcomes. Rather, teams with greater functional subgroup differentiation, though exhibiting relatively less cross-functional communication, exhibit greater cross-functional synthesis. These results suggest important implications for managers of cross-functional knowledge integration work as well as the future study of cross-functional teamwork of all sizes.

Staying Apart to Work Better Together: Team Structure in Cross-Functional Teams

Lindsay E. Larson
University of North Carolina at Chapel Hill
Lindsay_Larson@kenan-flagler.unc.edu

Alexandra M. Harris-Watson
University of Oklahoma
amharriswatson@ou.edu

Dorothy R. Carter
Michigan State University
dcarter3@msu.edu

Raquel Asencio
Duke University
rqlasencio@gmail.com

Leslie A. DeChurch
Northwestern University
dechurch@northwestern.edu

Ruth Kanfer
Georgia Institute of Technology
ruth.kanfer@psych.gatech.edu

Stephen J. Zaccaro
George Mason University
szaccaro@gmu.edu

This material is based upon work supported by the National Science Foundation under Grants SMA-1262474, SMA-1063901, SES-1738297, the Army Research Office under Grant W911NF-17-1-0444, and the National Aeronautics and Space Administration under Grant #80NSSC18K0511.

Correspondence may be directed to Lindsay Larson; Lindsay_Larson@kenan-flagler.unc.edu

STAYING APART TO WORK BETTER TOGETHER: TEAM STRUCTURE IN CROSS-FUNCTIONAL TEAMS

ABSTRACT

Organizations often leverage cross-functional teams to create innovative solutions and products, yet collaboration across functional boundaries is inherently challenging. Research on small teams largely suggests that, to facilitate team creative outcomes, subgroups should integrate across functional boundaries by increasing communication. In contrast, research on larger cross-functional teams (e.g., multiteam systems) suggests that too much communication across knowledge domains can worsen team outcomes. Using a quasi-experimental design, we investigate the influence of these two different team structures on cross-functional team communication and subsequent innovation outcomes. Contrary to the prevailing recommendation for an integrated team structure in small teams, results illustrate that integrating teams, and the resultant extensive cross-functional communication, does not enhance team innovation outcomes. Rather, teams with greater functional subgroup differentiation, though exhibiting relatively less cross-functional communication, exhibit greater cross-functional synthesis. These results suggest important implications for managers of cross-functional knowledge integration work as well as the future study of cross-functional teamwork of all sizes.

Keywords: cross-functional teams, communication, innovation, team development & building, virtual teams

INTRODUCTION

Cross-functional teams of knowledge workers are responsible for developing innovative solutions to solve some of the most complex problems of our generation (Hall et al., 2018). The proliferation of cross-functional teams can be seen across industries in organizations such as Apple (Podolny & Hansen, 2020), Pfizer (Wired Brand Lab, 2017), Boeing (Dumovich, 2003) , and NASA (Ferres, 2016). These teams collaborate to develop the next must-have electronics, vaccines to help quell a global pandemic, more efficient global air travel, and even vehicles to transport humans to other planets. Each cross-functional team consists of individuals from multiple functional backgrounds working together to integrate knowledge and innovate (Bunderson & Sutcliffe, 2002; Crowston, Specht, Hoover, Chudoba, & Watson-Manheim, 2015; Majchrzak, Jarvenpaa, & Bagherzadeh, 2015; Rosso, 2014). Research has demonstrated the great potential benefits of integrating differing functional perspectives and knowledge (Bell, Villado, Lukasik, Belau, & Briggs, 2011; Fiore, 2008; National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2004; Okhuysen & Eisenhardt, 2002). However, innovative collaboration across boundaries is a complex process. The primary challenges stem from the divides that naturally form between those with differing perspectives on how to approach team tasks (Bezrukova, 2013; Dougherty, 1992). Such challenges can result in lower innovation performance if team processes are not properly managed across team divisions (Gardner, Gino, & Staats, 2012).

To best coordinate team knowledge integration across functional domains, classic organizational design theory would suggest an intervention that augments team structure based on team needs (Galbraith, 1973; Tushman & Nadler, 1978). The small teams literature (research on teams of about 3-9 people) largely suggests that teams should be structured to strengthen shared identity and create a shared context by increasing coordination behaviors across faultlines (Hinds & Mortensen, 2005). We might expect that a structure that breaks down barriers between subgroups and encourages communication and information elaboration would be best for knowledge integration (Gilson, Maynard, Jones Young, Vartiainen, & Hakonen, 2015). In contrast, the literature on larger teams (e.g., 14-18 individuals in multiteam systems) suggests that when teams reach a certain size, coordination demands become too great to manage an integrated team structure. Rather, this literature recommends a team structure that maintains subgroup boundaries with only limited boundary-spanning coordination behaviors by a select few (Davison, Hollenbeck, Barnes, Sleesman, & Ilgen, 2012; Lanaj, Hollenbeck, Ilgen, Barnes, & Harmon, 2013). Thus, these two literatures suggest alternative strategies for bridging the boundaries between subgroups. However, to date, there has been no empirical investigation to confirm that small cross-functional teams would benefit more from integration than differentiation across functions.

The current study investigates this gap in the literature and discovers surprising implications for cross-functional collaboration. We examine team structure in small cross-functional innovation teams, previously thought to benefit most from integration rather than differentiation of functional subgroups. Holding team size constant (i.e., 6-7 person teams), we manipulate structure in cross-functional project teams, assigning teams to one of two conditions: 1) an integrated team wherein functional boundaries were de-emphasized and 2) a differentiated team wherein functional boundaries were emphasized. We evaluate the influence of team structure on cross-functional team communication frequency and critical cross-functional performance outcomes (i.e., novelty, implementability, and cross-functional synthesis of ideas). Our results suggest that differentiation limits cross-functional communication which turns out to be beneficial for cross-functional team performance. Counter to the prevailing recommendation for small teams, we find that cross-functional teams can innovate better when they use a structure of functional differentiation rather than functional integration. We discover that teams do not have to be large to benefit from differentiation. **Our surprising results offer both theoretical and practical insight into the formalization of team structure in cross-functional teams.**

BACKGROUND

This study focuses on cross-functional teams engaged in knowledge integration to achieve innovative outcomes. Cross-functional teams are teams that must collaborate and integrate the varying perspectives that derive from different areas of specialized knowledge (Bunderson & Sutcliffe, 2002; Majchrzak, More, & Faraj, 2012). For example, consider a group of 3 doctors and 3 computer scientists who want to submit a research proposal to develop a new artificially intelligent (AI) system to diagnose certain types of cancer more accurately. The doctors provide knowledge of the human body as well as information on how other doctors will most likely interface with the technology. The computer scientists provide knowledge of developing AI technologies and expertise in general technology user experience. The research proposal project team is an example of a cross-functional team consisting of two “knowledge-based subgroups” (Carton & Cummings, 2012) from two different “thought-worlds” (Dougherty, 1992; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Okhuysen & Bechky, 2009) coming together to integrate knowledge and create new ideas.

As in the example above, teams are increasingly organizing across functional boundaries to create innovative products and solutions (Hall et al., 2018). Cross-functional teams tend to produce more publications and publish in more diverse outlets than single-function teams (Hall et al., 2012; Stipelman et al., 2014; Stvilia et al., 2011). Cross-functional teams also generate more innovative outcomes than single-function teams (Cummings & Kiesler, 2005; Hall et al., 2018; Lee, Walsh, & Wang, 2015; Lungeanu & Contractor, 2015; Misra, Stokols, & Cheng, 2015). Moreover, teams that span boundaries experience greater levels of productivity and scientific impact compared to teams that do not span boundaries (Hall et al., 2018).

Despite the potential benefits, effective collaboration in cross-functional teams is complex and poses extensive challenges (Cooke & Hilton, 2015; Edmondson & Harvey, 2018; Edmondson & Nembhard, 2009; Seidel & O’Mahony, 2014). One reason such challenges arise is due to the emergence of faultlines between group members. Faultlines are divisions, or boundaries, within groups based on attributes that split the group into subgroups (Lau & Murnighan, 1998), such as functional or disciplinary background. Cross-functional teams face knowledge boundaries that are both “thick and difficult to surmount” (Kerrissey, Mayo, & Edmondson, 2021: 382). Team boundaries are imposed through the ways in which organizations structure the diversity of their workforce into teams. Boundaries can be related to functional training or field, educational background, organizational identity, demographic identities, or community relations (Hall, Stipelman, Vogel, & Stokols, 2017). The challenges of functional diversity in cross-functional teams mean that team members must allocate additional effort into the coordination of their cross-functional endeavors lest the "fragmentation and inefficiencies" (Hall et al., 2018: 536) of too much diversity debilitate potential innovation (Dahlander & Mcfarland, 2013; Lungeanu & Contractor, 2015; Misra et al., 2015; Stvilia et al., 2011; Sud & Thelwall, 2016). Thus, although functional diversity can benefit team innovation outcomes, management of cross-functional coordination introduces additional challenges.

Cross-Functional Team Structure and Communication

Paulus and colleagues (2021) suggest that functionally diverse groups are beneficial for creative activities. However, they also note an inherent challenge in determining "how to structure the collaboration... so as to maximize the efficiency of the process and optimize the quality of outputs or products" (Paulus et al., 2021: 270). In a study of cross-functional teams, Majchrzak and colleagues (2012) observed two methods for cross-functional knowledge integration: traverse and transcend. The traverse method suggests that teams must engage in the communication of deep knowledge to "traverse" the functional boundaries and integrate knowledge (Boland & Tenkasi, 1995; Cook & Brown, 1999; Dougherty, 1992; Hargadon & Bechky, 2006; Nonaka, 1994; Tsoukas, 2009). The transcend method suggests that teams can utilize particular practices, such as the use of boundary objects, to help communicate via a "neutral depersonalized common ground" and "transcend" knowledge boundaries. As such, team structure may impact cross-functional collaboration processes in ways that either emphasize ("traverse") or de-emphasize ("transcend") collaboration processes across functional subgroups to impact overall cross-functional innovation.

The case for integration. Classic organizational design theory would suggest an intervention focused on augmenting team structure to enable beneficial team processes (Galbraith, 1973; Tushman & Nadler, 1978). The team process of *communication* is considered particularly critical for overcoming coordination challenges and facilitating team success (Ancona & Caldwell, 1992; Fussell et al., 1998), especially among cross-functional teams (Fiore, 2008). Research suggests that face-to-face communication is helpful for productive collaboration within science teams (Binz-Scharf, Kalish, & Paik, 2015; Hall et al., 2018; Jeong & Choi, 2015; Vasileiadou & Vliegenthart, 2009). Moreover, the positive effects of diversity on innovation performance seem to depend on the extent to which communication behaviors such as information elaboration and information exchange occur (Hoever, Knippenberg, Ginkel, & Barkema, 2012; van Knippenberg, Dreu, & Homan, 2004; van Knippenberg, Ginkel, & Homan, 2013). Increasing regular communication has been shown to be helpful for integrating knowledge across different knowledge domains in teams (e.g., (Crowston et al., 2015; Majchrzak et al., 2015; Rosso, 2014). Research suggests that teams with knowledge-based subgroups, such as cross-functional teams, should focus on improving consideration of perspectives across knowledge-based subgroups (Carton & Cummings, 2012; Mannix & Neale, 2005), which can be facilitated via team communication. Another study of cross-functional teams demonstrated that not enough communication and coordination, specifically knowledge transfer, can be harmful for project outcomes (Cummings & Kiesler, 2007).

One type of team that is closely related to, but distinct from, cross-functional teams is virtual teams. In cross-functional teams, subgroups are primarily based on functional differences, such as differences in expertise, work function, or work tasks. Virtual teams consist of interdependent individuals who reside in different locations and collaborate via technological means (Gilson et al., 2015; Raghuram, Hill, Gibbs, & Maruping, 2019). Virtual team subgroups can be based on many factors, including "geographical dispersion, task type, work practices, culture, multiple team memberships, communication technology, leadership, and power dynamics" (Gilson et al., 2015: 1328). To effectively collaborate across boundaries, research on virtual teams suggests teams should increase spontaneous communication to help strengthen shared identity and create a shared context (Hinds & Mortensen, 2005). Communication has been shown to be helpful for coordination in global virtual teams as team task interdependencies increase (Maznevski & Chudoba, 2000). Also, as summarized in a review on virtual teams, "the few studies that have examined subgroups have tended to suggest they have a negative impact on team dynamics and outcomes" (Gilson et al., 2015: 1328). In a context where teams need to integrate knowledge, a structure that helps encourage communication and information elaboration between subgroups should be best for knowledge integration.

Because communication is a critical process for knowledge integration across the boundaries inherent to cross-functional teamwork, many interventions focus on improving cross-functional team outcomes by encouraging increased communication. Specifically, in smaller teams that can coordinate fewer relationships across functional divisions, research broadly suggests the creation of a single *integrated* team identity. Integrated teams are single teams wherein functional subgroups are not emphasized and, theoretically, functional differentiation is low. Ideally, this structure helps create shared group identity wherein team members closely integrate knowledge across functions to create the most innovative new technology. In our earlier example, a few doctors and computer scientists wished to collaborate on the development of a new AI technology. An integrated team in this scenario would stress the interdependencies of the doctors and engineers in the overall technology development and view the team as a single team with a single unifying team identity. Team members make relevant team-level decisions together and work interdependently towards their goals, facilitating extensive communication and coordination between all team members.

The case for differentiation. Importantly, although cross-functional teams are defined by their specialization, the literature on cross-functional teams tends to focus on *small* teams. Thus, the apparent consensus for integration in cross-functional teams stems primarily from research on small teams. In contrast, the literature on *larger* teams with specialized subgroups, such as multiteam systems, suggests an alternative structure.

Whereas cross-functional teams and virtual teams tend to be small to moderate in size (~3-9 people), multiteam systems are thought to be larger systems of teams (e.g., 14-18 individuals arranged into 2 or more component teams; Davison et al., 2012; de Vries, Hollenbeck, Davison, Walter, & van der Vegt, 2016; Lanaj et al., 2013). Multiteam systems are collections of interdependent teams working towards both proximal team goals and shared system-level goals (Mathieu, Marks, & Zaccaro, 2001). In multiteam systems, there are distinct teams whose members pursue goals at the team and system level. Thus, in multiteam systems, the subgroups are teams who each pursue their own proximal team goals, while working with other teams toward a larger system goal (Marks, DeChurch, Mathieu, Panzer, & Alonso, 2005; Mathieu et al., 2001). Neither cross-functional teams nor virtual teams typically exhibit this multi-tiered goal hierarchy. Whereas subgroups in multiteam systems are, in part, defined according to this goal hierarchy, subgroups in cross-functional teams are defined by their functional specialization and subgroups in virtual teams are defined by the presence of distanced subgroups, including spatial, temporal, or configurational distance (O’Leary & Cummings, 2007) as well as cultural distance (e.g., globally distributed virtual teams; Maznevski & Chudoba, 2000).

Despite the benefits of communication in cross-functional teams, it may be possible to have "too much" communication. Research on multiteam systems finds that when subgroups (i.e., component teams) engage in decentralized planning processes, the multiteam system experiences coordination failures that outweigh the possible benefits of decentralization that occur in smaller teams (Lanaj et al., 2013). Further, research suggests that subgroup boundaries should be maintained in cross-boundary collaboration, and only a few individuals should engage in boundary-spanning behaviors, such as communication and coordination actions (Davison et al., 2012).

Cross-functional collaboration imposes a burden on team members to maintain communication exchange between functional subgroups, a requirement that can quickly stretch an individual's capacity to both effectively communicate and complete team tasks. Research suggests this may be due to "role strain" that team members face when attempting to maintain communication exchanges within and between differing knowledge domains while also maintaining personal productivity as a contributor to the overall team project (Boardman & Bozeman, 2007; Cooke & Hilton, 2015; Cummings & Kiesler, 2005; Leahey, 2016; Shrum, Genuth, & Chompalov, 2008). Relatedly, Porck and colleagues (2019) found that multiteam systems benefited from strong identification with functional group memberships, rather than strong identification with the system, because it lessened team member burdens of uncertainty and depletion. Importantly, although examining different mechanisms, the study suggests that there are benefits of specialists focusing on their specialties rather than spending unnecessary resources trying to communicate or interact too much with those from other specialties.

Similarly, research suggests that communication can sometimes negatively impact team functioning when individuals are overwhelmed by the amount of communication occurring, or experience "communication overload" (Meier, 1963). Communication overload is defined as increasing exposure to information (Chung & Goldhaber, 1991). We assert that communication overload may also occur relationally as the number of relationships one must navigate and maintain becomes overwhelming. From a network perspective, a member of a cross-functional collaboration has communication "linkages" between themself and all other cross-functional team members, and some amount of time and effort is required to maintain each of those linkages. The more communication that occurs between individuals, and the larger the team size, the more time it takes that individual to manage all communication linkages (Brooks, 1975; Staats, Milkman, & Fox, 2012; Stasser & Taylor, 1991). Indeed, research has shown that as team size increases, groups struggle with coordination and communication processes (Blau, 1970; Shaw & Harkey, 1976). Thus, although research has suggested that frequent communication can be beneficial, research on boundary-spanning in large teams, role strain, and communication overload suggests that there may be a limit to the benefits of direct coordination and communication.

If too much communication can be detrimental to team functioning, and integrated team structures increase communication, then it is possible that an integrated team may exhibit lower performance than a team where functional differentiation is maintained. A *differentiated* team is a collection of functional subgroups working together as a project team towards a superordinate goal while maintaining some degree of functional entitativity. That is, a differentiated team has high functional differentiation. Ideally, this structure helps subgroups to hold one another accountable in their function-specific subtasks and helps teams ideate in their specialty before coming together to integrate ideas. In our research proposal example above, a differentiated team would foster the unique perspectives of the doctors and the computer scientists such that they could focus their work within their own unique perspectives before coming together with the other functions. Team members would make some decisions separately and only come together to make team-level decisions when necessary.

THE CURRENT STUDY

In either an integrated or differentiated cross-functional team structure, coordination and communication within the two functions and across functional boundaries will be challenging, yet critical, for overall project success (Marrone, 2010). However, each of these two team structures has very different implications for how individuals integrate knowledge across functions. Thus, understanding how to structure cross-functional teams is critical to fostering cross-functional performance and creativity.

The extant literature on small teams offers one possible prescription for how to best manage boundaries across functional subgroups, whereas the extant literature on large teams offers another. The prevailing consensus within the small teams literature is that subgroups should integrate across functional boundaries. In contrast, research on large teams suggests that, as teams become larger and more specialized, differentiation helps teams to better manage the coordination challenges of cross-boundary collaboration. Thus, there are two different recommendations for how to structure teams with specialized subgroups.

Despite these different recommendations, no empirical research has directly manipulated and tested the benefits of these two different structures within small cross-functional teams. The research that has investigated team structure in small teams tends to use a survey measure of team structure that measures the level of specialization, formalization, and hierarchy present in the team (Bunderson & Boumgarden, 2010), rather than via a direct manipulation of team structure and communication. The current study questions the prevailing notion that integration, rather than differentiation, is best for small cross-functional innovation teams.

To explore this research question, we test a serial mediation model (Figure 1) in which team structure (i.e., functional integration or functional differentiation) affects cross-functional team innovation outcomes via its effect on communication patterns. We use a quasi-experimental design to manipulate team structure among small cross-functional student project teams, a social network approach to operationalizing communication frequency (i.e., density), and subject matter expert (SME) ratings of project outcomes. We operationalize performance outcomes consistent with common critical outcomes of knowledge work in cross-functional teams, including novelty, implementability (van Knippenberg, 2017; West & Farr, 1990), and cross-functional synthesis reflected in the ideas of the final project. Results suggest important theoretical and practical implications for team structure in cross-functional innovation teams.

Insert Figure 1 about here

METHOD

Participants and Procedure

Participants were undergraduate students enrolled in either a psychology or ecology class at one of two universities in the southeastern United States (*N* = 426[1]) who coordinated over the course of the semester to complete a required course project with three deliverables. Of the 426 participants, 193 (47%) were female and 213 (50%) were male (20 participants did not report their gender). The average age of the sample was 20.81, and 62% of the sample was in at least

[1] Survey response rates varied by time point and condition. In the integrated team condition, 4.3% of ties and 2.4% of ties were missing at T1 and T2 respectively. In the differentiated team condition, 12.2% of ties and 6.6% of ties were missing at T1 and T2 respectively. Team-level data (e.g., dependent variables) was complete for all teams in both conditions.

their third year of university (12 participants did not report their year in university). Psychology students were from one of the universities, and the ecology students were from the other university. Team size was controlled across the two conditions such that each integrated team and differentiated team consisted of 3 ecology students and 3-4 psychology students.

We utilized a quasi-experimental design in which participants were assigned to a functional subgroup according to their enrollment in a psychology or ecology course, and the extent of differentiation was manipulated according to which of two semesters the students enrolled in the course. Participants enrolled in the first semester of the study were assigned to an integrated condition in which they were instructed that they would be a part of a cross-functional team and completed all deliverables throughout the semester together. In contrast, participants enrolled in the second semester of the study were assigned to a differentiated condition in which they were instructed that they would be part of a "taskforce" with two functional subgroups and were required to complete only the final deliverable together; all other deliverables would be submitted separately. Each condition was collected in the spring semester, one year apart, so the time of year was consistent between conditions. Although the extent of psychological differentiation between the two functions was manipulated, basic functional differentiation occurred naturally according to their course enrollment and university location. In total, there were 33 integrated teams and 31 differentiated teams.

At the beginning of each semester, all teams were required to complete a team charter together. Wording of the charters was designed to prompt participants to think about their team structure as either integrated or differentiated according to their assigned condition. Charters primed teams to think about and develop norms for either their "team" in the integrated condition or their "taskforce" (i.e., composed of the two separate functional teams) in the differentiated condition. The charters asked participants to collectively answer questions regarding their plans for communication norms (e.g., "Will your team/taskforce have regular meetings?"), operating guidelines (e.g., "How will your team/taskforce make decisions?"), and conflict management (e.g., "What strategies will your team/taskforce use to resolve differences of opinions among members?").

Figure 2 depicts the breakdown of tasks completed by teams in the two conditions. At Time 0, all participants across conditions completed the team charter and then worked together in their cross-functional team to choose an ecological issue as the focus for their project. Then, at Time 1, teams completed an observational study and a written report of the study and created and administered an attitudinal survey and a written report of the survey and results. In the differentiated condition, the observational study/report and the survey study/report were completed only with the members of their same function and submitted separately to their course instructor, whereas in the integrated condition, the two studies/reports were completed as a cross-functional team and submitted to a single online link. Finally, at Time 2, teams came together again as a cross-functional team to complete a single deliverable, a persuasive poster to address their chosen ecological issue by integrating psychological and ecological principles learned throughout their respective course semesters and their previous project deliverables from Time 1. Notably, across the two semesters/conditions, all project deliverable expectations were the exact same - the slides used to introduce the project and deliverables were the same, the technologies available to use were the same, the professors were the same, and the course syllabi and contents of each syllabus were held constant to ensure as much consistency between the conditions as possible outside of the manipulation of interdependence in project deliverables during Time 1.

Insert Figure 2 about here

Participants completed psychometric and sociometric measures after each deliverable. For the purposes of the current study, we discuss measures completed after the second deliverable (i.e., the middle of the project; "T1") and after the final deliverable (i.e., the end of the project; "T2"). T1 is included to account for the temporal distance between the manipulation and the end of the project. Except for an initial introductory meeting in which due dates were discussed, participants were not told when or how to communicate across teams in either condition.

Manipulation Check

To verify that the manipulation of team structure was successful in affecting participants' perceptions of differentiation between the functions, participants completed a 1-item pictorial measure of entitativity adapted from Hinds and Mortensen (2005) at all time points. Team entitativity is defined as the forces that unite team members together as a team and is conceptually representative of "(a) having shared goals and responsibilities, (b) cohesion, and (c) interdependence among team members" (Vangrieken, Boon, Dochy, & Kyndt, 2017: 6). As such, a team member's perceptions of team entitativity are a representation of the extent to which the team views the team members from the other function as a separate entity or as a single entity. The item asked participants to indicate which of 5 overlapping circles best reflected the relationship between the ecology and psychology students (1 = very different, 5 = very close). If the manipulation is successful, we expect participants in the integrated team condition to report a higher level of entitativity than participants in the differentiated team condition.

Measures

Communication frequency. Participants answered the question "Whom do you communicate with frequently?" using a 'round-robin' approach with a roster of their project team. Participants answered this question at all deliverable time points. *Cross-functional communication* was estimated by computing the density of ties occurring across functional subgroups in each project team[2]. To distinguish the effects of cross-functional communication from overall communication, we also estimated *functional communication* by computing the density of ties occurring within each functional subgroup and averaging across functions for each project team.

Cross-functional team performance. The final deliverable was an advertisement in the form of a persuasive poster designed to change human behavior regarding an ecological problem. Cross-functional team performance was operationalized as three variables: novelty of the final project, implementability of the final project, and cross-functional synthesis of concepts in the final project. Two subject matter experts (SMEs) scored each poster advertisement using 5-point Behaviorally Anchored Rating Scales (BARS) for each variable where 1 represented "poor," 2 represented "below average," 3 represented "average," 4 represented "above average," and 5 represented "excellent." SMEs were graduate student research assistants who were blind to the purposes of the experiment. Ratings were averaged to create a final score. Below, mean and median r_{WG} values are reported as a measure of inter-coder reliability for each outcome assessment.

[2] To mitigate the impact of missing data on our analyses, we utilized the "reconstruction" approach to missing data (Stork & Richards, 1992) such that ties were assumed to be reciprocal (i.e., if a team member reported communicating with a team member who did not respond, we assumed that tie to be reciprocated). Because some teams were missing data for more than one team member, this approach still resulted in some missing ties (0.2% and 0.4% for the integrated condition at T1 and T2 respectively; 3.4% and 0.8% for the differentiated condition at T1 and T2 respectively). All remaining missing ties were assumed to be null (i.e., weak ties; (Burt, 1987).

Project novelty (mean r_{WG} = .75; median r_{WG} = .88) was defined as the extent to which the final poster demonstrated original thoughts or ideas. Posters high in novelty targeted unique ecological problems, proposed projects that were entirely original, and proposed unique insights about human attitudes and behaviors relevant to the ecological issue. Posters low in novelty targeted more commonplace ecological problems that have been addressed many times before.

Project implementability (mean r_{WG} = .67; median r_{WG} = .83) was defined as the extent to which the proposed projects could be realistically executed. Posters high in implementability (1) had solutions that could be reasonably implemented in a variety of settings, and (2) had low likely costs of implementation in terms of time, money, etc. Posters low in implementability had proposed solutions that were entirely unrealistic and could not be feasibly enacted (e.g., too expensive, too large scale).

Cross-functional synthesis (mean r_{WG} = .72; median r_{WG} = .83) was defined as the extent to which the poster blended ecological and psychological concepts. Posters high in synthesis thoroughly explained the relation between human attitudes and the ecological issues, discussed the environmental factors that contribute to the formation of human attitudes, connected the data collection and ecological problem, and drew from social psychology concepts and aspects of the ecological issue. Posters low in synthesis provided little to no explanation for why human attitudes and behaviors contribute to or are relevant to the ecological issue, did not align the analysis of the ecological problem with the purpose of data collections, and did not discuss psychological concepts.

Analysis

To evaluate the effect of team structure on cross-functional team performance outcome variables via communication frequency, we tested a serial mediation model (i.e., a model in which there was an indirect effect of team structure on the three performance outcome variables via communication frequency; see Figure 1). All mediation analyses were conducted using path analysis with the *lavaan* (Rosseel, 2012) package in R. Indirect effects were tested using bootstrapping to calculate bias-corrected confidence intervals (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; MacKinnon, Lockwood, & Williams, 2004). We utilized 10,000 bootstrapping samples for all analyses. All variables were standardized (i.e., z-scored) prior to conducting analyses to facilitate interpretation. Functional communication was included as a control in all analyses.

RESULTS

Team structure conditions were coded as 0 for the differentiated team condition and 1 for the integrated team condition. Table 1 presents descriptive statistics for all study variables. Results of the manipulation check suggest that, as expected, condition was positively correlated to entitativity at both time points ($r = .49$, $p < .001$ at T1; $r = .34$, $p = .006$ at T2) such that participants in the integrated team condition reported greater entitativity between the two functions than did participants in the differentiated team condition. These results suggest that the experimental design was successful in manipulating team members' perceptions of functional differentiation.

Insert Table 1 about here

Further, although condition was significantly, positively correlated with cross-functional communication at both time points, condition did not correlate significantly with functional communication at either time point. That is, individuals in the integrated condition exhibited higher frequencies of cross-functional communication, but not functional communication, relative to the differentiated team condition. These results suggest the manipulation of team structure affected perceptions of team differentiation and *cross-functional* communication, but not *functional* communication, as intended.

Team Structure and Cross-Functional Communication

To investigate our research question regarding the effect of team structure on cross-functional team outcomes via communication frequency, we first examined the effect of team structure on cross-functional communication frequency. We used a simple mediation approach to investigate the effect of team structure on cross-functional communication at both T1 and T2. Table 2 shows the results of the simple mediation analyses. Results suggest that team structure was positively related to cross-functional communication at T1 such that communication frequency was higher in the integrated team condition relative to the differentiated team condition ($b = 1.33$, $p < .001$). Further, cross-functional communication at T1 was positively related to cross-functional communication at T2 ($b = .78$, $p < .001$). There was an indirect effect of team structure on cross-functional communication at T2 via cross-functional communication at T1 ($b = 1.03$, $p < .001$, 95% CI = [.73, 1.43]), and no additional direct effect of team structure on cross-functional communication ($b = -.17$, $p = .426$). Thus, results indicate that there was higher cross-functional communication in the integrated team condition than the differentiated team condition at both time points as expected.

Insert Table 2 about here

Team Structure and Performance: Mediation via Cross-Functional Communication

Next, we explored the effect of team structure on our cross-functional team performance variables via path analyses to investigate mediation via communication frequency. Figure 3 displays the results of path analyses regarding the effect of team structure on performance variables of novelty, implementability, and cross-functional synthesis.

Insert Figure 3 about here

Results showed no support for an effect of cross-functional communication on project novelty (b = -.26, p = .386). Moreover, the indirect effect of team structure on project novelty via cross-functional communication was non-significant (b = -.25, p = .205, 95% CI = [-.66, .12]). Thus, there was no clear support for an effect of team structure via communication frequency on project novelty. Additionally, there was no clear support for an effect of team structure on project implementability via cross-functional communication. The effect of cross-functional communication on project implementability was marginally significant (b = -.29, p = .096), and the indirect effect of team structure on project implementability via cross-functional communication was non-significant (b = -.30, SE = .20, p = .126, 95% CI = [-.74, .05]. In contrast, results showed support for a significant effect of cross-functional communication on cross-functional synthesis (b = -.40, p = .027). The indirect effect of team structure on cross-functional synthesis via cross-functional communication was marginally significant (b = -.42, p = .061, 95% CI = [-.94, -.06].

Thus, in answer to our research question, results suggest that increased cross-functional communication does not benefit cross-functional performance outcomes and, rather, may be detrimental to cross-functional synthesis. That is, integrated teams may experience greater communication frequency relative to differentiated teams, which in turn yields lower cross-functional synthesis.

To distinguish the effect of cross-functional communication from communication frequency generally, we also investigated the influence of functional communication. In contrast to the effect of cross-functional communication, functional communication showed a significant, positive effect on project implementability ($b = .34$, $p = .003$). Results showed a non-significant effect of functional communication on project novelty ($b = .03$, $p = .81$) and functional synthesis ($b = .18$, $p = .102$).

DISCUSSION

Prior research suggests that cross-functional teamwork is difficult, but the potential payoffs could create novel new ideas or products. Thus, identifying strategies for combating coordination challenges in cross-functional teams is critical to organizational success. Of particular interest is how managers can set cross-functional knowledge integration teams up for success from the start. In a quasi-experimental study of 64 small cross-functional teams collaborating over the course of one semester, we make surprising discoveries that have important implications for cross-functional teamwork theory and practice. First, we find that, contrary to prevailing wisdom regarding small teams, functional differentiation, rather than integration, was more beneficial to cross-functional team innovation outcomes. This discovery signals a call for more research regarding how we can best structure small cross-functional teams for successful innovation outcomes. Second, we elucidate this discovery by identifying a behavioral mechanism through which team structure impacts innovation outcomes. We found that *cross*-functional team communication occurs less often in a differentiated team structure, compared to an integrated team structure. Further, we find that although team structure influences *cross-functional* communication, team structure has no effect on *functional subgroup* communication.

Team Specialization rather than Team Size

Importantly, we provide evidence of the need for a possible consensus shift in the small teams literature. This literature suggests that cross-functional teams benefit most from integration of functional subgroup boundaries rather than differentiation of functional subgroup boundaries.

In smaller teams, the number of communication and coordination relationships should be manageable, so more emergent, informal structures should be most beneficial for team outcomes. In contrast, the large teams literature suggests that as teams become larger and the number of communication and coordination links eventually becomes too great to handle, teams are better off differentiating across functional boundaries. However, our results suggest that a differentiated structure, rather than an integrated structure, was more beneficial for small cross-functional teams. Thus, our study suggests that the specialization inherent in cross-functional teams, rather than the size, is what implies differentiation as an appropriate team structure.

Our findings regarding the importance of specialization, regardless of size, also contribute to areas of related research on innovation teams from functionally diverse backgrounds working across knowledge-based subgroups. For example, research suggests that information-based (e.g., related to education or work experience) faultlines may provide benefits to teams by encouraging healthy competition and intentional information elaboration processes, but only if properly managed to counteract the possible process challenges of working in teams with functional faultlines (Bezrukova, Jehn, Zanutto, & Thatcher, 2009; Gibson & Vermeulen, 2003; Phillips, 2003; Rink & Ellemers, 2007). The current study provides support for the idea that function-based faultlines are not inherently harmful if they are managed effectively, such as through the intentional use of differentiated team structure to manage cross-functional coordination.

Because this study examined cross-functional teams collaborating via virtual technologies across geographic boundaries, findings also help expand our understanding of virtual teams. In their review of virtual teams research, Gilson and colleagues (2015) describe a theme of globalization enabled by the proliferation of virtual teams, focusing on the geographic dispersion of such teams (Martins, Gilson, & Maynard, 2004) and how geographic dispersion likely creates faultlines between distributed subgroups (Cramton & Hinds, 2004). As discussed in the review, virtual teams research has emphasized the downsides of subgroups for team dynamics and outcomes. However, results from the current study suggest that some degree of subgrouping is helpful for innovative knowledge work in geographically distributed cross-functional teams. Notably, subgroups in the current study were based on functional expertise but were also distributed. Thus, more research is required to disentangle the effects of subgroups based on function- or geographic-based faultlines.

Our findings also connect research on cross-functional teams and multiteam systems, illustrating that findings from research on large, action-oriented multiteam systems also extend to smaller teams with specialized subgroups. For example, multiteam systems research suggests coordination across boundaries should occur by a select few rather than openly and informally across the entire system (Davison et al., 2012). In line with findings from the multiteam systems literature that emphasize the importance of boundary maintenance in large action-oriented teams, we find that too much cross-functional communication may force teams to not fully utilize the functional expertise and strengths that they each uniquely bring to the collaboration. We found that integrated teams communicated more frequently across functions relative to differentiated teams, and cross-functional communication frequency was *detrimental* to the outcome that we would perhaps most expect to benefit from increased communication frequency: cross-functional synthesis. Also, although the indirect effect of team structure on project novelty and implementability was non-significant, cross-functional communication showed a negative relationship with these outcomes.

Notably, team structure was not related to functional communication (i.e., communication density among team members within the same functional subgroup), but functional communication showed a significant, positive relationship with project implementability. Thus, the effect of team structure on cross-functional team performance is not attributable to communication frequency generally. Rather, the results suggest that *cross*-functional communication negatively affects *cross*-functional performance, and functional communication may positively impact *cross*-functional performance. Just as Davison and colleagues (2012) found that the paths of coordination mattered for overall system success, our results underscore that the path of communication matters for cross-functional team knowledge integration and innovation performance.

Although the current results suggest that extensive cross-functional communication is detrimental to performance, it is possible that communication density in fact shows a curvilinear relationship with critical outcomes. There may be a "too much of a good thing" effect of cross-functional communication on team outcomes such that some level of communication is necessary for effective functioning but that, beyond some threshold, communication becomes detrimental. This thought is detailed in theory work on teamwork processes among subgroups (Crawford & LePine, 2013). We expect that, because communication is still a critical collaboration process, there is likely a floor or minimum necessary level of communication. Further exploration on the specific patterns of communication necessary for the most efficient and effective cross-functional innovation is necessary.

Similarly, Porck and colleagues (2019) found that strong team-level identification was more helpful, and system-level identification was more harmful, to system-level performance in multiteam systems completing complex tasks. They conclude that their findings support the larger motivation behind organizing in multiteam systems, which is that the tasks are so complex that they cannot be completed by a single team alone. Rather, the tasks require the efforts of multiple, often specialized, component teams organizing as a single, larger system of differentiated teams. This logic can be similarly applied to the current findings. The tasks of cross-functional teams are inherently high in complexity as they require the collaboration of multiple functions. As such, they cannot be completed by a single function alone, and some degree of differentiation is likely required for maximizing the opportunities of diverse functional expertise while minimizing the challenges inherent to cross-functional collaboration.

Finally, the current findings have implications for the delineation of multiteam systems and how they relate to other team types. According to one component of the definition, multiteam systems "are unique entities that are larger than teams yet typically smaller than the larger organization(s) within which they are embedded" (Mathieu, Marks, & Zaccaro, 2001: 291). It is possible that some smaller multiteam systems are equivalent in size to some larger single teams. At the very least, results here suggest that, compared to the small teams literature, the multiteam systems literature may be better-suited to provide prescriptions for cross-functional teamwork. It is possible that other prescriptions for multiteam system effectiveness may extend to cross-functional teamwork, and vice versa. For example, would cross-functional teams like the ones in the current study also benefit from coordinated action from appointed boundary spanners (e.g., Davison et al., 2012)? Also, to what extent does identification with an individual's functional domain or the cross-functional team affect cross-functional team performance, and what role does depletion and task complexity play in these relationships (e.g., Porck et al., 2019)? We suggest that future research should investigate the extent to which *other* multiteam system prescriptions extend to smaller cross-functional teams.

Differentiation for Cross-Functional Innovation

One way to interpret our findings in the larger context of team innovation is to consider one classic process suggestion for creative thinking in teams: asynchronous brainstorming (Girotra, Terwiesch, & Ulrich, 2010; Paulus, Korde, Dickson, Carmeli, & Cohen-Meitar, 2015). The differentiated team structure may have influenced team process and outcomes for the same reasons asynchronous groups improve creative performance. In asynchronous brainstorming, team members ideate individually before team discussions, and this process results in higher quantities of ideas and higher accountability of each individual. This process helps prevent social loafing, increases individual accountability, and prevents conformity and premature agreement. We extend these findings such that when function-based subgroups ideate outside of project team discussions, subgroups may experience greater accountability and invest more effort into the products they bring to large team meetings, compared to integrated teams.

Relatedly, Harvey's dialectical model of extraordinary group creativity (2014) suggests that teams may achieve breakthrough innovation, rather than incremental innovation, through a unique process of creative synthesis. In creative synthesis, teams "focus their collective attention, enact ideas, and build on similarities within their diverse perspectives" (Harvey, 2014; 325). The differentiated team structure may have encouraged teams to understand and combine their resources, including function-based knowledge resources, through a process of creative synthesis. In contrast, evolutionary models of group creativity emphasize the creation of many ideas, which ideally increases the likelihood of a few "radically" innovative ideas through random variation. The integrated condition facilitated more interaction, which may have helped teams create a greater number of possible ideas or solutions (in line with an evolutionary model of idea generation through random variation; Campbell, 1960; Harvey, 2014; Simonton, 1999; Staw, 1990) but is more conducive to incremental innovation. In the differentiated structure, the more limited interdependencies may focus the coordination work across boundaries such that teams are more focused on creating a new shared view of the tasks or problem-space. This, in turn, helps teams create more "breakthrough" ideas, which would be judged as higher in team innovation performance in the current study. Likewise, in the study of innovation-focused cross-functional teams mentioned earlier (Majchrzak et al., 2012), the traverse method (similar to integrating across functions) may be more conducive to brainstorming for incremental innovation. Alternatively, the transcend method (similar to differentiating across functions) may be more conducive to creative synthesis for more "breakthrough" innovations. We encourage future research to explore the specific boundaries of when structural differentiation benefits cross-functional innovation.

This study also contributes to our understanding of subgrouping and conflict in creative teams. A recent study on goal interdependence as a moderator in the relationship between criticism and creativity in teams (Curhan, Labuzova, & Mehta, 2021) found that high goal interdependence among team members helped turn potential conflict between different viewpoints or perspectives into better creativity outcomes in team brainstorming. In the current study, the cross-functional nature of the project teams likely bred intergroup conflict, but we find that keeping functions differentiated led to greater innovative performance. We do not measure team conflict, so future research might investigate the effects of a differentiated team structure on the relationship between criticism and creative outcomes in teams. As such, further investigation of the team structures presented in this study are necessary to understand all the mechanisms behind the effect of cross-functional team structure on team outcomes.

Strengths and Limitations

This study contributes to team science via three methodological strengths. First, the manipulation of this study was meaningful. We directly manipulated team structure, which to the authors' knowledge has not been done before. Although structure manipulation has been done at a more macro-organizational level in the study of large systems of teams, this study examines a micro-organizational level and demonstrates that differentiation within smaller team sizes is meaningful in cross-functional collaboration.

A second methodological strength was our control of team size such that we limited the size of our cross-functional teams. Our findings suggest that differentiated team structure results in better cross-functional team performance. As previously discussed, one type of differentiated cross-functional team is a multiteam system. In the extant literature on multiteam systems, there is an underlying assumption that multiteam systems combine whole teams under a single, large, interconnected system (i.e., Davison et al., 2012; Lanaj et al., 2013). However, in this study, we controlled the size of our cross-functional teams such that the only manipulation was the level of functional differentiation and found that differentiation of functions was the factor that influenced cross-functional performance outcomes, controlling for size. This study suggests that differentiation may be helpful in both large *and* small cross-boundary collaborations.

The third methodological strength was that this study incorporated a high-fidelity simulation of cross-functional collaboration. Participants were highly invested in the outcomes of their cross-functional collaboration as their individual grades were at stake. Participants worked in these cross-functional teams for about 3 months, which is considered moderate in temporal stability (Hollenbeck, Beersma, & Schouten, 2012). The teams in this study also experienced the manipulation naturally, where their functions and geographic locations were predetermined by the participants themselves rather than artificially created in a laboratory setting. Overall, the teams in this study represent a relatively realistic view of a cross-functional project team that often comes together to create or innovate for a distinct period of time.

One limitation of the current study is sample size, particularly at the cross-functional team level. This study included 64 teams (33 integrated teams and 31 differentiated teams). Although this is a substantial sample at the individual participant level ($N = 426$), the sample size at the cross-functional team-level means that the main analyses suffer from limited statistical power. Indeed, we suspect that limited power may account for the marginal significance of several findings. We suggest that future investigations examine how team structure and resultant communication frequency impact innovation and explore alternative methodologies that might yield larger sample sizes. One approach might be to examine how team structure inhibits or promotes innovation and performance at the individual-level using a multilevel design.

Additionally, our sample consisted of undergraduate students from two US universities, which presented both strengths and weaknesses to our study. Because of the student sample, this study was limited in the amount of surveying that could be done. Our measure of communication frequency reflected undirected network ties. An interesting area of future research would be to explore directed communication ties and other ties including advice and hindrance relationships in cross-functional teams. However, because students received course grades based on their project deliverables, the task was of meaningful importance to the sample participants. Moreover, each functional team was located at a different university and, consequently, the two functions only interacted virtually. It is possible that effects explored here for *cross-functional* interaction may partially reflect the challenges inherent to geographical dispersion, although face-to-face communication may have simply exacerbated the challenges experienced by participants in the present study. Although this study cannot speak to the effects of boundary management or mismanagement in *non-virtual* cross-functional teams, such geographic dispersion and the resulting virtual interaction is increasingly common in today's organizations.

Moreover, we expect that *cross-functional* communication, as opposed to functional communication, is especially likely to be virtual in large, collaborative teams. For example, employees co-located at one organization may collaborate with employees co-located at another organization. Interestingly, millennial workers, the largest generation in the workforce (Fry, 2016) have been shown to perceive virtual communication as a method for breaking down organizational boundaries and increasing collaboration (Myers & Sadaghiani, 2010). Our sample consisted of millennials (individuals born between 1985 and 1999; Alsop, 2008), and we still found that teams performed better using a differentiated team structure despite a possible preference for breaking down boundaries via virtual communication. Nonetheless, future research should consider generational effects as well as the impact of geographical dispersion and virtual communication relative to in-person communication on overall communication patterns.

We also suggest that future research consider the possible temporal effects of team structure manipulation on innovation outcomes. Novelty seems to arise when functions are left to innovate on their own. Because the structure manipulation was implemented at the very beginning of the team life span, team structure most affected communication at the start of the project (T1). Teams in the integrated team condition likely experienced a good deal of process loss in their team processes because of the need to act as a singular team. In contrast, in the differentiated structure, teams may have been better positioned to focus on subgroup innovation, minimizing the process loss involved in focusing on the larger team. However, it is possible that if teams were brought together later (e.g., start as a differentiated structure and then move to an integrated structure), process loss may not have occurred to the same degree and communication may not be as detrimental to team outcomes. Similar advice for alternation between creative work in subsets of a larger entity and a larger entity is suggested in work on individual and group brainstorming effectiveness (Paulus et al., 2015). More temporally complex examinations of this phenomenon and the effects of leadership over time (i.e., Halbesleben, Novicevic, Harvey, & Buckley, 2003) would help explain the exact mechanisms behind the effects of team structure on innovative performance outcomes.

Finally, results suggest that extensive cross-functional communication in cross-functional teams is detrimental to performance outcomes and that team structure is an effective strategy for minimizing cross-functional communication overload. However, it is also possible that team members could be influenced to work in such structures without explicitly manipulating team structure at the start. Interventions could be designed to help team members attend to the unique demands of cross-functional teams that mitigate the need to intentionally structure teams in a particular way at the outset. For example, research has shown that perspective taking is an important moderator of the relationship between diversity and creativity in teams (Hoever et al., 2012), and a similar process may occur in our manipulation. Further, the findings of this study may vary in teams that are more familiar with one another or have experience working across boundaries with one another already. Such teams may already have existing norms for boundary spanning behaviors or assigned boundary spanners, which may change the effects of structure on overall outcomes. Future research should continue to explore the precise conditions and mechanisms by which team structure benefits communication patterns to identify other ways of inducing successful, strategic communication.

CONCLUSION

Organizations are increasingly using cross-functional team-based structures to innovate. However, as the complexity of the nature of cross-functional work increases, the complexity of navigating collaboration within these teams also increases. Our results suggest the importance of team structure and communication in cross-functional teams. However, contrary to popular belief, small cross-functional teams may benefit more from *limiting* cross-functional communication in cross-functional teams working on complex innovation projects. Future research should continue to explore how team structure, as well as other potential prescriptions and interventions suggested by related areas of research on specialized teams, such as multiteam systems, influence cross-functional team processes and effectiveness.

REFERENCES

Alsop, R. 2008. ***The trophy kids grow up: How the millennial generation is shaking up the workplace***. San Francisco: Wiley.

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

Bell, S. T., Villado, A. J., Lukasik, M. A., Belau, L., & Briggs, A. L. 2011. Getting specific about demographic diversity variable and team performance relationships: A meta-analysis. ***Journal of Management***, 37(3): 709–743.

Bezrukova, K. 2013. Understanding and addressing faultlines. ***National Research Council's Workshop on Science Team Dynamics and Effectiveness***. Washington, DC.

Bezrukova, K., Jehn, K. A., Zanutto, E. L., & Thatcher, S. M. B. 2009. Do Workgroup Faultlines Help or Hurt? A Moderated Model of Faultlines, Team Identification, and Group Performance. ***Organization Science***, 20(1): 35–50.

Binz-Scharf, M. C., Kalish, Y., & Paik, L. 2015. Making science: New generations of collaborative knowledge production. ***American Behavioral Scientist***, 59: 531–547.

Blau, P. M. 1970. A formal theory of differentiation in organizations. ***American Sociological Review***, 201–218.

Boardman, C., & Bozeman, B. 2007. Role strain in university research centers. ***The Journal of Higher Education***, 78(4): 430–463.

Boland, R. J., & Tenkasi, R. V. 1995. Perspective making and perspective taking in communities of knowing. ***Organization Science***, 6(4): 350–372.

Brooks, F. 1975. ***The mythical man–month: Essays on software engineering***. New York: Addison-Wesley.

Bunderson, J. S., & Boumgarden, P. 2010. Structure and Learning in Self-Managed Teams: Why "Bureaucratic" Teams Can Be Better Learners. ***Organization Science***, 21(3): 609–624.

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

Burt, R. S. 1987. Social Contagion and Innovation-Cohesion Versus Structural Equivalence. ***The American Journal of Sociology***, 92(6): 1287–1335.

Campbell, D. T. 1960. Blind variation and selective retentions in creative thought as in other knowledge processes. ***Psychological Review***, 67(6): 380–400.

Carton, A. M., & Cummings, J. N. 2012. A Theory of Subgroups in Work Teams. ***Academy of Management Review***, 37(3): 441–470.

Chung, C. J., & Goldhaber, G. 1991. Measuring communication load: A three-dimensional instrument. ***41st Annual Conference of the International Communication Association***. Chicago, IL.

Cook, S. D., & Brown, J. S. 1999. Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing. ***Organization Science***, 10(4): 381–400.

Cooke, N. J., & Hilton, M. L. 2015. ***Enhancing the effectiveness of team science***. Washington, D.C: National Academies Press.

Cramton, C., & Hinds, P. J. 2004. Subgroup Dynamics in Internationally Distributed Teams: Ethnocentrism or Cross-National Learning? ***Research in Organizational Behavior***, 26: 231–263.

Crowston, K., Specht, A., Hoover, C., Chudoba, K. M., & Watson-Manheim, M. B. 2015. Perceived discontinuities and continuities in transdisciplinary scientific working groups. ***Science of The Total Environment***, 534: 159–172.

Cummings, J. N., & Kiesler, S. 2005. Collaborative research across disciplinary and organizational boundaries. ***Social Studies of Science***, 35(5): 703–722.

Cummings, J. N., & Kiesler, S. 2007. Coordination costs and project outcomes in multi-university collaborations. ***Research Policy***, 36(10): 1620–1634.

Curhan, J. R., Labuzova, T., & Mehta, A. 2021. Cooperative Criticism: When Criticism Enhances Creativity in Brainstorming and Negotiation. ***Organization Science***, 32(5): 1256–1272.

Dahlander, L., & Mcfarland, D. 2013. Ties that last: Tie formation and persistence in research collaborations over time. ***Administrative Science Quarterly***, 58: 69–110.

Davison, R. B., Hollenbeck, J. R., Barnes, C. M., Sleesman, D. J., & Ilgen, D. R. 2012. Coordinated action in multiteam systems. ***Journal of Applied Psychology***, 97(4): 808–824.

de Vries, T. A., Hollenbeck, J. R., Davison, R. B., Walter, F., & van der Vegt, G. S. 2016. Managing Coordination in Multiteam Systems: Integrating Micro and Macro Perspectives. ***Academy of Management Journal***, 59(5): 1823–1844.

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

Dumovich, E. 2003. The Boeing of tomorrow. ***Boeing Frontiers***, 2(4). https://www.boeing.com/news/frontiers/archive/2003/august/cover1.html.

Edmondson, A. C., & Harvey, J. F. 2018. Cross-boundary teaming for innovation: Integrating research on teams and knowledge in organizations. ***Human Resource Management Review***, 28(4): 347–360.

Edmondson, A. C., & Nembhard, I. M. 2009. Product development and learning in project teams: The challenges are the benefits. ***Journal of Product Innovation Management***, 26(2): 123–138.

Ferres, Z. 2016. ***3 lessons entrepreneurs can learn from NASA about organizational design***. Entrepreneur. https://www.entrepreneur.com/article/254136.

Fiore, S. M. 2008. Interdisciplinarity as Teamwork: How the Science of Teams Can Inform Team Science. ***Small Group Research***, 39(3): 251–277.

Fry, R. 2016. ***Millennials overtake Baby Boomers as America's largest generation***. Pew Research Center.

Fussell, S. R., Kraut, R. E., Lerch, F. J., Scherlis, W. L., McNally, M. M., et al. 1998. Coordination, overload and team performance: Effects of team communication strategies. ***Proceedings of the 1998 ACM conference on Computer Supported Cooperative Work***, 275–284.

Galbraith, J. 1973. ***Designing complex organizations***. Reading, Mass.

Gardner, H., Gino, F., & Staats, B. 2012. Dynamically integrating knowledge in teams: A resource-based view of team performance. ***Academy of Management Journal***, 55: 998–1022.

Gibson, C., & Vermeulen, F. 2003. A Healthy Divide: Subgroups as a Stimulus for Team Learning Behavior. ***Administrative Science Quarterly***, 48(2): 202–239.

Gilson, L. L., Maynard, M. T., Jones Young, N. C., Vartiainen, M., & Hakonen, M. 2015. Virtual Teams Research: 10 Years, 10 Themes, and 10 Opportunities. ***Journal of Management***, 41(5): 1313–1337.

Girotra, K., Terwiesch, C., & Ulrich, K. T. 2010. Idea Generation and the Quality of the Best Idea. ***Management Science***, 56(4): 591–605.

Halbesleben, J. R., Novicevic, M. M., Harvey, M. G., & Buckley, M. R. 2003. Awareness of temporal complexity in leadership of creativity and innovation: A competency-based model. ***The Leadership Quarterly***, 14(4–5): 433–454.

Hall, K. L., Stipelman, B. A., Vogel, A. L., & Stokols, D. 2017. Understanding cross-disciplinary team-based research. ***Oxford Handbooks Online***. https://doi.org/10.1093/oxfordhb/9780198733522.013.28.

Hall, K. L., Stokols, D., Stipelman, B. A., Vogel, A. L., Feng, A., et al. 2012. Assessing the value of team science: A study comparing center- and investigator-initiated grants. ***American Journal of Preventive Medicine***, 42(2): 157–163.

Hall, K. L., Vogel, A. L., Huang, G. C., Serrano, K. J., Rice, E. L., et al. 2018. The science of team science: A review of the empirical evidence and research gaps on collaboration in science. ***American Psychologist***, 73(4): 532–548.

Hargadon, A. B., & Bechky, B. A. 2006. When collections of creatives become creative collectives: A field study of problem solving at work. ***Organization Science***, 17(4): 484–500.

Harvey, S. 2014. Creative synthesis: Exploring the process of extraordinary group creativity. ***Academy of Management Review***, 39(3): 324–343.

Hinds, P., & Mortensen, M. 2005. Understanding conflict in geographically distributed teams: The moderating effects of shared identity, shared context, and spontaneous communication. ***Organization Science***, 16. https://doi.org/10.1287/orsc.1050.0122.

Hoever, I. J., Knippenberg, D., Ginkel, W. P., & Barkema, H. G. 2012. Fostering team creativity: Perspective taking as key to unlocking diversity's potential. ***Journal of Applied Psychology***, 97(5): 982–996.

Hollenbeck, J. R., Beersma, B., & Schouten, M. E. 2012. Beyond Team Types and Taxonomies: A Dimensional Scaling Conceptualization for Team Description. ***The Academy of Management Review***, 37(1): 82–106.

Jeong, S., & Choi, J. Y. 2015. Collaborative research for academic knowledge creation: How team characteristics, motivation, and processes influence research impact. ***Science & Public Policy***, 42: 460–473.

Kerrissey, M. J., Mayo, A. T., & Edmondson, A. C. 2021. Joint Problem-Solving Orientation in Fluid Cross-Boundary Teams. ***Academy of Management Discoveries***, 7(3): 381–405.

Lanaj, K., Hollenbeck, J. R., Ilgen, D. R., Barnes, C. M., & Harmon, S. J. 2013. The Double-Edged Sword of Decentralized Planning in Multiteam Systems. ***Academy of Management Journal***, 56(3): 735–757.

Lau, D. C., & Murnighan, J. K. 1998. Demographic diversity and faultlines: The compositional dynamics of organizational groups. ***Academy of Management Review***, 23(2): 325–340.

Leahey, E. 2016. From Sole Investigator to Team Scientist: Trends in the Practice and Study of Research Collaboration. ***Annual Review of Sociology***, 42(1): 81–100.

Lee, Y.-N., Walsh, J. P., & Wang, J. 2015. Creativity in scientific teams: Unpacking novelty and impact. ***Research Policy***, 44(3): 684–697.

Lungeanu, A., & Contractor, N. S. 2015. The Effects of Diversity and Network Ties on Innovations: The Emergence of a New Scientific Field. ***American Behavioral Scientist***, 59(5): 548–564.

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. 2002. A comparison of methods to test mediation and other intervening variable effects. ***Psychological Methods***, 7: 83–104.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. 2004. Confidence limits for the indirect effect: Distribution of the product and resampling methods. ***Multivariate Behavioral Research***, 39: 99–128.

Majchrzak, A., Jarvenpaa, S. L., & Bagherzadeh, M. 2015. A review of interorganizational collaboration dynamics. ***Journal of Management***, 41(5): 1338–1360.

Majchrzak, A., More, P. H. B., & Faraj, S. 2012. Transcending Knowledge Differences in Cross-Functional Teams. ***Organization Science***, 23(4): 951–970.

Mannix, E., & Neale, M. A. 2005. What differences make a difference? The promise and reality of diverse teams in organizations. ***Psychological Science in the Public Interest***, 6(2): 31–55.

Marrone, J. A. 2010. Team boundary spanning: A multilevel review of past research and proposals for the future. ***Journal of Management***, 36(4): 911–940.

Martins, L. L., Gilson, L. L., & Maynard, M. T. 2004. Virtual Teams: What Do We Know and Where Do We Go From Here? ***Journal of Management***, 30(6): 805–835.

Mathieu, J. E., Heffner, T. S., Goodwin, G. F., Salas, E., & Cannon-Bowers, J. A. 2000. The influence of shared mental models on team process and performance. ***Journal of Applied Psychology***, 85(2): 273.

Mathieu, J. E., Marks, M. A., & Zaccaro, S. J. 2001. Multi-team systems. In N. Anderson, D. Ones, H. K. Sinangil, & C. Viswesvaran (Eds.), ***International handbook of work and organizational psychology***: 289–313. London: Sage.

Maznevski, M. L., & Chudoba, K. M. 2000. Bridging space over time: Global virtual team dynamics and effectiveness. ***Organization Science***, 11(5): 473–492.

Meier, R. L. 1963. Communications overload: Proposals from the study of a university library. ***Administrative Science Quarterly***, 7(4): 521–544.

Misra, S., Stokols, D., & Cheng, L. 2015. The transdisciplinary orientation scale: Factor structure and relation to the integrative quality and scope of scientific publications. ***Journal of Translational Medicine and Epidemiology***, 3(2): 1042.

Myers, K. K., & Sadaghiani, K. 2010. Millennials in the workplace: A communication perspective on millennials' organizational relationships and performance. ***Journal of Business and Psychology***, 25: 225–238.

National Academy of Sciences, National Academy of Engineering, & Institute of Medicine. 2004. ***Facilitating Interdisciplinary Research***: 11153. Washington, D.C.: National Academies Press.

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

Okhuysen, G. A., & Bechky, B. A. 2009. Coordination in organizations: An integrative perspective. ***Academy of Management Annals***, 3(1): 463–502.

Okhuysen, G. A., & Eisenhardt, K. M. 2002. Integrating Knowledge in Groups: How Formal Interventions Enable Flexibility. ***Organization Science***, 13(4): 370–386.

Paulus, P. B., Kenworthy, J. B., & Marusich, L. R. 2021. Alone Versus Together: Finding the Right Balance for Creativity. ***The Handbook of Solitude: Psychological Perspectives on Social Isolation, Social Withdrawal, and Being Alone***: 268–279.

Paulus, P. B., Korde, R. M., Dickson, J. J., Carmeli, A., & Cohen-Meitar, R. 2015. Asynchronous Brainstorming in an Industrial Setting: Exploratory Studies. ***Human Factors: The Journal of the Human Factors and Ergonomics Society***, 57(6): 1076–1094.

Phillips, K. W. 2003. The Effects of Categorically Based Expectations on Minority Influence: The Importance of Congruence. ***Personality and Social Psychology Bulletin***, 29(1): 3–13.

Podolny, J. M., & Hansen, M. T. 2020. How Apple Is Organized for Innovation. ***Harvard Business Review***, 86-95.

Porck, J. P., Matta, F. K., Hollenbeck, J. R., Oh, J. K., Lanaj, K., et al. 2019. Social Identification in Multiteam Systems: The Role of Depletion and Task Complexity. ***Academy of Management Journal***, 62(4): 1137–1162.

Raghuram, S., Hill, N. S., Gibbs, J. L., & Maruping, L. M. 2019. Virtual Work: Bridging Research Clusters. ***Academy of Management Annals***, 13(1): 308–341.

Rink, F., & Ellemers, N. 2007. Diversity as a Basis for Shared Organizational Identity: The Norm Congruity Principle. ***British Journal of Management***, 18(s1): S17–S27.

Rosseel, Y. 2012. Lavaan: An R package for structural equation modeling and more. Version 0.5–12 (BETA. ***Journal of Statistical Software***, 48: 1–36.

Rosso, B. D. 2014. Creativity and Constraints: Exploring the Role of Constraints in the Creative Processes of Research and Development Teams. ***Organization Studies***, 35(4): 551–585.

Seidel, V. P., & O'Mahony, S. 2014. Managing the repertoire: Stories, metaphors, prototypes, and concept coherence in product innovation. ***Organization Science***, 25(3): 691–712.

Shaw, M. E., & Harkey, B. 1976. Some effects of congruency of member characteristics and group structure upon group behavior. ***Journal of Personality and Social Psychology***, 34(3): 412–418.

Shrum, W., Genuth, J., & Chompalov, I. 2008. ***Structures of scientific collaboration***. Cambridge: MIT Press.

Simonton, D. K. 1999. ***Origins of Genius: Darwinian Perspectives on Creativity***. Oxford University Press.

Staats, B. R., Milkman, K. L., & Fox, C. R. 2012. The team scaling fallacy: Underestimating the declining efficiency of larger teams. ***Organizational Behavior and Human Decision Processes***, 118(2): 132–142.

Stasser, G., & Taylor, L. A. 1991. Speaking turns in face-to-face discussions. ***Journal of Personality and Social Psychology***, 60(5): 675–684.

Staw, B. M. 1990. An evolutionary approach to creativity and innovation. ***Innovation and creativity at work: Psychological and organizational strategies***: 287–308. Oxford, England: John Wiley & Sons.

Stipelman, B. A., Hall, K. L., Zoss, A., Okamoto, J., Stokols, D., et al. 2014. Mapping the impact of transdisciplinary research: A visual comparison of investigator initiated and team based tobacco use research publications. ***Journal of Translational Medicine & Epidemiology***, 2: 10331–10337.

Stork, D., & Richards, W. D. 1992. Nonrespondents in Communication Network Studies: Problems and Possibilities. ***Group & Organization Management***, 17(2): 193–209.

Stvilia, B., Hinnant, C. C., Schindler, K., Worrall, A., Burnett, G., et al. 2011. Composition of scientific teams and publication productivity at a national science lab. ***Journal of the American Society for Information Science and Technology***, 62(2): 270–283.

Sud, P., & Thelwall, M. 2016. Not all international collaboration is beneficial: The Mendeley readership and citation impact of biochemical research collaboration. ***Journal of the Association for Information Science and Technology***, 67: 1849–1857.

Tsoukas, H. 2009. A dialogical approach to the creation of new knowledge in organizations. ***Organization Science***, 20(6): 941–957.

Tushman, M. L., & Nadler, D. A. 1978. Information processing as an integrating concept in organizational design. ***Academy of Management Review***, 3(3): 613–624.

van Knippenberg, D. 2017. Team innovation. ***Annual Review of Organizational Psychology and Organizational Behavior***, 4: 211–233.

van Knippenberg, D., Dreu, C. K., & Homan, A. C. 2004. Work group diversity and group performance: An integrative model and research agenda. ***Journal of Applied Psychology***, 89(6): 1008.

van Knippenberg, D., Ginkel, W. P., & Homan, A. C. 2013. Diversity mindsets and the performance of diverse teams. ***Organizational Behavior and Human Decision Processes***, 121(2): 183–193.

Vangrieken, K., Boon, A., Dochy, F., & Kyndt, E. 2017. Group, Team, or Something in Between? Conceptualising and Measuring Team Entitativity. ***Frontline Learning Research***, 5(4): 1–41.

Vasileiadou, E., & Vliegenthart, R. 2009. Research productivity in the era of internet revisited. ***Research Policy***, 38: 1260–1268.

West, M. A., & Farr, J. L. 1990. ***Innovation and Creativity at Work: Psychological and Organizational Strategies***. Chichester, UK: Wiley.

Wired Brand Lab. 2017. ***Pfizer: What it Takes***. https://www.wired.com/brandlab/2017/10/pfizer-fpo/#intr

TABLE 1 Descriptive Statistics for All Variables

	Mean	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Team Structure	0.52	0.50									
2. Entitativity (T1)	2.92	0.62	.49**								
3. Entitativity (T2)	2.99	0.57	.34**	.73**							
4. Cross-functional Comm. (T1)	0.23	0.19	.67**	.53**	.35**						
5. Cross-functional Comm. (T2)	0.26	0.18	.43**	.42**	.17*	.72**					
6. Functional Comm. (T1)	0.74	0.22	-.15	.10	.02	-.06	-.16				
7. Functional Comm. (T2)	0.78	0.19	.09	.15	.12	-.09	-.08	.87**			
8. Novelty	1.69	0.68	-.24	-.21	-.27*	-.15	-.21*	.22*	.06		
9. Implementability	3.19	1.07	.10	.11	.15	-.01	-.16	.25*	.34**	.10	
10. Synthesis	3.11	0.93	.04	-.11	-.06	-.07	-.25*	.22	.19	.32**	.30*

Note. Team structure coded 0 = differentiated team condition ($N = 31$) and 1 = integrated team condition ($N = 33$).

†$p < .10$

*$p < .05$

**$p < .01$

TABLE 2 Path Analysis Results for Effect of Team Structure on Cross-Functional Communication

	Cross-Functional Comm. (T1)			Cross-Functional Comm. (T2)		
Predictor	*b*	SE	*p*	*b*	SE	*p*
Team Structure	1.33**	.18	< .001	-.17	.21	.426
Cross-Functional Comm. (T1)				.78**	.10	< .001

Indirect Effect of Team Structure on Cross-Functional Comm. (T2): $b = 1.03$, SE = .18, $p < .001$, 95% CI = [.73, 1.43]

Note. Team structure coded 0 = differentiated team condition ($N = 31$) and 1 = integrated team condition ($N = 33$).
†$p < .10$
*$p < .05$
**$p < .01$

FIGURE 1 Effect of Team Structure on Cross-Functional Performance Outcomes via Cross-Functional Communication

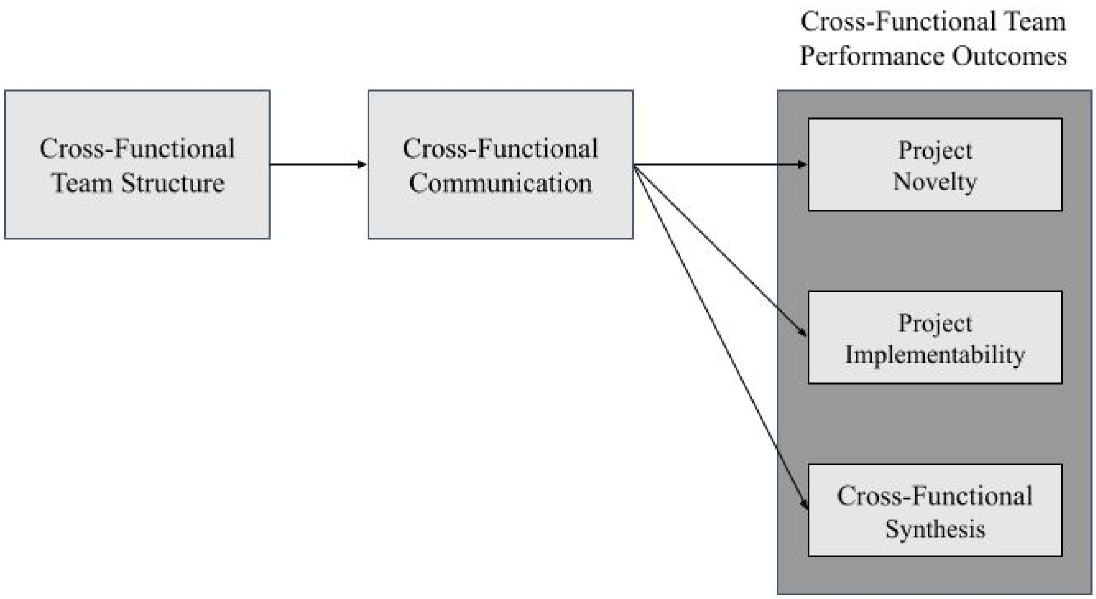
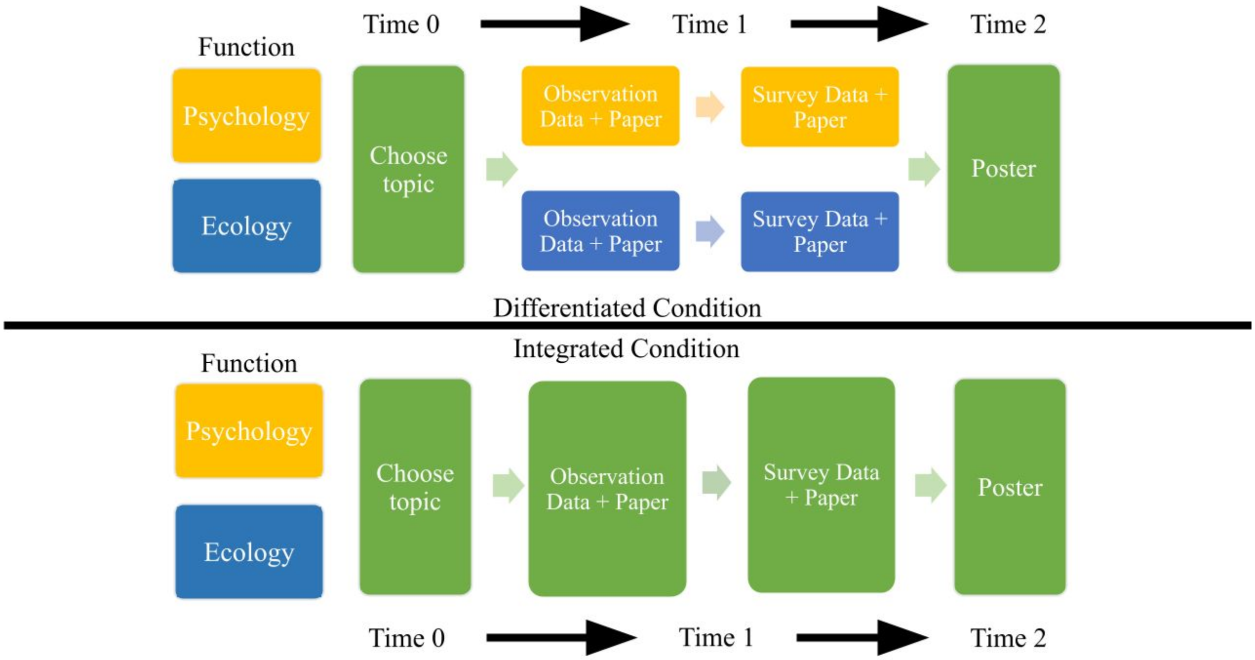
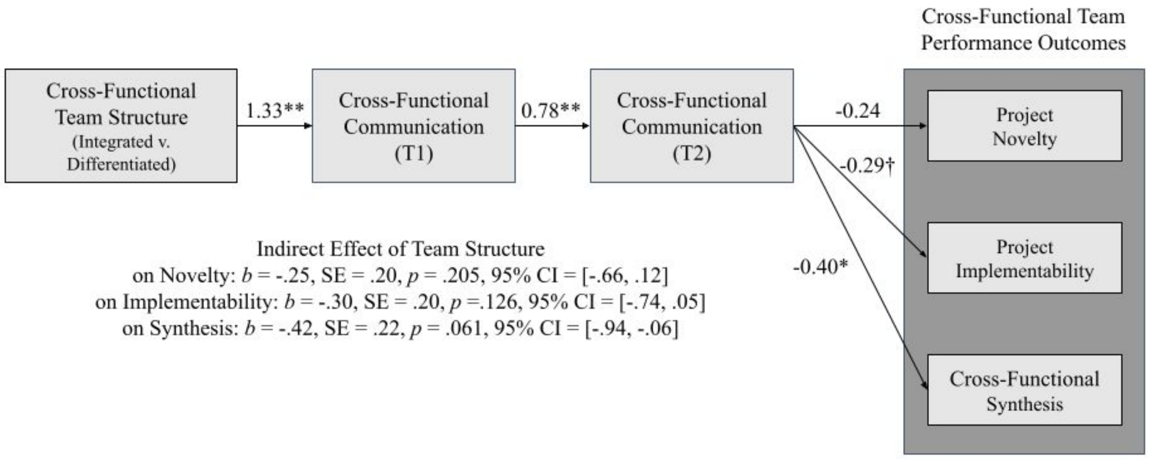


FIGURE 2 Detail of Team Structure Manipulation



Note. Differentiated team structure depicted above solid line; integrated team structure depicted below solid line. Green boxes represent periods of project in which teams were instructed to complete tasks together. Yellow/blue boxes represent periods of project in which teams were instructed to submit tasks as a single function.

FIGURE 3 Results of Path Analysis for Effect of Team Design on Novelty, Implementability, and Synthesis via Cross-Functional Communication



Note. Team structure coded 0 = differentiated team condition ($N = 31$) and 1 = integrated team condition ($N = 33$). Paths estimated but not pictured: direct effect of team structure on novelty ($b = -.26$, $p = .386$), implementability ($b = .51$, $p = .083$), and cross-functional synthesis ($b = .46$, $p = .074$), and the effect of functional communication on novelty ($b = .03$, $p = .809$), implementability ($b = .34$, $p = .003$), and cross-functional synthesis ($b = .18$, $p = .102$). Where paths are not explicitly estimated, variables were allowed to covary. Team structure coded 0 = differentiated team condition and 1 = integrated team condition.
†$p < .10$
*$p < .05$
**$p < .01$

Lindsay E. Larson (Lindsay_Larson@kenan-flagler.unc.edu) is a Postdoctoral Research Associate in Organizational Behavior at the Kenan-Flagler Business School at the University of North Carolina, Chapel Hill. She earned her Ph.D. in Media, Technology, & Society from Northwestern University. Her research interests include team effectiveness, leadership, and the future of teamwork.

Alexandra M. Harris-Watson (amharriswatson@ou.edu) is an Assistant Professor of Industrial/Organizational Psychology at the University of Oklahoma. She earned her Ph.D. in industrial/organizational psychology from the University of Georgia. Her research focuses on the role of individual differences, including personality and intelligence, at work.

Dorothy R. Carter (dcarter3@msu.edu) is an Associate Professor of Organizational Psychology at Michigan State University. She earned her Ph.D. in Organizational Psychology from Georgia Institute of Technology. Her research focuses on team and multiteam system functioning and effectiveness, innovation, leadership dynamics, and networks.

Raquel Asencio (rqlasencio@gmail.com) is a Visiting Research Fellow at the Social Science Research Institute (SSRI) at Duke University. She earned her Ph.D. in Organizational Psychology from Georgia Institute of Technology. Her research focuses on understanding how teams and individuals effectively operate and innovate.

Leslie A. DeChurch (dechurch@northwestern.edu) is Professor of Communication Studies and Professor of Psychology (by courtesy) at Northwestern University. She earned her Ph.D. in Industrial & Organizational Psychology. Her research interests include team effectiveness, leadership, multiteam systems, and human-AI collaboration.

Ruth Kanfer (rkanfer@gatech.edu) is a Professor of Industrial/Organizational Psychology at Georgia Institute of Technology. She earned her Ph.D. in Psychology from Arizona State University. Her research studies adult learning, motivation, and development related to workers and their careers.

Stephen J. Zaccaro (szaccaro@gmu.edu) is a Professor of Industrial-Organizational Psychology at George Mason University. He earned his Ph.D. in Psychology from the University of Connecticut. His research investigates organizational leadership, group dynamics, multiteam systems, team performance, and work attitudes.