BALANCING THE INTERNAL AND EXTERNAL SOCIAL CAPITAL

OF DIVERSE R&D TEAMS

by

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ABSTRACT OF THE DISSERTATION

Balancing the Internal and External Social Capital of Diverse R&D Teams

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Using a sample of 58 science laboratory teams, this paper explores the impact of

team demographic and informational diversity on team performance through the

mediation of internal and external social capital in R&D teams. Diversity research has

failed to find consistent results about the relationship between team diversity and

performance. I argue that the mixed empirical results may be caused by the complex

dynamics of internal and external networks in teams. Diverse teams may decrease team

performance through reduced internal social capital and may increase team performance

through increased external social capital. Therefore, the effects of team diversity on

performance may be dependent on the extent to which the diversity impact on

performance via external social capital (network size, social and job-related relationship,

and network diversity) is higher than via internal social capital (social cohesion, job-

related cohesion, trust, and cooperative norms). In addition, the effects of task

characteristics (task interdependence and task routineness) on the relationships among

social capital, diversity, and team performance were explored. Results showed that

demographic diversity decreased internal social capital whereas informational diversity

increased internal social capital. Both internal and external social capital increased team

performance. Ethnicity/nationality diversity decreased team performance via reduced internal social capital and increased external social capital. The potential moderating effects of task characteristics were examined also. The moderating effects of task interdependence did not always show consistent patterns. However, for teams that performed non-routine tasks, I found stronger relationships between diversity and internal and external social capital compared to teams that performed routine tasks. In addition, for teams that performed non-routine tasks, I found stronger relationships between job-related internal and external social capital and team performance, compared to teams that performed routine tasks.

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INTRODUCTION

Research Background

Performance in R&D teams may be increased by facilitating the transfer of diverse and innovative knowledge and information (Hirst & Mann, 2004). In the context of highly competitive markets, globalization, and rapidly advancing technology, knowledge and information are core resources and capabilities for ensuring a firm's survival and competitive advantages (DeNisi, Hitt, & Jackson, 2003). Thus, facilitating the transfer of knowledge and information in R&D teams can contribute to the enhancement of firm performance by achieving technological advancement, knowledge creation, and new product development.

A great deal of research on R&D teams has pointed out the importance of social and technical communications, interpersonal relationships, and research collaboration within as well as outside the teams to enhance overall R&D team performance (Dailey, 1978; Keller, Julian, & Kedia 1996; Pirola-Merlo, Hartel, Mann, & Hirst, 2002; Van den Bulte, & Moenaert, 1998). R&D teams may acquire knowledge and information by utilizing internal and external networks, which provide access to social capital. *Social capital* is defined as the sum of the actual and potential resources embedded within the network of social and job-related relationships possessed by a social unit. Social capital may be one of the critical resources needed to facilitate the acquisition and transfer of knowledge and information in organizations (Nahapiet & Ghoshal, 1998)—especially those in which managing R&D teams that consist of knowledge workers such as scientists and engineers is critical for organizational success.

Organizations are faced with another challenge in order to manage R&D teams effectively: how to take advantage of demographic and informational diversity. Previous research has indicated that demographic diversity and informational diversity are antecedents of team performance and social capital (Jackson, Joshi, & Erhardt, 2003; Reagans & Zuckerman, 2001; Reagans, Zuckerman, & McEvily, 2004). R&D teams may facilitate the transfer of knowledge and information by increasing *informational diversity*, which refers to the diversity of knowledge, skills, and experiences related to tasks and jobs and *demographic diversity*, which refers to the diversity of demographic attributes.

Diversity has become a critical issue in organizations because of the dramatically changing demographic composition in U.S. workplaces during the last decades. According to a Bureau of Labor Statistics (BLS 2002-12) labor force projection, the proportion of non-White people in the labor force is expected to increase from 16.8% to 19.7%. The proportion of females is expected to increase from 46.6% to 47.5% by 2012. In particular, the proportions of female, minority, and foreign scientists in the R&D workforce in the U.S. have surged. More than one-fourth of 1997-2001 recipients of doctoral degrees in engineering and science are neither U.S. citizens nor permanent residents (National Science Foundation, 2004). The proportion of non-White (about 33%) scientists and engineers who earned doctoral degrees has doubled in the past 25 years, as has the proportion of female scientists and engineers (about 33%) (National Science Foundation, 2004). In the near future, people of color and women will outnumber White men in the science and engineering workforce. Due to the rapidly growing number of scientists and engineers from diverse backgrounds, managing demographic diversity and coping with cultural issues have become pressing issues for R&D teams in organizations.

Team task characteristics may also be related to team information-processing (Arrow, McGrath, & Berdahl, 2000; Gladstein, 1984). Two task characteristics that are likely to influence the interaction among R&D team members are task interdependence and task non-routineness. *Task interdependence* refers to the extent to which team tasks are interrelated among team members (Saavedra, Earley, & Van Dyne, 1993). *Task non-routineness* refers to the degree of variability, uncertainty, and complexity of tasks (Jehn, 1995). Because task interdependence and task non-routineness may control and regulate employee behaviors to transfer and exchange information (Gladstein, 1984), it may capture the dynamics of intra- and interteam relations. Thus, task characteristics may influence team behaviors as well as the usefulness of internal and external social capital.

For those reasons, I argue that informational and demographic diversity, social capital, task interdependence, and task routineness all shape the information-processing, group dynamics, and overall performance of R&D teams. Therefore, this thesis explores the link of demographic and informational diversity and social capital to team performance in R&D teams and it considers task interdependence and task routineness as possible moderators of the relationships among diversity, social capital, and R&D team performance.

The Relationships among Diversity, Social Capital, and Team Performance

Research on diversity has proposed two contradictory views about the effects of work team diversity: an optimistic view and a pessimistic view. Drawing on social identity theory (Ashforth & Mael, 1989), the similarity-attraction paradigm (Byrne, 1971), and self-categorization theory (Turner, 1987), the pessimistic view asserts that team diversity reduces team performance due to the increased conflict and strains that

occur among team members. On the contrary, the optimistic view argues that team diversity can improve team performance through the expansion of creative and innovative ideas.

Empirical research has found mixed effects of diversity on performance and affective outcomes (for a review, Jackson et al., 2003; Milliken & Martins, 1996). Demographic diversity in terms of gender, ethnicity, and age does not significantly predict team social integration (Harrison, Price, Gavin, & Florey, 2002; O'Reilly, Caldwell, & Barnett, 1989). However, some studies have found that age diversity significantly increased turnover (Jackson, Brett, Sessa, Cooper, Julin, & Peyronnin, 1991; Wiersema & Bird, 1993) and ethnic diversity significantly reduced performance (Leonard, Levine, & Joshi, 2004). Timmerman (2000) found that the effect of ethnic diversity on team performance was either significantly negative or non-significant according to the level of task requirements. Jehn, Northcraft, and Neale (1999) reported that sex, age, educational and functional diversity significantly increased team performance. The conflicting results may be caused by the lack of the systematic examination of the 'black box' between diversity and team performance.

The black box can be better understood by clarifying how internal and external social capital mediates the relationship between team diversity and team performance. The pessimistic view on diversity implies that team diversity may reduce *internal social capital* (social and job-related interactions, trust, and cooperative norms "within" teams), because team diversity hinders the coordination and exchange of actions through reduced trust and collectivity (Coleman, 1988).

The optimistic view, however, implies that available knowledge, skills, and

information within teams may be increased through the *external social capital* (networks with people "outside" of the team) that diverse team members bring into the team (Burt, 1997; Reagans & Zuckerman, 2001; Reagans et al., 2004). Heterogeneous team members bridge structural holes between internal members and external members, and thereby enhance the team's capacity for creative actions (Burt, 1997). Therefore, the optimistic view suggests that the benefits of plentiful information from a diverse team's external networking may be higher than the costs of discord and conflict among team members. Even though external social capital would be a critical mediator that explains the optimistic views on diversity, most research examining the black box has not examined external team networking. Furthermore, diversity studies including external communication have assessed only overall external communication frequencies (for example, Ancona & Caldwell, 1992; Keller, 2001). External communication frequencies may provide meaningful information to explain boundary-spanning activities, but they are related only to the quantity, not the "pattern" and "quality" of a team member's external networking. Therefore, external social capital may be a more precise approach to measure team external networking.

Drawing on both optimistic and pessimistic views, one discovers that team diversity may not always influence team performance in a uni-directional way because of the opposite relationships between the diversity-internal social capital link and the diversity-external social capital link. Although there is the tradeoff relationship between the diversity-internal social capital link and the diversity-external social capital link, prior research has focused on either the impact of diversity on internal dynamics or the impact of diversity on boundary-spanning activities. To my knowledge, there is only one study

that explored the impact of diversity on team performance through the mediation of both internal and external networks. Reagans et al. (2004) argued that inconsistent findings of the impact of diversity on team performance may be caused by the opposite effects of diversity on internal social networks and external social networks. Reagans et al. (2004) contributed to the diversity and team social capital literature by showing that the impact of functional and tenure diversity on team performance was non-significant. This is because the *negative* influence of diversity on team performance through the mediation of internal social network density is equal to the *positive* influence of diversity on team performance through the mediation of external social network range.

In this paper, I extend the model of Reagans and colleagues. Firstly, I examine both informational (tenure, status, education, and areas of specialty) and demographic diversity (ethnicity/nationality, gender, and age), whereas Reagans and colleagues included only tenure and functional diversity. Secondly, whereas Reagans and colleagues examined internal network density and external network range, this study includes other aspects of internal and external social capital. Internal social network density would not be enough to capture internal social capital. External social capital cannot be perfectly encapsulated as external social network range. Particularly, since people develop their networks based on their social relationships as well as job/work relationships, considering those relationships together may increase the likelihood of capturing a comprehensive picture of relationships in the networks. Accordingly, unlike Reagans et al. (2004), this study included several dimensions of external social capital, including network diversity in terms of gender, ethnicity, level, and function, social and job-related network size, and social and job-related tie strength. Drawing on Coleman's (1988) network closure

perspective, this study clarifies the dimensions of internal social capital by including social and job-related density, trust density, and cooperative norms.

The Impact of Task Characteristics

Lastly, this study extends Reagans et al. (2004) by considering how networking patterns are influenced by task characteristics. Task characteristics, including task interdependence and task non-routineness, may influence the team's capacity for exchanging and acquiring task-relevant information and resources (Gladstein, 1984). If task characteristics require team members to interact with one another and seek task-related information and knowledge, social capital may reduce friction among diverse team members and may be useful for enhancing team performance. Teams may be more motivated to acquire internal and external social capital to obtain knowledge and information when tasks are highly interdependent and complex. In addition, internal and external social capital is more valuable when team members are obliged to work together than when team members do not need to interact with one another. However, diversity research typically has not considered task requirements and the amount of information-processing due to the task requirements (Van Knippenberg, De Dreu & Homan, 2004). Therefore, this study seeks to contribute to research on diversity and social capital by examining how task characteristics influence the relationship among diversity, social capital, and team performance.

The nature of team tasks such as *task interdependence* (the extent to which team task requirements are interconnected among team members) and *task non-routineness* (the degree of variability and uncertainty of tasks) determine the team's capacity for exchanging and acquiring task-relevant information and resources (Gladstein, 1984).

Teams may be more motivated to acquire social capital and to obtain knowledge and information when team tasks are highly interdependent and complex.

To summarize, this study contributes to the current research on diversity and social capital in several ways. First, it examines the black box between diversity and team performance. Specifically, it posits internal and external social capital as pivotal mediators through which diversity influences performance. Second, this study will clarify why no consistent uni-directional relationship between diversity and team performance has been found in prior studies. Drawing on Reagans et al. (2004)'s argument, this study empirically examines the conflicting effects of diversity. However, this study does not merely replicate Reagans et al. (2004)'s study. By more thoroughly investigating diversity and social capital, this study extends and refines Reagans et al. (2004): it includes both informational and demographic diversity, as well as the diverse aspects of internal and external social capital that Reagans et al. (2004) did not investigate. Third, this study highlights the significant role of task interdependence and task routineness/non-routineness on team internal and external networking. Investigating the task characteristics' impact on the relationships among diversity, social capital, and team performance is a unique contribution to the current research on diversity and team social capital. Fourth, this study contributes to research on team social capital. Previous studies of social capital and social networks have focused on either organizational social capital or individual social capital. This study is one of a few studies to examine team-level social capital. Last, this study examines both internal and external social capital in order to better capture the complete flow of information and knowledge.

WHAT IS TEAM SOCIAL CAPITAL?

Numerous definitions of social capital have been offered (for a review, Adler & Kwon, 2002). However, scholars have agreed that the sources of social capital lie in the structure of social networks and that the content and quality of social ties may determine social capital. Social capital is derived from the structure and content of interpersonal relationships, through which resources become available to a social unit. In the previous literature, however, social capital has often been treated as an individual-level resource rather than as a group-level resource. A large body of literature on social capital (or social networks) has examined how individuals (or individual firms) form and utilize social networks and acquire benefits (and costs) from their social relations (for an example, Morrison, 2002). However, team-level social capital has not been rigorously examined.

Team social capital can be derived from social relations between team members within a team and/or it can be embedded in social relations between team members and people outside of the team's formal boundary. In this paper, *team internal social capital* is defined as the social resources available due to the structure and quality of interpersonal relations among team members; *team external social capital* is defined as the social resources available due to the structure and quality of interpersonal relations between members of the focal team and those outside the team.

Prior research has argued that both forms of social capital are critical predictors of team performance (Katz, Lazer, Arrow, & Contractor, 2004; Oh, Chung, & Labianca, 2004). Internal social capital increases team performance through enhanced interpersonal relations and communication (bonding view) and external social capital improves team performance by improving the team's access to external information and resources

(bridging view). Drawing on previous theoretical and empirical findings, I argue that the bridging view may provide theoretical arguments to explain the benefits of external social capital, whereas the bonding view may provide theoretical arguments to explain the benefits of internal social capital.

Theoretical Background

There are ongoing debates with regard to what forms of network structures and relationships are likely to be most effective to increase team performance. Two distinct views on social capital are available in the current literature: a bridging view and a bonding view (Adler & Kwon, 2002; Gargiulo & Benassi, 2000; Watson & Papamarcos, 2002). Both views emphasize the importance of the social linkages among actors in systems and both acknowledge the potential benefits and costs of different network structures.

Bonding view. The bonding view is based on Coleman's *network closure perspective*. Coleman (1988) introduced the concept of social capital and argued that the development social capital can be facilitated by two factors: the closure of social networks and appropriable social organization. The closure of social networks refers to a network structure that all actors, discrete individuals that link to others in a network (Kilduff & Tsai, 2003), closely interact with and communicate with one another. The network closure is operationalized as *network density*. In a social unit with high network density, interpersonal interactions are not concentrated on only a few actors, but are spread over all actors. Benefits through the closure of social networks belong to all actors in a social unit rather than only to some actors, because some actors are not singled out from other actors in the social unit. Another characteristic of social capital is

appropriation of social networks, which means that once social networks are created for one purpose, they can be used for other purposes. Coleman argued that when the social network for one purpose (e.g. socialization among team members) is used for other purposes (e.g. the transfer of job-related knowledge and information) social capital is increased.

Network closure may facilitate the formation and development of social capital (Coleman, 1988). Because actors in a social unit characterized by network closure are strongly interconnected, they are unlikely to hide resources and information. The closure of social networks allows actors to monitor and guide the behaviors of one another and develop a collective norm of cooperation. The network closure may help actors build trust because it makes actors feel less risky about trusting and sharing information. Therefore, network closure shapes a trustworthy environment in that no one in the social unit will betray another person in the same unit. The trustworthiness of the social environment may allow actors to anticipate that their favors will be repaid in the future and so will be obliged to repay others' favors (Coleman, 1988). Since it is difficult for actors to escape from their obligations, trust between actors may be quite durable. In general, the bonding view has been used to emphasize the importance of actors' collectivity in social units such as groups and organizations because it emphasizes the benefits of strong interpersonal relationships within a formal or informal boundary.

Bridging view. The bridging view highlights some focal individuals (e.g. team managers), teams, or firms' relative success in terms of acquiring social networks over competitors. The bridging view focuses on the benefits of external networks. The bridging view of social capital is based on *structural hole theory* (Burt, 1992, 1997).

Structural hole theory is an opposing view to Coleman's network closure perspective.

Burt (1992) argued that network closure is inefficient to acquire information and knowledge, because contacts in a closed network are redundant. Network closure may lead to the formation of redundant ties within teams, which may result in team members having same sources of information. In contrast, team members who have non-redundant ties (in a network with rich structural holes) can get a higher volume of information and knowledge and use their time for making networks more efficiently. Redundancy in a social network can be measured as cohesive contacts and structurally equivalent contacts. Cohesive contacts mean that all team members have strong ties that are likely to have access to the same information. Structurally equivalent contacts mean that all actors in a social network are linked to the same third parties, which provides actors the same sources of information (Burt, 1992). Actors in a closed network spend more time than is necessary to access information, because highly cohesive and structurally equivalent contacts have actors repeatedly access the same information.

In sum, structural hole theory (Burt, 1992, 1997) has often been employed to explain the benefits of external social capital or external social networks. It emphasizes the cost of networks that are decentralized, small, and homophilious and the benefit of centralized, large, and diverse social networks. Supporters of structural hole theory argue that because a team develops a strong shared view in a dense network, team members may be unwilling to accept new and diverse perspectives (Burt, 1992; Ibarra, 1992). However, if actors have contacts with many people beyond a social unit boundary, they may have more opportunity to acquire a larger volume of resources and knowledge and learn new perspectives. Accordingly, actors do not need to make cohesive and structurally

equivalent contacts to get access to information. Instead, actors may gain diverse information and knowledge through social networks that can connect between two or more social units.

Researchers supporting the network closure perspective highlight the benefits of strong interpersonal relationships in decentralized and dense social networks. Increased collectivity in the team can prevent some focal team members from exclusively possessing information. In addition, network closure may improve the efficiency of information and knowledge sharing, because in the trustworthy environment team members can spend less time monitoring others' behaviors and coordinating work.

This study employs the network closure perspective to predict the effects of team internal social capital and the structural hole theory to explain the effect of team external social capital.

Team Internal Social Capital and Performance

The network closure perspective suggests that if team members are psychologically intimate and trust each other, they expect to receive and are obliged to repay others' favors. In addition, the trustworthy environment caused by network closure may facilitate the formation of a cooperative norm. Although they did not examine networks within a team, previous studies of teams have shown the positive impact of team cohesiveness, norms, trust, and communication on performance (for instance, Campion, Medsker, & Higgs, 1993; Mullen & Copper, 1994). In addition, previous research on group networks has found that social network density within teams increased team performance (Oh et al., 2004; Reagans & Zuckerman, 2001; Reagans et al., 2004; Rulke & Galaskiewicz, 2000). The results of the previous studies imply that network

closure "within teams" is beneficial to increase team performance and effectiveness.

Drawing on Coleman (1988)'s network closure perspective, I argue that internal social capital is comprised of (1) social and job-related network cohesion, (2) cooperative norms, and (3) density of trust within a team. These three dimensions of internal social capital are not mutually exclusive; they are positively associated with one another.

Social and job-related cohesion. Social cohesion refers to the density of social ties between team members and represents the degree to which team members have interpersonal relationships based on their social activities. *Job-related cohesion* refers to the density of job-related ties between team members and represents the degree to which team members have interpersonal relationships based on their job activities. According to the appropriation of social networks, a characteristic of network closure, social networks created for one purpose (e.g. social-related ties) can be utilized for other purposes (e.g. job-related ties). Since some team members interact with each other when they perform their job or tasks and also become socially close, social and job-related ties sometimes overlap and help build stronger relationships. For example, team members A and B, who are working closely on a task (high job-related ties), may develop a close social relationship as a result. Also, team members A and B, who are frequently going out for lunch (high social-related ties), may help each other perform jobs and make strong job-related ties.

Both social and job-related cohesion may improve team performance. If team members frequently communicate with each other about task-related issues, they are more likely to achieve job-related goals and so team performance may increase. Thus, close social relationships between team members may help establish positive work

relationships and reduce conflict. Prior research on team networks has found that social network density within teams positively predicts team performance. Rulke and Galaskiewicz (2000) found that MBA game teams with decentralized social networks performed better than teams with centralized social networks. Reagans and Zuckerman (2001) found that R&D teams high in network density outperform teams low in network density. Sparrowe, Liden, Wayne, and Kraimer (2001) showed that the density of hindrance networks (networks in which people are not willing to share resources and information) reduced team performance. Using the data of MBA student teams, Baldwin, Bedell, and Johnson (1997) found that within-team communication and friendship improved team members' perceived team performance. Reagans et al. (2004) found that the density of internal networks significantly reduced the duration of completing projects in project teams. Oh et al. (2004) found that the density of informal socializing relationships was positively associated with team performance. Therefore, I propose the following hypothesis:

H1a: Social and job-related cohesion will be positively associated with team performance.

Cooperative norms. Group norms refer to shared standards or ideas in the minds of group members under which behaviors and attitudes are socially regulated and expected (Birenbaum & Sagarin, 1976; Homans, 1950). Norms serve to judge the appropriateness of behaviors and function as controlling interactions within groups (Birenbaum & Sagarin, 1976; O'Reilly III & Caldwell, 1985). Norms also exert social influence on group members to conform to group central behaviors and attitudes and to perceive homogeneous values (O'Reilly III & Caldwell, 1985).

Cooperative group norms, defined as those group norms supporting cooperation, may cause group members to put importance on mutual interests and objectives rather than individual interests and pursuits (Chatman & Flynn, 2001). Network closure may create and facilitate the development and effectiveness of cooperative group norms. When all team members are closely interconnected (i.e. network closure), they may put social pressure on each other to obey shared norms for cooperative attitudes and behaviors.

It can be demonstrated that cooperative norms may increase team performance. Nahapiet and Ghoshal (1998) argued that norms supporting cooperation exert a significant influence on the exchange of knowledge and motivation to engage in such exchanges, which subsequently increases performance. Chatman & Flynn (2001) found the positive effect of cooperative norms on team effectiveness and efficiency. Therefore, I propose the following hypothesis:

H1b: Norms for cooperation will be positively associated with team performance.

Trust. The third dimension of internal social capital is trust. To measure trust that reflects network closure within teams, it must be operationalized as the density of trust. Mayer, Davis, and Schoorman defined *trust* as "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trust, irrespective of the ability to monitor or control that other party" (1995: 712). When they trust one another, team members are willing to take risks on their colleagues' opportunistic behaviors (Williams, 2001). Hence, a substantial body of literature addresses the fact that that trust may increase cooperative behaviors (Mayer et al., 1995; Jones & George, 1998; Nahapiet & Ghoshal, 1998).

Trust among team members may be reinforced by social and job-related cohesion. Through interpersonal interactions among team members, a team member may build up the belief that his or her team members will not take advantage of him or her. Trust allows team members to expect social and economic exchange (conditional trust) and/or to perceive shared values and positive mood and emotions (unconditional trust) (Jones & George, 1998). Such expectations and positive affective states promote social/job interactions that may enhance teamwork and cooperation (Jones & George, 1998; Williams, 2001). Recognizing that the three forms of internal social capital - social and job-related cohesion, cooperative norms, and trust density - are positively related to each other, I propose the following hypothesis:

H1c: Trust will be positively associated with team performance.

Team External Social Capital and Performance

Teams are seldom isolated from their larger organizational context. Usually, team members perform a variety of activities and tasks in collaboration with external team members. In addition, teams should learn and understand other parts of the organization and should have managers who know the teams' activities, tasks, and accomplishments (Ancona & Caldwell, 1992). A large body of research on social capital and social networks has addressed a variety of benefits of external social capital. External social capital may facilitate knowledge sharing and transfer (Hansen, 1999, 2002; Tsai, 2002), reduce interunit conflicts (Nelson, 1989), increase resource exchange and combination (Tsai & Ghoshal, 1998), and make task coordination easier (Gargiulo & Benassi, 2000). External social networks have a crucial role to play in knowledge and information transfer and acquisition and may promote team organizational performance (Katz, Lazer,

Arrow, & Contractor, 2004; Oh et al. 2004; Reagans & McEvily, 2003; Reagans et al. 2004; Thompson, 2004).

Highlighting the bridging role of social networks, prior research has examined several aspects of external social capital including network centrality, network size, network diversity, and external tie strength. To measure network centrality in R&D teams, one should be able to find all actors in an organization. Since it is impossible to identify all actors in an organization and to ask all respondents to answer about their relationships with all other actors in an organization, it is not possible to include network centrality here. Therefore, for the purposes of this paper, team external social capital consists of (1) size, (2) the strength of social and job-related relationship, and (3) level, specialty (or major), and demographic (gender and ethnicity) diversity of external informational networks. Previous studies have suggested that there are a number of different external networks such as communication, advice, support, influence, friendship, customer, and hindrance (Ibarra, 1992; Mehra, Kilduff, & Brass, 1998; Sparrowe et al., 2001; Yli-Renko, Autio, & Sapienza, 2001). In this paper, I measure informational networks because getting information and knowledge through external networks would most contribute to the enhancement of R&D team performance and would be most relevant to job activities of R&D teams. Furthermore, social and job-related relationships of informational networks would reflect friendship and advice networks.

Network size. Prior research showed that bigger external networks of managers and teams enhanced team performance (for example, Gargiulo & Benassi, 2000; Sparrowe et al., 2001). Vigorous boundary-spanning activities (e.g. external

communication) may be critical factors for promoting team performance (Ancona & Caldwell, 1992; Keller, 2001). The volume of resources and information available in the team may be greater when team members have access to more people outside of a team. Therefore, the size of informational networks in the team - in operational terms, the number of informational ties of team members with people outside the team in the organization - can have a positive influence on team performance.

H2a: The size of external informational networks will be positively related to team performance.

The strength of social and job-related relationships. The strength of social and job-related relationships in external informational networks may increase team performance. If team members have strong job-related relationships with external members, they may get critical information easily for performing jobs effectively. In addition, strong social and job-related relationships make interteam collaboration and coordination easier. Strong relationships with people outside the team can allow team members to save time in acquiring new knowledge and information because they do not need to spend extra time locating where they can find and learn critical information.

Strong relationships, in particular, are useful for acquiring tacit and complex knowledge. There are debates on the different effects of weak and strong ties on performance. Drawing on Granovetter (1973)'s weak tie argument, some scholars suggest that distant and infrequent contacts are more efficient for searching and sharing new knowledge and information (Hansen, 1999). Strong ties may encourage actors to spend a substantial proportion of time helping others and may then impede an actor's ability to accept new projects. However, in order to obtain and transfer knowledge and information,

people in a network must be motivated to and must have enough ability to share their knowledge (Hansen, 1999; Adler & Kwon, 2002). If actors do not have close and strong interpersonal relationships with each other, they may not be willing to share critical information, especially in competitive environments. Since strong ties between teams may decrease interteam conflicts (Labianca, Brass, & Gray, 1998; Nelson, 1989), they may reduce the likelihood of performance problems. Seibert, Kraimer, and Liden (2001) found that weak ties reduce career sponsorship and access to information. Existing research has found that strong ties are more useful for searching and sharing knowledge and information (Hansen, 1999, 2002; Reagans & McEvily, 2003; Tsai, 2002; Tsai & Ghoshal, 1998). Hansen (1999, 2002) also found that strong and direct interunit ties facilitate the transfer of complex and non-codifiable knowledge but impede the transfer of simple and codifiable knowledge. Therefore, although weak ties can bring their own benefits, they may pose problems to the transfer of information and knowledge, particularly in areas of non-codified, complex, and high volume knowledge and information. Therefore, I propose the following hypothesis:

H2b: The strength of social and job-related relationships in external informational networks will be positively related to team performance.

Network diversity. Informational networks with people outside a team who are working in a variety of levels and specialties, and who have different demographic backgrounds, may enhance team performance. The *diversity* of social networks increases team performance because it may allow team members to acquire diverse knowledge and information. On the contrary, homogeneous networks may not contribute to the improvement of team performance since team members may be able to repeatedly

acquire similar resources and views. Teams can gain feedback, information, and resources through vertical networking activities (networking with people in other levels). In addition, they can acquire various perspectives and information through horizontal networking activities (networking with people in different specialties and demographic background) (Joshi, 2006). Hence, the diversity of informational networks in terms of level, specialty, and demographics may contribute to the enhancement of team performance. Therefore, I propose the following hypothesis:

H2c: The level, specialty, and demographic diversity of external informational networks will be positively related to team performance.

THE EFFECTS OF TEAM DIVERSITY ON INTERNAL SOCIAL CAPITAL

Team diversity may be an important antecedent of team internal social capital. Research on diversity has long offered theoretical and empirical evidence with regard to the relationship between team diversity and interpersonal relationships within team (for example, O'Reilly, Caldwell, & Barnett, 1989). According to the similarity-attraction paradigm (Byrne, 1971), social identity theory (Ashforth & Mael, 1989), and self-categorization theory (Turner, 1987), team members perceive identities based on individual attributes and feel more attracted toward other team members who belong to the same social groups. People categorize others into in-groups and into out-groups based on individual attributes such as demographics, education, tenure, functional backgrounds, and value. Through intergroup comparisons, they develop positive social identity for in-groups (Ashforth & Mael, 1989). Therefore, team heterogeneity may reduce social and job-related interactions, trust among team members, and cooperative norms within teams.

Research on homophilious networks and social psychology suggests that the similarity of attributes between people can make communication easier, facilitate the formation of trust, and ease the predictability of behaviors and attitudes (Brass, 1995; Ibarra, 1992; McPherson, Smith-Lovin, & Cook, 2001; Riordan, 2000).

There are several aspects of diversity. Jackson, May, and Whitney (1995) and Milliken and Martins (1996) categorized types of diversity as readily detectable attributes and underlying attributes. Readily detectable attributes refer to individual attributes that can be quickly determined by only a brief exposure to a target person and include demographic attributes (e.g. gender, ethnicity, nationality, age) and informational attributes (e.g. tenure, and education). Underlying attributes refer to individual attributes

that are recognized only after a target person becomes well acquainted and include social status, KSAs, values, and personalities. Although research on diversity has found that the diversity of underlying attributes such as personality and value may affect interpersonal relations (Harrison, Price, & Bell, 1998; Harrison et al., 2002; Jehn et al., 1999), this study focuses on readily detectable attributes. Since people from distinct backgrounds may behave differently and perceive different cultural values, demographic and informational attributes may capture the different effects of the underlying attributes. This section provides theoretical explanations about the impact of team demographic and informational diversity on internal social capital.

The Effect of Demographic Diversity on Internal Social Capital

Social identity theory, self-categorization theory, and similarity-attraction theory have been popularly used to understand and predict the pessimistic views of the effect of demographic diversity. The pessimistic view asserts that demographic diversity reduces team performance due to the increased conflicts and strains among team members.

Social identity theory. The social identity theory argues that social identity is shaped from relative and comparative group memberships, because a group (e.g., women) of a social category is meaningful only if there is another group (e.g., men) (Ashforth & Mael, 1989, p. 21). People categorize similar others into an in-group and others who have different attributes into the out-groups. Through the intergroup comparison, they develop positive social identity for in-groups, which may build in-group bias and intergroup inequality. In-group bias causes group members to regard their own group as superior to other groups (in-group favoritism) (Brown, 2000). Ethnic, gender, age, and nationality identification - specific forms of social identification – may

occur when people find themselves embedded in their social groups based on ethnicity, gender, age, and nationality. If people have positive racial, gender, age, and nationality identity, they may favor in-group members (e.g. whites, men) over out-group members (e.g. Hispanic, women).

Similarity-attraction paradigm. Drawing on the psychological principle that interpersonal attraction is generated by similar attributes (Byrne, 1971), a great deal of research on organizational demography has used the similarity-attraction paradigm as a theoretical background (Tsui, Egan, & O'Reilly, 1992). If people have similar attitudes (physical, social, and status traits) with other team members, they tend to have greater attraction among team members. However, if people do not have common attributes with other team members, they may conflict and have no cooperation. Because demographic similarity may lead to perceived similarity in attitudes and values, it is likely to affect interpersonal attractions between team members.

Using the similarity-attraction paradigm, a large body of literature has demonstrated that demographic similarity within an organization or a team is associated with the supervisor's performance rating (Tsui & O'Reilly, 1989), turnover (Jackson et al., 1991; Wagner, Pfeffer, & O'Reilly, 1984), employee reactions (citizenship, absenteeism, and work change behaviors) (Perry, Kulik, & Zhou, 1999) and CEO compensation (Westphal & Zajac, 1995). However, Tsui et al. (1992) criticized that similarity-attraction theory could not fully clarify organizational demography. The paradigm cannot explain why there are demographic effects even when there are "no actual interactions" among group members.

Self-categorization theory. Self-categorization theory has been used to explain the

same phenomena of team dynamics due to team heterogeneity (Riordan & Shore, 1997; Tsui et al., 1992; Westphal & Zajac, 1995). People tend to define themselves based on distinguishable social characteristics (e.g. demographic characteristics) and to categorize themselves psychologically as group members. Through the categorization process, they attach themselves to members in the same group and develop and maintain a positive self-identity (Turner & Haslam, 2001).

Self-categorization theory is different in its scope from social identity theory (Brown, 2000). Social identity theory focuses on intergroup relations and social conflicts, whereas self-categorization theory focuses on the psychological group and group processes such as social cohesion, cooperation, and influence (Turner & Haslam, 2001). The self-categorization theory may provide only partial explanation for the effects of the similarity-attraction paradigm because the concept of self-categorization theory explains a person's motivation to maintain a positive self-identity (Jackson, Stone & Alvarez, 1993).

Although those three theories explain different psychological processes, they render similar predictions regarding team diversity (Westphal & Zajac, 1995). For these reasons, diversity research has borrowed principles from all three theories.

Diversity impact on internal social capital. Drawing on social identity theory, similarity-attraction theory, and self-categorization theory, one can predict that gender, ethnic, age, and nationality diversity reduces team member interactions, trust, and cooperation under certain conditions. Some research has found that racial, gender, age, and nationality diversity negatively predict team communication and cohesion and positively predict team conflict and emotional responses to organizations (for a review,

Milliken & Martins, 1996).

Theories and empirical findings on diversity have suggested that members of diverse teams are less likely to communicate and interact with one another. Instead, they may be socially closer with others who have similar demographic attributes. Since team members in a demographically heterogeneous team are unlikely to interact with everyone on the team, the team is likely to have a low level of social and job-related cohesion. In addition, demographic diversity may reduce the density of trust in the team, because different social identities among team members produce intergroup comparisons, in-group favoritism, and out-group discrimination. All of these subsequently increase intergroup conflicts. Prior research found that age dissimilarity between team members and other team peers reduced trust between them (Chattopadhyay, 1999). Thus, team members who are working in a heterogeneous team may not help one another to perform tasks. Low social and job-related interactions among team members on the heterogeneous team can impede the formation of cooperative norms. Team members in a demographically diverse team may perceive strong self-identities based on their social groups and focus on their own interests rather than overall team norms (Chatman & Flynn, 2001). Therefore, team demographic diversity in terms of gender, ethnicity, and age may reduce social and job-related interactions among team members, trust, and cooperative norms on the team.

H3a: Team demographic diversity will be negatively associated with social cohesion and job-related cohesion.

H3b: Team demographic diversity will be negatively associated with norms for cooperation.

H3c: Team demographic diversity will be negatively associated with trust.

The Effect of Informational Diversity on Internal Social Capital

The theoretical rationale for the impact of demographic diversity can be also used to explain the impact of informational diversity. *Informational diversity* refers to the degree to which team members' backgrounds, related to knowledge and insights, are different (Jehn et al., 1999). In this paper, informational diversity includes diversity in terms of tenure, education, the areas of specialty, and level.

Team members who have different educational, level, specialty, and tenure backgrounds may have different knowledge and perspectives, which are likely to reduce group cohesiveness and increase conflicts. Drawing on social identity theory, similarity-attraction theory, and self-categorization theory, diversity research has found that team members working in a diverse team may not get along with one another. Jackson et al. (1991) found that diversity with regard to experience outside the industry and college major positively predicted turnover rate. In the investigation of 45 work teams, Pelled, Eisenhardt, and Xin (1999) found a positive effect of functional diversity on task conflict and a positive effect of tenure diversity on emotional conflict. O'Reilly III et al. (1989) found that tenure diversity reduced team social integration. Ancona & Caldwell (1992) found that functional diversity could be negatively associated with team innovation via internal conflicts. Keller (2001) found a significant and negative impact of functional diversity on internal communication within teams.

There is little empirical research on the relationship between informational diversity and internal social capital. However, the relationship may have similar predictions to the association between informational diversity and group processes such

as communication, cohesion, and conflicts. Research on homophily suggests that team members tend to make homophilious ties more than heterogeneous ties, because background similarity fosters liking and trust (Bunderson, 2003; Ibarra, 1992). Bunderson (2003) found that team tenure and education similarity between management and team members positively predicted the centrality of work-related interactions. Thus, education and job experience dissimilarity may increase the likelihood of creating debates on job-related issues, because of diverse perspectives and opinions among team members (Jehn et al., 1999). Thus, social network research has found that team functional and tenure diversity reduced the density of communication frequency (Reagans & Zuckerman, 2001; Reagans et al., 2004). Accordingly, informational diversity in education, tenure, the areas of specialty, and level may reduce social and job-related cohesion, cooperative norms, and trust within teams.

H4a: Team informational diversity will be negatively associated with social and job-related cohesion.

H4b: Team informational diversity will be negatively associated with norms for cooperation.

H4c: Team informational diversity will be negatively associated with trust.

THE EFFECTS OF TEAM DIVERSITY ON EXTERNAL SOCIAL CAPITAL

Optimistic views on team diversity have posited that team members with different attributes can bring diverse perspectives and new ideas into the team, which may increase team performance, innovation and creativity (Jackson et al., 2003). Racial diversity is positively related to cognitive outcomes such as the quality of ideas (McLeod & Lobel, 1992) and team diversity in ethnicity, gender, function, and age increases learning behaviors (Gibson & Vermeulen, 2003). This optimistic perspective is consistent with the bridging view on social capital, which emphasizes the benefits of team members' contacts with external members. Since team members can bridge internal members to external members through homophilious ties with external members, the external ties of heterogeneous teams may bring diverse information and perspectives to the team (Reagans & Zuckerman, 2001). This section deals with the impact of team demographic and informational diversity on external social capital.

The Effect of Demographic Diversity on External Social Capital

As explained in the previous section, team diversity may reduce internal social capital. At the same time, team diversity may increase external social capital. According to structural hole theory, information and resources may be increased in a team by networking with people "outside" of the team (Burt, 1997; Reagans & Zuckerman, 2001). Team diversity may foster this external networking.

Impact on the size. According to social identity theory, self-categorization theory, and similarity-attraction theory, team members in heterogeneous teams are unlikely to have close interpersonal relationships, which results in a low level of team internal social capital. Since high internal social capital due to demographic homogeneity may cause

team members to have cognitive insulation from the outer world (Gargiulo & Benassi, 2000), team members may not feel the need to make external networks and may not be motivated to acquire new knowledge and resources. Therefore, high internal social capital within homogeneous teams can facilitate the transfer of knowledge and resources within teams but can obstruct team members from learning new and diverse knowledge and information from external members. However, since heterogeneous teams are more likely to be open to new perspectives and to be motivated to gain access toward external resources and information, they are likely to make contacts with people outside of the teams. Therefore, team diversity can be positively associated with the *size* of informational networks with external members.

H5a: Team demographic diversity will be positively associated with the size of external informational networks.

Impact on the strength of relationships. Team diversity may be positively associated with the strength of social and job-related relationships of informational networks with external members. The influence of demographic diversity on the relationship strength of informational networks has rarely been investigated. However, research on homophily provides implications regarding the relationships between demographic diversity and external social capital.

According to the homophily literature, individuals tend to make homophilious networks in organizations rather than heterogeneous networks (McPherson et al., 2001). The preference on homophilious ties may have heterogeneous teams build weaker internal relationships and stronger external relationships and develop larger and more diverse external networks than may homogeneous teams. Furthermore, since

homogeneous teams tend to have a stronger bond among team members than do heterogeneous teams, they may not be motivated to socialize with people outside the teams. However, team members in heterogeneous teams are more likely to actively engage in social activities with people outside the teams. In particular, the homophilious tendency has heterogeneous teams bringing diverse information, knowledge, and perspectives to the teams through homophilious external ties. Accordingly, demographically heterogeneous teams can make stronger social and job-related relationships with external members.

H5b: Team demographic diversity will be positively associated with the strength of social and job-related relationships of external informational networks.

Impact on network diversity. Similarly, team demographic diversity can be positively associated with the demographic (gender and ethnicity) and informational (level and specialty) network diversity of external informational networks. Team members in a heterogeneous team may be more open-minded toward different perspectives than may those in a homogeneous team, because they have been working with other team members who have different backgrounds. As a result, team members in a demographically heterogeneous team tend to be open to external networking with people who have different backgrounds. Team members in a heterogeneous group are more likely to transport diverse external networks into the teams than are those in homogeneous teams. Since team members in a diverse team may bring innovative and creative ideas and a variety of skills, information, and experience to the team through external informational networks, team demographic diversity may increase the diversity of external networks.

According to social identity theory, similarity-attraction theory, and self-categorization theory, team members may feel more attracted to external members who belong to the same social categories rather than those who belong to different social categories. Therefore, team demographic diversity will be more positively related to the demographic network diversity of external informational networks than will the informational network diversity of external informational networks.

H5c: The relationship between team demographic diversity and the demographic network diversity of external informational networks will be stronger than will the relationship between team demographic diversity and the informational network diversity of external informational networks.

The Effect of Informational Diversity on External Social Capital

Informational diversity is also positively associated with the strength of social and job-related relationships, size, and diversity of external informational networks. Informational diversity is likely to bring a variety of expertise, opinions, and perspectives to the team, especially through team members' external networks with external members with similar educational, status, and functional backgrounds. Bunderson (2003) showed that team managers' functional background similarity positively predicted the centrality of the team's workflow networks. Recently, Reagans et al. (2004) explored the relationship between functional diversity and external social capital and found that the functional diversity of project teams significantly increased the range of external networks.

Impact on the size and the strength of relationships. Research on boundary-spanning activities and external communications can bring similar propositions about

external social capital. Diverse teams in terms of function and status may be more likely to take strategic actions to adapt to the environment (Ancona & Caldwell, 1992). Diversity in functional background allows team members to engage in communication with people outside of the team boundary who have the same functional background, because they speak a common language. In addition, individuals with similar tenure may exhibit greater propensity for communicating with one another than individuals with dissimilar tenure because they have a shared understanding of organizational events. Keller (2001) argued that cross-functional teams do not always work well. Because their members may be dissatisfied and have high job stress, cross-functional teams have low cooperation and cohesion and high conflict. Nevertheless, cross-functional teams may result in higher performance, because team members can facilitate creativity through external communications. Keller found that functional diversity was negatively related to internal communication, but was positively related to external communication. Team members who have different attributes from other team members are more likely to engage in external communication activities.

Similar to the theoretical rationale of the impact of demographic diversity on external social capital, informational diversity will increase the size and strength of social and job-related relationships of external informational networks. Team members in a heterogeneous team in terms of education, tenure, level, and specialty may be more open to new perspectives and information than may team members in a homogeneous team. In addition, team members in a heterogeneous team may not get along with their peers on the team because of different backgrounds. Instead, they may seek to develop close relationships with people outside the team.

H6a: Team informational diversity will be positively associated with the size of external informational networks.

H6b: Team informational diversity will be positively associated with the strength of social and job-related relationships of external informational networks.

Impact on network diversity. Demographic and informational diversity can increase the diversity of external networks, but the degree of the effects may vary across different types of diversity in external networks. The influence of informational diversity on diversity of external informational networks may be stronger than the impact of demographic diversity on the diversity of external informational networks. Because team members may make more ties to external members with similar backgrounds, heterogeneous teams in education, tenure, and status would build more ties based on those attributes than ties based on gender, ethnicity/nationality, and age.

H6c: The relationship between team informational diversity and the informational network diversity of external informational networks will be stronger than will the relationship between team demographic diversity and the demographic network diversity of external informational networks.

SOCIAL CAPITAL AS A MEDIATOR OF THE RELATIONSHIP BETWEEN TEAM

DIVERSITY AND PERFORMANCE

Research on diversity has mainly focused on internal team functioning so as to investigate the black box between diversity and team performance. Furthermore, previous research showed mixed or non-significant results with regard to the impact of team diversity on group processes such as communication, cooperation, and conflicts and affective reactions such as cohesion, satisfaction, and commitment (Jackson et al., 2003). Diversity studies have often failed to find significant results that team diversity reduces team communication, cooperation, and cohesion and increases team conflicts, which are mediators between diversity and performance (Jackson et al., 2003).

The non-significant associations between team diversity and group process variables may be caused by the following reasons. First, most research on team diversity has included at most one or two group process and affective reaction measures. Furthermore, boundary-spanning activities and external networking have often been ignored in team diversity research. Internal and external social capital may more comprehensively capture complex team functioning than may group process measures. Second, group process variables such as communication, cohesion, and cooperation have been measured as aggregated variables about how each team member perceives intrateam relations. Even though the traditional measures have been used only if internal reliability is high enough, they may make it difficult to capture complex team dynamics. Therefore, I argue that internal and external social capital may provide better explanations for the effects of diversity on team performance.

As explained in the previous sections, team members with different backgrounds

may perceive different perspectives and identities and thereby may not be psychologically attracted to one another. As a result, team demographic and informational diversity may reduce internal social capital (social and job-related cohesion, cooperative norms and trust). In addition, internal social capital may be positively associated with team performance. If a team has high internal social capital, team members are more likely to know one another well and feel less at risk about sharing information. The low level of psychological safety may improve team members' learning activities and performance (Edmondson, 1999). Homogeneous teams may have higher cohesiveness, cooperation, and lower conflict, which subsequently results in increased team performance (Kramer, Hanna, Su, & Wei, 2001). That is, team diversity may lower internal social capital, which subsequently reduces team performance.

On the contrary, team diversity may enhance external social capital, because team members seek external networking with people who have similar backgrounds to their own. Thus, the low level of psychological attachment within teams may allow team members to open up to get new perspectives and ideas from external members (Ancona & Caldwell, 1992; Bunderson 2003; Katz, 1982; Keller, 2001). When a team has high external social capital, it may have more information and resources from other teams. Because team members with high external social capital have more opportunities to access information and resources, the team may perform better than other teams with low external social capital. Previous literature has shown the positive impact of external social capital on team performance through increased information, resources, and knowledge (Hansen, 1999, 2002; Labianca et al., 1998: Nelson, 1989). Thus, research that posited positive relationships between diversity and team performance argued that

team members in heterogeneous teams can bring diverse views and perspectives and draw creative ideas to the teams (for example, Hambrick, Cho, & Chen, 1996). Reagans and Zuckerman (2001) suggested that external tenure network diversity positively predicts productivity. They did not measure team members' actual contacts with people outside the team who have the same background as team members, but the results may imply the positive impact of team diversity on external social capital. Therefore, team diversity may amplify performance via increased external social capital.

Given the theoretical and empirical literature, both internal and external social capital can mediate the relationship between diversity and team performance. On the one hand, team diversity may decrease team performance via decreased internal social capital. On the other hand, team diversity may increase team performance via increased external social capital. Accordingly, no one can easily conclude whether or not team diversity positively (or negatively) predicts team performance. This argument also reflects the mixed results of such relationships in previous empirical studies (for a review, Jackson et al., 2003).

Reagans et al. (2004) presented that the theoretical links between diversity and team performance through internal and external social capital explain the mixed results of team diversity on performance. Drawing on the Reagans et al. model, Figure 1 shows the signs of coefficients. Team diversity may be positively associated with team performance when the effect of increased external social capital is stronger than is the effect of decreased internal social capital. On the contrary, team diversity may be negatively associated with team performance when the effect of increased external social capital is less than the effect of decreased internal social capital. If regression results show that the

hypothesized signs of the coefficients are correct and the effect of diversity on team performance is fully mediated by internal and external social capital, the overall effect of diversity on performance is $(\beta 1 \ \gamma 1) - (\beta 2 \ \gamma 2)$. Therefore, whether or not the effect of diversity on performance is positive (or negative) depends on whether or not the positive diversity effect on team performance through external social capital $(\beta 1 \ \gamma 1)$ is smaller (or bigger) than the negative diversity effect on team performance through internal social capital $(\beta 2 \ \gamma 2)$.

Insert Figure 1 about here

Figure 2 provides specific directions of the effects of diversity on team performance through the mediation of internal and external social capital. When the link of diversity-internal social capital-performance is bigger than the link of diversity-external social capital-performance, the overall effect of diversity on performance will be negative. When the link of diversity-internal social capital-performance is smaller than the link of diversity-external social capital-performance, the overall effect of diversity on performance will be positive. When the link of diversity-internal social capital-performance is equal to the link of diversity-external social capital-performance, the overall effect of diversity on performance will be insignificant.

Figures 1 and 2 show that the direction of the effect of diversity on team performance may not be determined merely by comparing the sign and magnitude of the diversity-internal social capital link $(\beta 2)$ with those of the diversity-external social capital $(\beta 1)$, because the overall effect of diversity on performance may rely on the magnitude of

the internal social capital-performance link (γ2) and the external social capital-performance link (γ1). Even though (1) the diversity-internal social capital link is negative (β2 < 0), (2) the diversity-external social capital is positive (β1 > 0). Therefore, as (3) the absolute value of the diversity-internal social capital link (β2) is equal to one of the diversity-external social capital (β1), the overall effect of diversity on team performance ((β1 γ1) + (β2 γ2)) may be either negative or positive. Under the conditions (β1 >0, β2 <0, and |β1| = |β2|), when the internal social capital-performance link (γ2) is bigger than the external social capital-performance link (γ1), the overall effect of diversity on team performance ((β1 γ1) + (β2 γ2)) will be negative. That is, if team internal social capital contributes to team performance increase more than does team external social capital under the conditions (β1 >0, β2 <0, and |β1| = |β2|), the overall effect of diversity on team performance will be positive. On the contrary, under the same conditions, when the internal social capital-performance link (γ2) is smaller than the external social capital-performance link (γ1), the overall effect of diversity on team performance ((β1 γ1) + (β2 γ2)) will be positive. Therefore, the effects of team diversity on performance rely on the level of effects of diversity on internal or external social capital and the level of effects of internal and external social capital on team performance.

Insert Figure 2 about here

H7: Team demographic and informational diversity will affect performance through external social capital and internal social capital. The direction of the team

diversity effect on team performance depends on whether or not the diversity effect on

team performance as mediated through external social capital is bigger (or smaller) than

the diversity effect on team performance as mediated through internal social capital.

THE ROLE OF TASK CHARACTERISTICS

In rapidly changing environments, organizations strive to improve their ability to search information from a variety of outside sources (Aldrich & Herker, 1977). Thus, in such organizational contexts, teams (and team members) may change networking behaviors or strategies to acquire more diverse and innovative information and resources. Teams may develop different patterns of networking as different task requirements and constraints are given (Brown & Miller, 2000).

This section presents the moderating impact of task requirements on the link of diversity to internal and external social capital and the link of internal and external social capital to performance. No standard task typologies are described in the existing literature (Druskat & Kayes, 1999). However, task interdependence and task routineness/non-routineness have been widely recognized as important (for example, Campion, Papper, & Medsker, 1996; Gladstein, 1984). Task interdependence and task routineness/non-routineness may stand for the information-processing requirements of tasks and determine the team's capacity for exchanging and acquiring task-relevant information and resources (Gladstein, 1984). Thus, they have been seen as moderators between internal interactions and team performance and as the determinants of within-group interactions (Guzzo & Shea, 1992).

Task Interdependence

Team members may adopt different work behaviors to exchange information and resources such as when they adjust to a given task structure. Task interdependence is a task structure that may influence intrateam and interteam interactions to exchange information and resources. *Task interdependence* refers to the extent to which team task

requirements are interconnected (Saavedra et al., 1993). Thompson (1967) and Van de Ven, Delbecq, and Koenig (1976) proposed a hierarchy of task interdependence in terms of workflow: pooled interdependence, sequential interdependence, reciprocal interdependence, and team interdependence (or simultaneous, multi-directional workflow). *Pooled interdependence* is a task structure where each team member works individually without direct interactions among team members and represents the lowest level of task interdependence. *Sequential interdependence* is a task structure where each team member works individually but must perform his or her task after another completes a task. Under sequential interdependence, each team member must perform a part of the overall project in a successive order. *Reciprocal interdependence* is a task structure where team members perform individually, in general, but their tasks can be completed by temporarily lagged and two-way interactions (Saavedra et al. 1993). *Team interdependence* is the highest level of task interdependence where all team members work simultaneously and make job-related decisions collectively to complete a project. As Thompson (1967) and Van de Ven et al. (1976) argued, the four types of task interdependence are not different constructs but one construct that varies in degree only.

 Task interdependence as a moderator of the relationship between diversity and internal social capital. The influence of team diversity and group process on performance was thought to be affected by task interdependence (Gladstein, 1984; Jehn et al., 1999). When team members depend on one another to perform their tasks effectively, they are more likely to be motivated to cooperate and collaborate with one another (Saavedra et al., 1993). That is, if team tasks can be performed effectively only if team members collaborate and cooperate, members are more likely to interact with one another

and value cooperative norms. Even though team members in diverse teams are not attracted to one another at first sight, they may become close if they are required to work together.

Diversity studies have found that team diversity may not always reduce interpersonal interactions: the effects of diversity on interpersonal interactions may depend on task constraints. Interpersonal relations between racially different groups may be high when there are high task interdependence and a supportive peer climate (Bacharach, Bamberger, & Vashdi, 2005). Prior research found that task interdependence decreased the negative effects of sex and age diversity on workgroup satisfaction and commitment (Jehn et al., 1999). Chatman and Spataro (2005) found that individuals who are dissimilar in age, gender, and nationality to their colleagues in their business unit are more cooperative when the business unit's culture is collectivistic rather than individualistic. Even though they did not investigate task characteristics, the results imply that task interdependence cues team members to behave in a more cooperative manner. Therefore, by manipulating tasks to make them more interdependent, organizations may generate significant interpersonal relationships among team members and may reduce demography-based identities (Bacharach et al., in press).

In conclusion, team diversity is less likely to reduce team internal social capital when team tasks require high cooperation and cohesiveness among team members (high interdependence) than when team tasks require low cooperation (low interdependence).

H8a: The negative relationship between team diversity and internal social capital will be weaker when task interdependence is high than when it is low.

Task interdependence as a moderator of the relationship between diversity and

external social capital. Task interdependence may reflect the degree to which team members exchange knowledge, information, and resources (Gladstein, 1984). Since highly interdependent tasks may require each team member to perform a part of an entire project, task interdependence may motivate team members to exchange knowledge and information from activities to give and take feedback. Therefore, highly interdependent tasks may enhance information-seeking activities.

Task interdependence may not only increase the exchange of knowledge and information among team members, but also motivate team members to search for knowledge and information from people who are outside the team. If team members do not need to work together with other team members (e.g. pooled interdependence), team members may not be motivated to contribute their time to an information search. However, under team interdependence (the highest level of task interdependence), team members may build abilities and skills with regard to interpersonal interactions and networking and may be open to being connected to people outside the team. Thus, because task interdependence may promote intrinsic motivation (Hirst, 1988), team members may be motivated to seek new knowledge and information in order to satisfy their self-determining needs.

Task interdependence may amplify the effect of team diversity on external networking. Since both team diversity and task interdependence allow team members to be motivated to make external networks to acquire information and knowledge, a synergic effect on external social capital may occur. Van der Vegt and Janssen (2003) found that diverse teams were more likely to generate and promote new ideas under high task interdependence than under low task interdependence. The results imply that task

interdependence may elevate diverse teams' information and knowledge seeking. Therefore, I hypothesize that team diversity increases external social capital more under high task interdependence than low task interdependence.

H8b: The positive relationship between team diversity and external social capital will be stronger when task interdependence is high than when it is low.

Task interdependence as a moderator of the relationship between internal social capital and performance. High interdependence may increase activities to develop skills and knowledge through work coordination and mutual adjustment among team members (Thompson, 1967). Internal social capital may reflect the degree of information-processing capacity within teams. Teams may be most effective when the information-processing capacity is matched to task requirements that promote the information-process (Gladstein, 1984).

Task interdependence, therefore, may moderate the relationship between internal social capital and team performance. When tasks require collaboration among team members, trust, social and job-related interactions, and norms for cooperation in the team may be more useful for increasing team performance. When tasks require team members to work individually without direct interaction with others, trust, social and job-related interactions, and norms for cooperation may not help increase team performance.

H8c: The positive effect of internal social capital on performance will be stronger in teams with high task interdependence more than in teams with low task interdependence.

Task interdependence as a moderator of the relationship between external social capital and performance. Task interdependence may be more useful at increasing team

performance when external social capital is high rather than low. Information-seeking activities may bring new knowledge and information into teams. If task interdependence is high, acquired knowledge and information may be more useful because team members would exchange the knowledge and information with one another. The contribution of new knowledge information to team performance may motivate and encourage team members to engage in external networking.

Team interdependence and external social capital, therefore, may have a synergistic impact on team performance. Accordingly, external social capital may increase team performance more under high task interdependence than low task interdependence.

H8d: The positive effect of external social capital on performance will be stronger in teams with high task interdependence compared to those with low task interdependence.

Task Routineness/Non-routineness

When tasks involve active information-processing, boundary-spanning activities and intrateam interactions can help improve team performance (Gladstein, 1984). Task routineness/non-routineness is one type of task requirement associated with information-processing activities. *Task routineness* refers to the degree to which team members repeatedly perform similar tasks (Jehn, 1995). On the contrary, *non-routine tasks* are characterized by high variability (Jehn, 1995). Routinized tasks do not need a large volume of knowledge and information to perform and do not involve problem-solving activities, because task procedures are, in general, predetermined and are relatively easy to perform (Brown & Miller, 2000).

Like task interdependence, task routineness/non-routineness may influence the relationships among diversity, social capital, and performance. Next, I explain the effects of task routineness on each of the relationships.

Task routineness as a moderator of the relationship between diversity and internal social capital. According to the information-processing researchers (Galbraith, 1973; Thompson, 1967; Tushman, 1977; Van Knippenberg et al., 2004), teams performing routine tasks may not need to actively seek out new ideas and information because those tasks require team members to engage in repeated and simple work. However, when teams must perform non-routine tasks, team members face a variety of problems to be solved and may feel pressure to learn new skills and knowledge in order to perform effectively.

Internal social capital can be a good source of ideas and information when tasks are non-routine. Pelled and colleagues (1999) found that task routineness decreased the positive effect of functional diversity and racial diversity on task conflicts. They argued that because routine tasks do not require team members to exchange ideas and opinions, team members would not have many opportunities to interact and exchange opinions with others and thereby task-related conflict may be reduced. Since routine tasks may be completed without open communication (Brown & Miller, 2000), they may reduce the internal social capital that is decreased by diversity.

Task routineness, therefore, may augment the negative relationship between team diversity and internal social capital, whereas task non-routineness may decrease the negative relationship between team diversity and internal social capital.

H9a: Routine (non-routine) tasks will increase (decrease) the negative

relationship between team diversity and internal social capital.

Task routineness as a moderator of the relationship between diversity and

external social capital. When tasks are complex and non-routine, a team's ability to get

diverse ideas and information from outside people may be increased. Non-routine tasks

may encourage team members to seek diverse information and knowledge. By utilizing

new information and knowledge, non-routine tasks may motivate team members to

develop creativity in order to solve problems that they encounter. If team tasks require

creativity and innovative thinking, the positive influence of diversity on external social

capital may be increased.

Therefore, the positive relationship between team diversity and external social

capital may be increased under non-routine or complex task requirements and constraints,

whereas the positive relationship may be decreased under routine or simple task

requirements.

H9b: The positive relationship between team diversity and external social capital

will be weaker when tasks are routine than when they are non-routine.

Task routineness as a moderator of the relationship between internal social

capital and performance. Teams performing non-routine tasks may use decentralized

networks and decentralized decision-making to perform them effectively (Brown &

Miller, 2000). Since routine tasks do not require intensive coordination and agreement

among team members (Van de Ven et al., 1976), teams performing routine tasks may be

less likely to develop internal social capital. Therefore, if tasks are complex or non-

routine, close interpersonal relationships, trust, and cooperative norms among team

members may contribute to the enhancement of team performance. Accordingly, the

positive effect of internal social capital on team performance may be higher in teams performing non-routine tasks than in those performing routine tasks.

H9c: In teams with non-routine task requirements, the positive effect of internal social capital on performance will be stronger than in teams with routine task requirements.

Task routineness as a moderator of the relationship between external social capital and performance. Similarly to the previous argument, increased information and knowledge through external social capital may become more valuable for performance in teams performing non-routine tasks than in those performing routine tasks. Those teams' needs and motivation to develop external social capital may be higher and thereby they are more likely to utilize external social capital to perform effectively.

Although they did not examine external social capital, Jehn and colleagues (1999) found that task non-routineness increased the positive relationship between informational diversity (diversity of education, functional area in the firm, and position in the firm) and workgroup performance. The study implies that when tasks require active exchanges of opinions and interactions, informational diversity increases team performance more.

H9d: In teams with non-routine task requirements, the positive effect of external social capital on performance will be stronger than in teams with routine task requirements.

METHODS

Procedure and Sample

The sample of this study was collected from biology and chemistry research laboratory teams in two universities. I chose this team setting to test my hypotheses, because from interviews with professors, post-docs, and doctoral students, I found that some characteristics of science research laboratories were similar to those of R&D teams in organizations. Knowledge acquisitions and sharing and work collaborations through internal and external social capital are critical activities for the laboratories to enhance performance. In addition, in science research laboratories, each professor (or laboratory head) runs a laboratory (or a team) and hires employees such as research professors, research associates, technicians, post-docs, doctoral students, and master's students. Professors receive their salaries from the universities, but should acquire external grants in order to perform experiments and keep their laboratories running. Laboratory members receive their salaries from the grants that a laboratory head (or a professor) has acquired. Laboratory members' salaries can be determined by negotiation between the laboratory head and laboratory members.

A laboratory is typically working on multiple research projects at the same time. However, although not all members in the laboratory are always involved in the same project, they often interact with one another to learn research methods, experiment processes and to exchange knowledge, skills, and resources. Since the successful completion of research projects in a laboratory is extremely important in order to keep acquiring external grants and writing research papers, a laboratory team typically has a weekly meeting to keep track of work processes and to discuss problems that team

members have encountered while they perform experiments. The weekly meetings are also utilized to develop and share knowledge and skills.

In addition, laboratory team members often engage in external networking to obtain information and knowledge. Laboratory heads are often supposed to collaborate on research projects with professors in other laboratories because the large scale of research projects may not be feasibly conducted by only one laboratory. When team members in a laboratory team are working on a research project with people in other laboratory teams, they interact with one another to acquire work-related knowledge and information. Even when team members do not work on a project with external members, they sometimes engage in external networking to seek knowledge and information. People in the same research area may help one another with regard to experiment processes and job-related knowledge. Therefore, internal and external networking are important activities for science laboratory teams to be successful.

Seventy laboratory teams (80 managers and 350 team members) in universities participated in the survey. Drawing on Sparrowe at al. (2001), teams with less than 80% response rates were excluded in order to ensure accurate network patterns at the team level. One large laboratory that included multiple laboratory teams was excluded because it was not operated as a single team. 58 laboratory teams (58 managers and 264 team members) remained for data analyses. Data collection procedures were as follows: first, I contacted professors who ran research laboratories at biology and chemistry departments in universities via mail (or email) and phone calls. Each professor was briefed about the purpose of the study and what participation would entail. I then inquired if he or she was interested in participating in the study. Second, I interviewed several doctoral students

and professors to get information about the work structure of laboratory teams and the nature of works, if professors agreed to participate in the survey. I asked each professor to provide the names of team members for the team member survey. Third, I sent the team member survey to all members at the laboratories by mail and sent manager surveys to laboratory heads. I also asked team members to forward their vitae to obtain their academic performance record.

The member survey asks team members to answer their demographic information, task routineness, and social networks. The manager survey asks professors to evaluate team performance and to provide task interdependence.

Measures

Team diversity. Drawing on the categorization of diversity in the previous literature (Jackson et al., 2003; Jackson et al., 1995; Miliken & Martins, 1996; Tsui, et al., 1992), individual background variables include gender (0 = male; 1 = female), ethnicity/nationality, age, job status (1=professor, 2=post-doc, 3=technician, 4=doctoral student, 5=master's student), tenure, and major specialty. Since there are large proportions of foreign nationals as well as minorities who have U.S. citizenship in the sample, ethnicity and nationality were combined (1=white-U.S., 2=black-U.S., 3=Hispanic-U.S., 4=Indian-U.S., 5=Chinese-U.S., 6=others-U.S., 7=Indian, 8=Chinese, 9=Japanese, 10=Korean, 11=Taiwanese, 12 =Australian and Canadian, 13 =European, 14 =Hispanic, and 15= others). This helped to identify different subgroups in terms of nationality and ethnicity. Major specialty could not be easily categorized based on a single standard because the areas of specialty were very diverse even in a department. Therefore, I manually assigned a number to each person's major specialty in order to

capture team-level major diversity. In other words, a number assigned to a major specialty category did not stand for a single group that represents a major specialty group in all observations. The number for each major specialty category was used only for differentiating diverse major specialty groups in a team. The maximum number of different major specialty groups in a team was four. Education diversity was computed but was excluded from the analyses to avoid overlap with job status and tenure variables.

For the categorical variables of gender, ethnicity and nationality, current major, and level, I computed gender, ethnicity, nationality, education, and level diversity scores using Blau's index of heterogeneity, which is defined as:

$$(1-\Sigma \, pi^2)$$

where p is the proportion of group members in a category, and i is the number of different categories in the group. For the continuous variable of tenure and age, the within-group coefficient of variation was used.

Internal social capital. Internal social capital includes social and job-related cohesion, cooperative norm, and trust. To conduct the network survey using sociometic techniques, I provided each team member with a roster acquired from laboratory heads or HR departments (refer to Appendix 1). In the first column, respondents filled out first and last name initials of team members. In the second and third columns, they filled out their social and job-related relationships with each co-worker. In the last column, respondents answered how much they trust each co-worker.

Social and job-related cohesion were measured as the density of social and job-related relationships. The density of social and job-related relationships was defined as the mean of social and job-related relationships between any two members of team k

(Reagans & Zuckerman, 2001). Similarly, *trust* was measured as the density of trust. The density of trust was operationalized as the average trust between any two members of team k. Internal social and job-related density and trust density were obtained by using the following formula (Reagans & Zuckerman, 2001):

$$Density_k = \frac{\sum_{i=1}^{N_k} \sum_{j=1}^{N_k} z_{ijk} / \max(z_{ijk})}{N_k(N_k - 1)} \quad , \quad j \neq i$$

where z_{ijk} is the social or job-related relationship at which team member *i* perceives relationship strength with team member j, max (z_{ijk}) is the possible largest tie score, and N_k is the number of team members in team *k* (Reagans & Zuckerman, 2001). The highest value of density is 1 and the lowest value is 0.

The third dimension of social capital is norms for cooperation. Chatman and Flynn (2001) developed a measure of *group norms for cooperation* and included five items. One example is "It is/was important for us to maintain harmony within the team." They assessed the measure twice using Likert-type scales (1, "strongly disagree, to 7, "strongly agree") and found the reliability coefficient was .62 and .77, respectively. Team-level group norms for cooperation were yielded by summing average scores of items of group norms.

External social capital. Egocentric network data were collected to measure external social capital, because acquiring all names in external networks of team members was not plausible. In the first row, I asked team members to indicate the first and last name initials of people in the organization who have been valuable resources of work-related/job-related information. The number of people in the informational

networks was restricted up to ten. In the second to fourth row, demographic information of each person was asked about. In the next two rows, social and job-related relationships with each person were asked about.

External social capital consists of the strength of social and job-related relationships, network size, and demographic and informational network diversity in informational networks. A large body of research has used those indicators to assess external social capital or external networks (for example, Brass, 1995; Ibarra, 1992; Tsai & Ghoshal, 1998). The *strength of social (job-related) relationships* of informational networks was operationalized as the sum of social (job-related) relationships divided by the maximum strength of total social (job-related) informational network ties. *Network size* was operationalized as the total number of people in the informational network. *Demographic network diversity of informational networks* was measured as the number of people in the network who were different gender and ethnic groups from respondents divided by total ties. *Informational network diversity of informational networks* was measured as the number of people in the network who had different levels and specialties from respondents divided by total ties.

To gauge team-level external social capital, each indicator of external social capital was aggregated and then divided by team size.

Task interdependence. Task interdependence was measured using a hierarchy of workflow from Van de Ven and Ferry (1980). Since they were originally developed to detect workflow within a business unit, the illustrations of workflow were modified to adapt them to team settings. As Thompson (1967) suggested, task interdependence was assessed using a Guttman scale (1= 'almost none of the work', 5= 'almost all of the

work'). It was reported by laboratory heads.

Task routineness. A 7-point Likert-type response scale was used, ranging from 1, anchoring on 'completely disagree' to 7, anchoring on 'completely agree.' Using Perrow (1970) and Van de Ven et al. (1976), Jehn (1995) developed 20 task routineness items. Van der Vegt & Janssen (2003) selected 6 items and Jehn et al. (1999) selected 12 items from the original 20 items. I selected four items of task routineness from Jehn (1995)'s 20 items, after I referred to selected items by Van der Vegt and Janssen (2003) and Jehn et al. (1999).

Perceived team performance. A variety of performance measures was obtained. First, perceived team performance was measured on the basis of scales from Campion et al., (1996) and Ancona and Caldwell (1992). From interviews with professors who manage their own laboratories, I modified Campion et al. (1996)'s scale. A 7-point Likert-type response scale was used, ranging from 1, anchoring on 'very poor' to 7, anchoring on 'outstanding.' Both team members and laboratory team managers answered the questions about perceived team performance.

Objective team performance. Second, publications and conference presentations produced by team members in the past year were used as other indicators of team performance. This information was retrieved by vitae of team members. They may provide partial information of performance, because all team members are not always involved in publications and conference presentations. However, they may be more appropriate to measure team performance than may perceived team performance ratings assessed by team members, because self-rated team performance ratings may be overestimated. Hence, the average number of publications (journal articles) per team

member was used to measure team performance. However, the average number of publications may not capture the quality of team performance.

Following McFayen and Cannella (2004) and Stephan and Levin (1991), therefore, I used the Institute of Scientific Information (ISI)'s *impact factor* to measure team performance. Impact factor scores are created by the number of citation counts of a journal that is adjusted by using the frequency of issues, the volume of journals, and the history of journals. As McFayen and Cannella (2004) indicated, citations may reflect the size, nature, and growth rate of a field. For example, some fields (e.g. chemistry) that have long been examined by a larger pool of scientists may have more citations than may other fields (e.g. environmental science) that have been investigated by a smaller pool of scientists. Therefore, the impact factors of some fields are higher than those of other fields.

To solve the problem, I developed *adjusted impact factor scores*. Adjusted impact factor scores refer to numeric scores that are standardized by each academic field. I sorted impact factors by academic field and then standardized the scores. The adjusted impact factor scores may remove different scores of impact factor across academic fields. Then, I calculated weighted impact factor scores of each team member. For example, a team member has three publications in two journals, with two in journal A, which has an impact factor of 4, and with one in journal B, which has an impact factor of 1. The individual's weighted impact factor score would be 9 [(2x4) + (1x1)]. To gauge team performance, I summed weighted impact factor scores of all team members and divided them by the number of team members.

Knowledge availability. Last, I measured *knowledge availability* as a proxy

measure of team performance. Knowledge availability is an important outcome in R&D

teams, where the ultimate work purpose is to create new knowledge. Knowledge

availability in a team was measured using Spreitzer's (1996) access to resources. Three

items assess the extent to which team members have access to knowledge needed to

perform their jobs. Responses were made with a 7-point scale (1 = 'strongly disagree' to

7 = 'strongly agree'). Team members answered these questions.

  Controls. Team size, university dummy, team human capital, and needs for

networks were used as control variables. *Team size* was measured as the number of team

members in a team. *Team human capital* was measured as the proportion of people with a

doctoral degree and as the average of team members' tenure in a laboratory. Team

diversity may not always drive team members to engage in networking activities. Highly

educated or high performing individuals may be more motivated to gather information

and resources to achieve career goals. In addition, *needs for internal and external*

networks assessed by team members were included because they may determine

motivation to engage in networking activities. Four items (two items for needs for

internal networks and two items for needs for external networks) were developed for this

study. Responses were made using a scale ranging from 'not at all (1)' to 'to a great

extent (5)'. One example item for needs for internal networks is "To what extent do you

think your social-related relationship with your coworkers in your lab is needed to

perform your work effectively?" Therefore, team human capital and needs for networks

were controlled.

Data Analysis

  A regression procedure for mediation (Baron & Kenny, 1986) was conducted to

test the hypotheses of mediation. The hypotheses describe how team diversity influences

team performance through the mediation of internal social capital and external social

capital as illustrated in Figure 3. Sources of data are summarized in Figure 3 as well. The

moderation of task interdependence and task routineness was tested using hierarchical

block regression. To test the hypotheses, the regression analyses were conducted as the

following sequence. First, team performance was regressed on internal social capital after

controlling for diversity as well as control variables (team size, university dummy, the

average of tenure, Ph.D. proportion, and needs for internal and external networks).

Second, team performance was regressed on external social capital as well after

controlling for diversity and other control variables. Third, internal social capital was

regressed on team diversity after controlling for control variables. Fourth, external social

capital was regressed on team diversity after controlling for control variables. Fifth, task

interdependence and task routineness were added to all the prior models to test

moderation. Last, to test mediation (Baron & Kenny, 1986), I interpreted the results from

the first four hierarchical models.

Insert Figure 3 about here

RESULTS

Table 1 reports the means and standard deviations of all the variables. The frequencies and proportions of demographics are shown in Table 2. Teams in the sample have large proportions of international students or immigrants especially from China, India, and South Korea. The proportion of White U.S. citizens was 26.52%. The mean of perceived team performance rated by mangers was 5.50 (S.D. = .57), the mean of perceived team performance rated by employees was 5.32 (S.D. = .47), the mean of knowledge availability was 4.94 (S.D. = .71), and the mean of objective team performance was 1.25 (S.D. = 1.5). Unlike hypotheses, positive correlations between age and status diversity and internal social capital were found. However, I found the negative correlations between ethnic and gender diversity and internal social capital.

Insert Table 1 about here

Insert Table 2 about here

Perceived team performance rated by employees, cooperative norms, and task routineness were factor-analyzed to evaluate the structure of the measures. The results from a maximum likelihood method with a varimax rotation shown in Table 3, yielded an interpretable three factor solution that accounted for 53.1% of the variance. Factor loadings of .30 or higher were used to select items to explain a factor. Reliability was α = .70 for group norms for cooperation, α = .80 for task routineness, α = .89 for perceived

team performance (rated by employees). Reliability for knowledge availability was .92 and perceived team performance rated by managers was .88.

Insert Table 3 about here

Table 4 reports bivariate correlations for all the variables in the model. Unlike hypotheses, positive correlations between age and status diversity and internal social capital were found. However, I found negative correlations between ethnicity/nationality and gender diversity and internal social capital. Moderate correlations among the dimensions of internal social capital were found. No significant correlations between diversity and external social capital were found. Because there was a strong correlation between social cohesion and job-related cohesion (alpha=.79), predictor variables were checked for multicollinearity. The highest VIF in the model was 4.01, which is far below the commonly given rule of thumb of a maximum VIF value in excess of 10 (Neter, Kutner, Nachtsheim, & Wasserman, 1996). In addition, removing either social cohesion or job-related cohesion from the overall model significantly reduced the variance of some criterion variables (team performance variables), which invalidated the overall model. Therefore, substantial multicollinearity was not found in the model.

Table 5 and Table 6 summarize the results of hierarchical regression models testing all hypotheses. Overall, I found partial support for the hypotheses. Detailed results for each hypothesis are reported and interpreted in the following sections.

Insert Table 4 about here

Insert Table 5 about here

Insert Table 6 about here

The Relationship between Internal Social Capital and Team Performance

Table 7 provides the results of regression analyses of diversity and internal social capital on team performance. Overall, I found a mixed impact of diversity variables on team performance, as I hypothesized in H7. Diversity variables did not affect team performance variables unidirectionally. The relationships between diversity and team performance were sometimes negative, sometimes positive, or sometimes even non-significant.

To assess the impact of internal social capital on team performance, I conducted hierarchical regression analyses to see the addition of variance of internal social capital after controlling for diversity variables. Results show that teams with high internal social capital typically performed better than did teams with low social capital, supporting H1a, H1b, and H1c. Socially cohesive and cooperative teams reported that they had more available knowledge (β= .45, t=2.85, p<.01; β= .69, t=6.12, p<.01), supporting H1a and H1b. Highly cohesive teams, in terms of job-related activities, were more highly rated by

team managers than were less highly cohesive teams (β= .63, t=2.74, p<.01). In addition, if team members trust one another and have cooperative norms on a team, they tend to report that their team performs well (β= .64, t=2.99, p<.01; β= .45, t=2.51, p<.05).

Unlike H1a, however, the impact of social cohesion on team performance turned out to be opposite to the impact of the other dimensions of internal social capital on team performance. Socially cohesive teams were not favorably rated by team managers (β= -1.08, t=-5.32, p<.01) and by both team managers and team members (β= -0.79, t=-3.39, p<.01). However, unlike the negative consequence of social relationship within teams, internal social capital still contributed to the increase of available knowledge within a team. None of the internal social capital dimensions were significantly associated with objective team performance.

Insert Table 7 about here

The Relationship between External Social Capital and Team Performance

External network size was not significantly associated with all team performance variables, which did not support H2a. As seen in Table 8, however, some dimensions of external social capital were positively associated with team performance, supporting H2b and H2c. Teams that acquired strong social relationships with people in external informational networks were positively rated by team managers and team members after controlling for team diversity (β= .70, t=2.84, p<.01; β= .50, t=2.27, p<.05), supporting H2b. Interestingly, both external social relations and external job-related relations were strong predictors of objective team performance (β= .24, t=3.23, p<.01; β= .27, t=2.78,

p<.01), supporting H2b.

The diversity of external networks significantly enhanced team performance, which supported H2c. Teams with diverse informational networks in terms of level and ethnicity were more highly rated by managers (*β*= .84, *t*=3.37, *p*<.01; *β*= .69, *t*=2.20, *p*<.05). Teams with diverse informational networks in terms of major were more likely to be perceived as high performance teams by team members (*β*= .66, *t*=3.23, *p*<.01). Teams with diverse informational networks in terms of major reported that they have much knowledge available (*β*= .39, *t*=2.84, *p*<.01). However, the diversity of external level networks negatively predicted objective performance after controlling for external network size, social and job-related external network strength (*β*= -.34, *t*=-2.62, *p*<.05).

Insert Table 8 about here

The Relationship between Diversity and Internal Social Capital

A negative relationship between diversity and internal social capital was hypothesized (H3a ~ H4c). Yet, the results demonstrated the different impact between demographic and informational diversity on internal social capital, as seen in Table 9. Overall, two demographic diversity variables (ethnicity/nationality and age) negatively predicted internal social capital, supporting H3a~H3c. Informational diversity positively predicted internal social capital, which is opposite to H4a~H4c.

Ethnicity/nationality diversity, one dimension of demographic diversity, negatively affected social cohesion (*β*= -.68, *t*=-3.61, *p*<.01), job-related cohesion (*β*= -.64, *t*=-4.01, *p*<.01), trust density (*β*= -.78, *t*=-3.88, *p*<.01), and group norms for

cooperation (β= -.45, t=-2.16, p<.05), even after controlling for task interdependence and task routineness. Diverse teams in terms of age were likely to report lower trust level within teams (β= -.37, t=-2.42, p<.05). However, diverse teams in terms of sex were more likely to be socially cohesive (β= .48, t=2.77, p<.05), had higher trust levels (β= .43, t=2.33, p<.05), and had more cooperative group norms (β= .76, t=4.22, p<.01).

Interestingly, informational diversity, the diversity of knowledge, skills, and experiences related to tasks and jobs (status, tenure, and major), positively predicted social cohesion, job-related cohesion, and group norms for cooperation, which is opposite to H4a~H4c. Status diversity was positively associated with social cohesion (β= .42, t=2.63, p<.01) and job related cohesion within a team (β= .32, t=2.42, p<.01), even after controlling for task interdependence and task routineness. Teams with high tenure diversity were more likely to build cooperative norms (β= .73, t=3.78, p<.01). Teams with high major diversity were more likely to be socially cohesive (β= .29, t=2.12, p<.05) and build cooperative norms (β= .32, t=2.20, p<.05).

Insert Table 9 about here

The Relationship between Diversity and External Social Capital

In Table 10 and Table 11, results showed the mixed impact of demographic and informational diversity on various dimensions of informational external social capital. Team demographic and informational diversity was not associated with the size of external informational networks, not supporting H5a. However, only major diversity, one dimension of informational diversity, was negatively associated with external network

size (β= -.41, t=-2.74, p<.05), which is opposite to H6a.

H5b and H6b were partially supported. Neither demographic nor informational diversity were associated with external social relations. Yet, ethnicity/nationality diversity positively predicted the strength of job-related relations in external networks (β= .55, t=2.77, p<.01).

As predicted in H5c and H6c, demographic diversity was more likely to be related to the demographic diversity of external informational networks and informational diversity was more likely to be related to the informational diversity of external informational network. Diverse teams in terms of ethnicity/nationality were more likely to acquire networks with people with different ethnic background outside of teams (β= .59, t=3.32, p<.01). Similarly, diverse teams in terms of major reported that they had a diversity of external networks in terms of department (β= .38, t=3.28, p<.01). Yet, the age diversity was positively associated with the major diversity of external networks. The results suggest that people tend to acquire knowledge and information through homophilious external networks.

Insert Table 10 about here

Insert Table 11 about here

The Moderating Effects of Task Characteristics

Both task interdependence and task routineness significantly moderated the relationship between diversity and social capital and the relationship between social capital and performance. Yet, the effects of task interdependence and task routineness on the relationship between diversity and social capital and the relationship between social capital and team performance did not show consistent patterns. Results are summarized below.

Insert Table 12 about here

Insert Table 13 about here

Task interdependence as a moderator of the relationship between diversity and internal social capital. Only two interactions between diversity and internal social capital were supported H8a. However, the other significant interactions between diversity and internal social capital showed inconsistent results. Tenure diversity was negatively associated with job cohesion when team tasks were not interdependent, whereas tenure diversity was not associated with job cohesion when team tasks were interdependent (β= 2.03, t=7.90, p<.01), supporting H8a (see Figure 11). The negative relationship between ethnicity/nationality diversity and cooperative norms was stronger in less interdependent teams than in more interdependent teams (β= 2.76, t=10.15, p<.01), supporting H8a (see Figure 15).

On the contrary, diversity was more positively associated with some internal social capital variables under low interdependence than under high interdependence. Age and status diversity were more positively related to social and job-related cohesion under low task interdependence than under high task interdependence (see Figure 4 & 5 and Figure 9 & 10). In addition, ethnicity/nationality diversity was more positively related to trust under low task interdependence than under high task interdependence (see Figure 12). Sex, tenure, and major diversity were more positively related to cooperative norms under low task interdependence than under high task interdependence (see Figure 14, 17, & 18). These results imply that diverse team members were more likely to perceive close relations to one another when their tasks did not require them to work together closely.

In addition, some diversity variables (tenure, sex, status diversity) positively predicted internal social capital under high interdependence and negatively predicted internal social capital under low interdependence. Tenure diversity was positively related to social cohesion under high task interdependence, whereas it was negatively related to social cohesion under low task interdependence (see Figure 6). Similarly, sex diversity was positively related to job-related cohesion under high task interdependence, whereas it was negatively related to job-related cohesion under low task interdependence (see Figure 7). Status diversity was more positively related to cooperative norms under high task interdependence than low task interdependence (see Figure 16). These results were opposite to H8a. In teams that were required to work together, team members from different demographic background can actively interact with one another.

Insert Figures 4 through 18 about here

Task interdependence as a moderator of the relationship between diversity and external social capital. Task interdependence significantly moderated the relationship between diversity and external networks. Yet, task interdependence sometimes strengthened the relationship and sometimes weakened the relationship. Similar to the moderation of task interdependence between diversity and internal social capital, the moderation of task interdependence between diversity and external social capital did not show consistent patterns.

The positive relationships between status diversity and external network size (see Figure 21), between sex diversity and external social relations (see Figure 23), and between status diversity and external social relations (see Figure 25) were stronger when task interdependence was high than low, supporting H8b.

On the contrary, the positive relationships between sex diversity and external network size (see Figure 19), between major diversity and external network size (see Figure 22), between ethnicity/nationality diversity and external job-related relations (see Figure 27), between ethnicity/nationality diversity and diversity of external ethnic networks (see Figure 32), and between major diversity and diversity of external major networks (see Figure 33) were stronger when tasks were less interdependent. Team members from different social groups may not have close interactions with each other. In particular, because team members did not need to work together under low task interdependence, they would not have a chance to build relationships within the team.

Therefore, diverse teams would engage in external networking more actively when they were not required to work together.

Insert Figures 19 through 34 about here

Task interdependence as a moderator of the relationship between internal social capital and performance. Overall, task interdependence weakened the relationship between internal social capital (cohesive, cooperative, and trust) and performance, which is opposite to H8c. The results showed that teams that had high internal social capital were likely to perform better, were more highly rated by managers and members, and had more available knowledge when team members were not obliged to work together than when team members were required to work together. The relationship between social cohesion and performance and knowledge availability was more strongly positive when team tasks were not interdependent than when tasks were interdependent (see Figure 35, 37, 41, & 45). Similarly, trust and cooperative norms among team members were more likely to enhance team performance in less interdependent teams than more interdependent teams (see Figure 39, 40, 43, & 44).

The relationship between job-related cohesion and team performance showed different patters from the relationship between the other internal social capital variables (cohesive, cooperative, and trust) and performance. The relationship between job-related cohesion and team performance was more negative when tasks were interdependent than when tasks were not interdependent (see Figure 36, 38, & 42).

Insert Figures 35 through 45 about here

Task interdependence as a moderator of the relationship between external social capital and performance. The positive relationships between external network size and team performance (rated by team members and knowledge availability), between external social relations and team performance (rated by team members and objective team performance), and between external job-related relations and objective team performance were weaker under high task interdependence than low task interdependence, opposite to H8d (Figure 49, 50, 54, 56, & 57). In other words, teams that engaged in active external networking would perform better when team members did not need to work together within teams than when they had to work together within teams. The result may imply that team members are able to allocate more time to external networking instead of internal networking to obtain a lot of knowledge and information when they are not obliged to work with other team members than when they must work with other team members.

In addition, external network size and external social relations had negative relationships with performance rated by managers when tasks were not interdependent whereas they were not related to performance rated by managers when tasks were interdependent (see Figure 46 & 47).

I found only two interactions supporting H8d. The positive relationships between external job-related relations and team performance rated by managers (β= 5.25, t=5.78, p<.01) and between external network size and objective team performance (β= 1.51,

t=3.91, *p*<.01) were stronger under high task interdependence than low task

interdependence, supporting H8d (see Figure 48 & 55).

Insert Figures 46 through 57 about here

Task routineness as a moderator of the relationship between team diversity and

internal social capital. Overall, the results showed that the moderation of task

routineness between team demographic diversity and internal social capital was different

from the moderation of task routineness between team informational diversity and

internal social capital.

On the one hand, diverse teams in terms of major, tenure, and status (high

informational diversity) increased internal social capital (social cohesion, job-related

cohesion, trust, and cooperative norms) more highly when tasks were not routine than

when tasks were routine (see Figure 59, 60, 62, 65, 66, 67, 71, 72, &73). The results

suggest that when tasks were non-routine and complex, team members were motivated to

interact with other team members who had different skills, experience, and knowledge to

acquire information and knowledge, which as a result increased internal social capital.

On the other hand, diverse teams in terms of ethnicity/nationality and age (high

demographic diversity) decreased internal social capital more highly when tasks were not

routine than when tasks were routine, which is opposite to H9a (see Figure 58, 61, 64, 69,

& 70). The results implied that team members who were demographically different from

one another were more likely to have interpersonal conflicts when tasks were complex

and non-routine, which may lower internal social capital. Since non-routine tasks may

require team members to interact with one another, individuals would have more

opportunities to recognize their value and cultural differences between different

ethnicity/nationality and age groups and would increase interpersonal conflicts within

teams.

Insert Figures 58 through 73 about here

Task routineness as a moderator of the relationship between team diversity and

external social capital. Similarly, the moderating effects of task routineness were

different for different types of team diversity. Informational diversity tends to increase

external social capital more under task non-routineness than under task routineness.

Ethnicity/nationality, status, and tenure diversity increased external network size more

highly when tasks were non-routine than when tasks were routine (β= -2.76, t=-2.39,

p<.05; β= -5.28, t=-5.90, p<.01; β= -3.60, t=-4.15, p<.01), supporting H9b (see Figure 74,

76, & 77). Sex, status, and tenure diversity increased external social relations more highly

when tasks were non-routine than when tasks were routine (β= -10.04, t=-8.90, p<.01; β=

-3.70, t=-3.20, p<.01; β= -6.34, t=-5.67, p<.01), supporting H9b (see Figure 78, 81, &

82).

On the contrary, demographic diversity tends to decrease external social capital

more under task non-routineness than under task routineness. Age diversity decreased

external network size more highly when tasks were non-routine than when tasks were

routine (see Figure 75). Ethnicity/nationality and age diversity decreased external social

relations more highly when tasks were non-routine than when tasks were routine (see

Figure 79 & 80). Sex diversity decreased external job-related relations more highly when tasks were non-routine than when the tasks were routine (see Figure 84).

In addition, task routineness moderated the relationship between demographic and informational diversity and the diversity of external social capital. Major diversity increased the diversity of external major and department networks more highly when tasks were non-routine than when tasks were routine (β= -5.34, t=-7.04, p<.01; β= -2.51, t=-4.84, p<.01), supporting H9b (see Figure 87 & 88). However, sex diversity increased the diversity of external sex networks more highly and status diversity decreased the diversity of external level networks more highly when tasks were routine than when tasks were non-routine, which is opposite to H9b (see Figure 85 & 86).

Insert Figures 74 through 88 about here

Task routineness as a moderator of the relationship between internal social capital and performance. The relationship between internal social capital and team performance was contingent on task routineness. Job-related cohesion increased performance as rated by managers (β= -6.97, t=-5.58, p<.01) and knowledge availability more highly (β= -5.36, t=-4.55, p<.01) when tasks were non-routine than when tasks were routine, supporting H9c (see Figure 90 & 98). Similarly, social cohesion, trust density, and cooperative norms increased performance rated by members more highly when tasks were non-routine than when tasks were routine (β= -10.27, t=-4.61, p<.01; β= -7.43, t=-5.00, p<.01; β= -3.83, t=-7.04, p<.01), supporting H9c (see Figure 92, 94, & 95).

On the contrary, social cohesion and cooperative norms decreased performance rated by managers more highly (Figure 89 &91), job-related cohesion decreased performance rated by members (Figure 93), and social cohesion decreased knowledge availability (Figure 97) more highly when tasks were non-routine than when tasks were routine, which is opposite to H9c.

Insert Figures 89 through 98 about here

Task routineness as a moderator of the relationship between external social capital and performance. Last, there is significant evidence that the relationship between external social capital and team performance was moderated by task routineness. External job-related relations were more likely to be positively related to perceived team performance rated by managers and members and objective team performance when tasks were non-routine than when tasks were routine (β= -7.12, t=-4.86, p<.01; β= -3.97, t=-6.89, p<.01; β= -3.68, t=-5.43, p<.01), supporting H9d (see Figure 99, 102, & 109). In addition, external network size was more likely to be positively related to perceived team performance rated by members and objective team performance when tasks were non-routine than when tasks were routine (β= -1.07, t=-3.32, p<.01; β= -2.45, t=-6.58, p<.01), supporting H9d (see Figure 100 & 107).

External social relations, however, were related to objective team performance more strongly when tasks were routine than when tasks were non-routine. External social relations were positively related to performance rated by members and knowledge availability when tasks were routine, whereas external social relations were negatively

related to performance rated by members and knowledge availability when tasks were non-routine (see Figure 103 & 105).

Insert Figures 99 through 106 about here

The Mediating Roles of Internal and External Social Capital

The impact of diversity on team performance was sometimes positive, sometimes negative, or sometimes non-significant (see Table 7) as I argued in H7. However, it was not obvious that the impact of diversity on team performance was contingent on the difference between diversity impact on performance through internal social capital and diversity impact on performance through external social capital. First, most diversity variables except ethnicity/nationality diversity were positively associated with internal social capital, which is opposite to the hypotheses (see Table 9). Second, diversity was not related to external social capital with a few exceptions (see Table 10 & 11). Third, internal social capital was not associated with objective team performance and negatively influenced performance as rated by managers.

Nevertheless, internal and external social capital mediated the relationship between ethnicity/nationality and major diversity and some team performance variables. Internal social capital (social cohesion, trust, and cooperative norms) and external social capital (job-related relations and diversity of external ethnic networks) mediated the impact of ethnicity/nationality diversity of perceived team performance rated by managers and members and knowledge availability. The combination of the strong relationships between ethnicity/nationality diversity and internal social capital and

between and internal social capital and team performance was stronger than the combination of the weak relationship between ethnicity/nationality diversity and external social capital and between external social capital and performance. Similarly, major diversity moderately affected knowledge availability through the mediation of both internal social capital (social cohesion and cooperative norms) and external social capital (external network size and diversity of external level networks and department networks).

The mediation of internal social capital between status diversity and team performance rated by members was found. In addition, sex, status, and tenure diversity were associated with team performance through the mediation of internal social capital. However, external social capital did not mediate the relationship between such diversity variables and team performance.

DISCUSSION

The following research questions were investigated in the thesis: Is team diversity a determinant of internal and external social capital and team performance? Does internal and external social capital mediate the link between diversity and team performance? Do task characteristics moderate the link between diversity and social capital and the link between social capital and team performance? Why are there conflicting results on diversity research? I collected data from science laboratories that are similar settings to R&D teams in organizations to investigate those research questions. Although there were some inconsistent or mixed results found, there were a number of interesting results.

First, after controlling for diversity, internal social capital was positively associated with performance ratings by managers and members and knowledge availability. However, interestingly, laboratory managers unfavorably rated socially cohesive teams. The negative relationship between social cohesion and perceived team performance rated by managers may be explained by unique work styles and climate in laboratory teams. In interviews with managers, they emphasized the importance of job-related social capital for enhancing team performance, but believed that social gathering was related neither to their performance nor to productivity. They thought spending time with colleagues after work could lead to wasting work time. Because of their skeptical views on the social relationship, team managers may rate socially cohesive teams low on team performance.

Another finding was the positive relationship between external social capital and performance. Specifically, teams with strong social relations with people in external informational networks were rated as high-performing teams by managers and members

and produced more publications. In addition, teams with strong external social and job-related relations produced more publications than did teams with weak external social and job-related relations. In addition, the diversity of external level, ethnic, major and department networks was positively associated with perceived team performance as rated by managers and members and with overall knowledge availability.

Interestingly, however, external network size appeared not to be related to any team outcome variables. These results may be explained by the strong tie argument (Hansen, 1999), suggesting that the number of people in a network would not explain the acquisition of tacit knowledge through the network that may contribute to performance. The strength of relationships in a network would play a more significant role to motivate to share and obtain tacit knowledge. Accordingly, the strength of relationships in external informational networks may be more critical for work performance than external network size.

Demographic diversity was *negatively* associated with internal social capital, whereas informational diversity was *positively* associated with internal social capital. The positive relationship between informational diversity and internal social capital can be explained in that diverse job status, tenure, and major backgrounds may facilitate interpersonal interactions within R&D teams and may not merely increase interpersonal conflicts. In particular, in a knowledge and innovation intensive climate, team members are more likely to recognize that the collaboration among people who have different knowledge and skills is a key for the increase of team performance, innovation and creativity (Jackson et al., 2003). In other words, R&D team members may see the value or needs of social capital with people who have new and advanced knowledge and

information. Besides, since collaboration among people who have different skills and specialties is necessary for the nature of science research, some professors intentionally hire lab members who have different backgrounds and promote lab members to share and learn from each other. Therefore, informational diversity enhanced internal social capital.

Whereas diversity was a strong predictor of internal social capital, most diversity variables were not significantly related to external social capital. Since the positive impact of informational diversity on internal social capital implies that team members can obtain sufficient work-related information through networks within teams, they would not need to make external networks to acquire information and knowledge. Some team managers even reported hiring new team members who have different knowledge and specialties to instill new ideas and skills. Further, since the subjects of research projects in R&D teams are too specialized, and knowledge and skills required in a research project may be very different from those in other research projects, team members would not feel the need to engage in external networking. For these reasons, diversity was not a significant predictor of external social capital in R&D teams.

As for the relationship between diversity and team performance, I argued that the relationship would not be consistent because the relationship may depend on the relationships among diversity, social capital, and performance. Informational diversity positively predicted internal social capital and diversity had a weak relationship with external social capital. Further, the direction of the impact of diversity on performance did not clearly depend on the strength of the relationships among diversity, internal and external social capital, and performance. Only the negative impact of ethnicity/nationality diversity on performance could be explained by the difference between the diversity -

internal and external social capital relationship and the internal and external social capital performance relationship.

Task characteristics turned out to be significant predictors of internal social capital and team performance. Although the main impact of task characteristics on social capital and team performance was not hypothesized, task interdependence increased internal social capital and improved team performance ratings. Task routineness significantly decreased internal social capital.

The relationships between diversity and internal and external social capital and between internal and external social capital and performance were significantly moderated by task interdependence and task routineness even when there were no main impacts. Unfortunately, the moderating effects of task interdependence did not always support the hypotheses and did not show consistent patterns.

However, the moderation of task routineness showed much more consistent patterns. Overall, teams that performed non-routine tasks had the stronger relationships between diversity and internal and external social capital than did teams that performed routine tasks. Informational diversity increased internal social capital more highly when tasks were not routine than when tasks were routine. Non-routine and complex tasks motivate team members to make connections with other team members who have different skills, experience, and knowledge in order to acquire information and knowledge, which in return increased internal social capital. On the other hand, demographic diversity decreased internal social capital more highly when tasks were not routine than when tasks were routine. The results suggest that team members who were demographically different from one another were more likely to have interpersonal

conflicts when tasks were complex and non-routine, which may lower internal social capital. Since non-routine tasks may require team members to interact with one another, individuals would have more opportunities to recognize their value and cultural differences between different ethnicity/nationality and age groups and would increase interpersonal conflicts within teams. Non-routine tasks may motivate team members to acquire new knowledge and information and thereby to engage in internal and external networking. Therefore, the positive impact of diversity on internal and external social capital increased when tasks were non-routine.

In addition, teams that performed non-routine tasks had stronger relationships between job-related internal and external social capital and team performance than did teams that performed routine tasks. However, interestingly, teams that performed routine tasks had stronger relationships between social-related internal and external social capital and team performance than did teams that performed non-routine tasks. In other words, job-related networking was facilitated under non-routine tasks, whereas social-related networking was increased more under routine tasks. The results imply that team members were more likely to engage in social activities with people in their internal and external networks when tasks were routine because they did not need to spend time on job-related networking and instead spent more time on social-related networking.

Contributions

In the context of increasing interests in team diversity effectiveness in both the academic and business world, team diversity research has long been developed and is increasingly sophisticated. Yet, there are still some weaknesses in team diversity research. The most noticeable weakness may be that prior research did not find consistent results

on the impact of diversity on team performance. Therefore, the current study attempted to answer a fundamental question on the drawback of research findings in previous diversity research: Why are there mixed results on diversity research? To answer the question, I adopted and extended Reagans et al. (2004)'s theoretical and practical argument. Reagans et al. (2004) argued and showed that the insignificant effects of team functional diversity on team performance were caused by the tradeoff between the effect of functional diversity on team performance via internal networks and the effect of functional diversity on team performance via external networks. Although I found some different results from the hypotheses, I found the negative impact of ethnicity/nationality on performance in the tradeoff between the negative relationship in diversity and performance via internal social capital and the positive relationship in diversity and performance. This supports Reagans et al. (2004)'s argument. However, Reagans et al. (2004)'s argument should be carefully examined by considering the context and relations in the team, since informational diversity is positively associated with internal social capital. Demographic diversity may increase conflicts and reduce internal interactions and, at the same time, informational diversity may increase internal interactions. In addition, the mixed impact of diversity on performance may be caused by the lack of understanding of task characteristics. Task interdependence and task routineness/non-routineness as contextual factors may determine interpersonal relationships among team members and network behaviors. Thus, this study advanced research on diversity and social capital by investigating the importance of task characteristics for the linkage among team diversity, internal and external social capital, and team performance.

Another weakness found in prior diversity studies was that diversity research

tends to focus on only a few demographic attributes (Jackson et al., 2003). However, in the actual organizational context, individual behaviors and attitudes, interpersonal relations, and subsequent reactions would not occur based on only a few social groups. Individuals would feel in-group favoritism and out-group discrimination based on various individual attributes. Hence, this study closely examined the different influences of demographic and informational diversity on internal and external social capital.

Previous research on the black box between diversity and team performance has focused on either internal dynamics or external social capital (for example, Nelson, 1989; Tsai, 2002; Yli-Renko, Autio & Sapienza, 2001) alone, but not both. Team diversity may increase the likelihood that team members do not closely interact with one another and may engage in more external networking with people with similar backgrounds to their own. Since team external networks are critical sources of new perspectives and resources (Joshi, 2006; Reagans & Zucherman, 2001), diverse teams may perform better using external networks. In particular, for R&D teams that are likely to engage in knowledge work, increased resources and information through external networks contribute to better team performance. Nevertheless, few studies of team diversity consider external social capital and networks. The current study is one of only a few studies to capture both team-level internal and external social capital.

In addition, this study is one of the few studies to examine team social capital. Mapping social networks of all organizational members may not be practically feasible as a means of exploring the internal social capital of an organization. However, it is somewhat striking that even team-level internal social capital has not been extensively investigated (for an exception, see Oh, Chung, & Labianca, 2004; Reagans, Zuckerman,

& McEvily, 2004). Since team members develop social capital *within* as well as *outside* a team boundary, team dynamics may be better captured by taking into account both internal and external social capital than any single form of social capital. Therefore, this study explains the black box by considering external dynamics as well as internal dynamics. This study is one of a few studies on team-level internal and external social capital.

This study also provides practical implications regarding how organizations should manage R&D teams. When team members do not have close relationships, the information and resources that some team members acquire from external networks may not be shared with other team members. In addition, team diversity may impede the accomplishment of both goals to enhance internal and external social capital. The complex dynamics, with regard to the diversity impact on team performance, demonstrate that increasing team diversity is not a sufficient condition for enhancing team performance in R&D teams. When selecting team members, organizations should consider internal and external social capital as well as diversity.

Since the relative advantages between internal and external social capital depend on task requirements, companies need to take into account whether demographic composition and social capital are matched with task requirements. Furthermore, in light of team task requirements corresponding to their strategies, companies should make a decision whether they focus on either internal social capital or external social capital in order to increase team performance.

From interviews with managers and members, interviewees admitted that they did not see the contribution of external informational networks to team performance. In

particular, they did not value social relations in external informational networks. However, science laboratories that engaged in strong social and job-related relationships, and where there were demographically diverse relationships in their external informational networks, were more likely to perform well. The results address that team managers and members did not acknowledge the worth of external informational networks, but that these networks in fact significantly enhanced team performance. The finding may provide critical implications on laboratory operations and management in that lab leaders and members should understand the value of external social capital as a source of knowledge and information and then make efforts to utilize external social capital for developing their knowledge and skills.

Limitations and Research Direction

Although there were significant theoretical and practical contributions in the findings, this study has a few limitations. First, results found the negative relationship between demographic diversity and internal social capital and the positive relationship between informational diversity and internal social capital. Although the relationship between diversity and internal social capital was mixed, the results would not be different from diversity research. The mixed effects of diversity on team processes have long been found in prior studies (for a review, Jackson et al., 2000; Milliken & Martins, 1996). The positive effect of tenure and major specialty diversity may be explained in a few ways. The overlap in backgrounds among the members of a subgroup may have a positive impact on the exchange of information and productive debates, because subgroup members may form a cohort that shares similar perspectives and thus form a supportive climate (Gibson & Vermeulen, 2003). Hence, team informational diversity can improve

team performance through the expansion of creative and innovative ideas (Jackson et al., 2003).

The mixed impact of diversity may be caused by using inappropriate measures of team diversity. Diversity measures (Blau's index and coefficient of variation) in this study assume that the effects of individual demographic attributes are independent of each other. This approach may not be appropriate because the effects of multiple attributes may not be additive. As an alternative approach, fautlines that may capture multiple attributes simultaneously (Lau & Murnighan, 1998) may reduce the measurement error of team diversity, which may eliminate the mixed impact of diversity. Therefore, drawing on faultlines theory, future research may better capture team diversity using multiple attributes at the same time.

There were also a few limitations on measures. Team members rated knowledge availability and perceived team performance. To reduce self-rated bias, I also measured team performance rated by team managers and objective team performance using the quality and quantity of publications in the past year. The objective team performance variable, however, may not offer a true representation of team performance because research publications are typically produced after at least one-year's examination and thus they may not be conducted in the same research labs. Further, many team members who consist of doctoral students worked in the team for only a few years. Although there may be potential measurement biases in objective team performance, it may still be a valid measure to assess team performance in that team publications can stand for productivity of the teams. To reduce the bias, I eliminated team members who worked for the team for less than six months from the data. In addition, although I used some self-

reported outcome variables, some key independent variables such as demographic and informational diversity were computed using objective individual attributes. Further, task interdependence was evaluated by team managers.

Although the overall relationship between social capital and team performance was assumed to be linear and positive, the true relationship may be curvilinear. According to the network closure perspective, close relationships among team members may improve team performance. However, an internal bond that is too strong may inadvertently develop a cognitive barricade toward the external world. In other words, if team members develop strong relationships and team identities, they may not be open to interacting with external members. In addition, because too strong relationships in networks may increase the likelihood that individuals acquire similar knowledge and information repeatedly, actual knowledge creation can be inhibited in the long-term (McFadyen & Cannella, 2004). As a result, too strong internal social capital may not contribute to the enhancement of team performance, because of the limited access to knowledge and information.

Similarly, too strong ties with people outside the team may decrease the internal cooperation and collaboration that are necessary to perform team tasks successfully, because team members do not develop the optimal level of team identity and psychological bond (Oh et al., 2004). Team members may not put forth enough time and effort to socialize with other team members when they spend too much time and effort on interacting with external members. Consequently, too strong external social capital may not be positively associated with team performance because it may reduce internal social capital. Yet, social capital and social network research has not examined the curvilinear

relationship between internal (or external) social capital and team performance (for an exception, Oh et al., 2004). In future research, I would argue that the relationship between the internal and external social capital and team performance may be an inverted-U shape.

Team leader behaviors and styles may be critical factors that impact the effect of diversity on internal and external social capital and team performance. According to preliminary interviews with team leaders and members, team leaders in R&D teams can have a huge effect on team member behaviors and team effectiveness. Team leaders assign the roles and tasks for each team member in a research project. Since team leaders are financially in charge of the teams, their power over team members would be stronger than the power of team leaders in other types of teams. Therefore, leadership styles may moderate the effect of diversity on internal and external social capital and the effect of the internal and external social capital on team performance.

Last, scientists who are working in laboratories were from many different countries. Nearly 43 percent of the sample were from Asian countries such as China, India, and South Korea. Six percent of the sample were from European countries. Even though I measured nationality diversity by using objective categories, it may not capture cultural differences that may affect their interactions. For example, the diversity score of teams that consist of an Asian Indian, an African, and a White-American were the same as the score of teams that consist of a Korean, a Chinese, and a Japanese, because each team member in both teams has different national backgrounds. Yet, team members in the former team would be more culturally distant from one another than would those in the latter team since the former team members were from more culturally distant countries.

Team members in the former team may feel more attracted to one another than those in the latter team. Accordingly, the team dynamics of nationally diverse teams may not be fully captured by assessing nationality diversity.

To detect cultural diversity in nationally diverse teams, cultural differences embedded in national origin should be considered. Drawing on Hofstede (1991) and Kogut & Singh (1988)'s approach, I would use the cultural index of Hofstede to measure those cultural dimensions and would be able to compute team diversity based on the cultural index. Using the cultural diversity measure, I would be able to examine the impact of deep-level diversity on social capital and performance.

Conclusion

This study examined the impact of demographic and informational diversity on team performance through the mediation of internal and external social capital in order to investigate the black box between diversity and performance. This study also examined the moderation of task interdependence and routineness. I found the positive impact of informational diversity on internal social capital and the negative impact of demographic diversity on internal social capita. Both internal and external social capital increased performance. Although there were some mixed results, findings suggest that the negative impact of ethnicity/nationality diversity on team performance relied on the tradeoff relationship between ethnicity/nationality diversity and performance via internal social capital and between ethnicity/nationality diversity and performance via external social capital. In addition, task characteristics played significant roles on team members' networking and interpersonal relationships in diverse teams.

TABLE 1. Descriptive Statistics

Variables	Mean	s.d.
University dummy	.66	.48
Team size	4.28	1.32
Tenure average	3.16	2.28
Ph.D. proportion	34.10	30.20
Needs for coworker network	3.84	.44
Needs for external network	3.15	.67
Sex diversity	.27	.22
Ethnic nation diversity	.50	.30
Age diversity	.13	.08
Status diversity	.34	.27
Tenure diversity	.53	.31
Major specialty diversity	.45	.40
Social cohesion	.84	.34
Job-related cohesion	.74	.37
Trust density	.39	.18
Group norms for cooperation	5.09	.56
External network size	3.22	1.68
External social relations	.38	.14
External job-related relations	.45	.10
Diversity of external sex networks	.48	.21
Diversity of external level networks	.82	.16
External level higher	.69	.21
Diversity of external ethnic networks	.47	.27
Diversity of external major networks	.43	.30
Diversity of external department networks	.43	.27
Task interdependence (TI)	1.32	.39
Task routineness (TR)	3.44	.79
Perceived team performance (rated by managers)	5.50	.57
Perceived team performance (rated by members)	5.32	.47
Perceived team performance (rated by both managers and members)	10.82	.72
Knowledge availability	4.94	.71
Objective team performance	1.25	1.50

TABLE 2. Demographic Profiles of the Sample

Demographics		Frequency	Percent (%)
Sex	Male	132	50.00
	Female	132	50.00
Citizenship	U.S.	106	40.15
	Non-U.S.	158	59.85
Job status	Professor	12	4.55
	Post-doc	64	24.24
	Technician	24	9.09
	Doctoral student	142	53.79
	Master's student	22	8.33
Ethnicity/nationality	White-U.S.	70	26.52
	Black- U.S.	4	1.52
	Hispanic- U.S.	2	.76
	Indian- U.S.	10	3.79
	Chinese- U.S.	12	4.55
	Others- U.S.	8	3.03
	Indian	28	10.61
	Chinese	62	23.48
	Japanese	6	2.27
	Korean	24	9.09
	Taiwanese	6	2.27
	Australian & Canadian	6	2.27
	European	16	6.06
	Hispanic	6	2.27
	Others	4	1.52

TABLE 3. Factor Analysis Results

Items	Factor		
	1	2	3
Perceived performance 8	.85		
Perceived performance 7	.80		
Perceived performance 6	.76		
Perceived performance 5	.70		
Perceived performance 1	.68		
Perceived performance 2	.62		
Task routineness 5		.94	
Task routineness 4		.90	
Task routineness 3		.56	
Task routineness 1		.47	
Task routineness 2		.35	
Group norms for cooperation 1			.90
Group norms for cooperation 3			.70
Group norms for cooperation 4			.58
Group norms for cooperation 1			.34
Group norms for cooperation 2			.32

TABLE 4. Intercorrelations[a]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. University dummy															
2. Team size	-.07														
3. Tenure average	-.23	-.09													
4. Ph.D. proportion	.10	-.28*	.04												
5. Needs for coworker network	-.05	-.04	-.51**	-.35**											
6. Needs for external network	.06	-.18	-.30*	.08	.38**										
7. Sex diversity	-.17	.44**	.20	-.06	-.11	-.09									
8. Ethnicity/nationality diversity	-.30*	.18	.13	-.35**	.17	-.10	.48**								
9. Age diversity	-.40**	.06	.06	-.10	-.06	-.42**	.19	.18							
10. Status diversity	-.56**	.03	.19	.17	.02	-.23	.24	.26	.50**						
11. Tenure diversity	-.09	.26*	.11	-.15	-.17	-.37**	.03	.46**	.39**	.32*					
12. Major diversity	-.28*	-.09	.12	-.08	.29*	.26	.18	.25	.05	.34**	-.22				
13. Social cohesion	-.16	-.22	.13	.12	-.29*	-.07	.17	-.09	.27*	.39**	.02	.23			
14. Job-related cohesion	.00	-.14	.20	.19	-.29*	-.13	.19	-.15	.28*	.31*	-.09	.29*	.79**		
15. Trust density	.27*	.03	-.29*	.14	-.20	.03	.01	-.36**	-.10	-.06	-.10	-.08	.54**	.57**	
16. Cooperative norms	-.12	.06	-.10	-.27*	.23	-.02	.35**	.35**	.33*	.16	.30*	.21	.13	.19	-.04
17. External network size	-.24	-.15	.22	.08	-.12	.19	-.07	-.06	.15	.15	.19	-.20	.03	-.27*	-.02
18. External social relations	-.20	-.14	.06	-.17	.13	.19	.04	.00	-.04	.05	-.13	.23	.06	-.04	.09
19. External job-related relations	.09	-.03	.31*	.16	.01	.20	.21	.29*	-.14	.18	.01	.29*	.10	.37**	-.04
20. Diversity of external sex networks	-.06	.25	-.12	-.08	-.24	.06	.12	.02	-.01	-.09	.08	-.11	.19	.02	.12
21. Diversity of external level networks	-.04	-.06	.34**	-.09	-.11	-.38**	.18	-.05	.01	.12	-.20	-.10	.15	.30*	-.03
22. Diversity of external ethnic Networks	.22	-.11	.09	.10	-.21	-.22	-.03	.17	.18	.32*	.23	.14	.23	.37**	.05
23. Diversity of external major networks	-.20	.03	.01	-.12	.02	.06	.12	.00	.46**	.25	.00	.24	.40**	.25	.05
24. Diversity of external department networks	-.24	-.05	.06	.36**	.01	.49**	.04	-.18	.06	.29*	-.18	.47**	.31*	.34**	.13
25. Task interdependence (TI)	-.25	-.10	.18	.19	-.14	.10	-.18	.08	.08	.18	.20	.20	.25	.39**	.15
26. Task routineness (TR)	.03	.18	-.21	-.42**	.56**	.26	.17	.01	-.26*	-.20	-.29*	.17	-.25	-.27*	-.05

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
27. Perceived performance (by managers)	-.07	-.05	-.08	-.08	-.15	.06	-.20	-.18	.16	-.11	.23	-.39**	-.14	-.03	.16
28. Perceived performance (by members)	.02	-.10	.08	-.11	.05	-.15	.18	.32*	.23	-.11	.02	.09	-.07	.03	-.05
29. Perceived performance (by both)	-.04	-.11	-.01	-.13	-.08	-.06	-.04	.07	.28*	-.16	.20	-.24	-.15	.00	.09
30. Knowledge availability	-.12	-.02	-.17	-.22	.21	.53**	.17	.12	-.16	-.15	-.02	.20	.14	-.02	.05
31. Objective team performance	-.07	-.25	.80**	.26	-.49*	-.35**	-.03	-.06	.07	.23	.08	.06	.19	.30*	-.15

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
17. External network size	-.13														
18. External social relations	.08	.17													
19. External job-related relations	.01	-.17	-.17												
20. Diversity of external sex networks	.04	.04	-.44**	-.16											
21. Diversity of external level networks	-.11	-.20	-.35**	.26*	.08										
22. Diversity of external ethnic networks	.16	-.22	-.51**	.26	.29*	.09									
23. Diversity of external major networks	.20	.19	-.23	-.19	.51**	.03	.25								
24. Diversity of external department networks	.14	.14	.22	.28*	-.08	-.27*	-.04	.21							
25. Task interdependence (TI)	.12	.11	-.16	.26	.20	-.10	.27*	.24	.36**						
26. Task routineness (TR)	.19	-.04	.25	-.14	-.04	-.11	-.32*	.01	-.01	-.13					
27. Perceived performance (by managers)	.14	.28*	.13	-.25	.11	-.02	-.16	.05	.04	.33*	.06				
28. Perceived performance (by members)	.28*	-.02	.22	-.19	-.14	-.27*	.03	.20	-.18	.03	-.03	-.05			
29. Perceived performance (by both)	.29*	.20	.24	-.32*	-.01	-.19	-.11	.17	-.08	.28*	.03	.75**	.62*		
30. Knowledge availability	.58**	.17	.02	-.02	.47**	-.10	-.11	.32*	.29*	.20	.33*	.25	-.07	.15	
31. Objective team performance	-.20	.18	.14	.33*	-.41**	.17	.12	-.24	.07	.15	-.32*	-.11	.14	.01	-.43**

Note. N =58. ** $p < .01$. * $p < .05$. † $p < .10$. Two-tailed.

TABLE 5. Summary of Results: The Impact on Team Performance

Variable	Perceived Performance (by manager)	Perceived Performance (by members)	Perceived Performance (by both)	Knowledge Availability	Objective Team Performance
Internal Social Capital (Table 7)					
Social cohesion	(-)**		(-)**	(+)*	
Job-related cohesion	(+)*	(-)†		(-)†	
Trust density		(+)**	(+)**		
Cooperative norms		(+)*	(+)†	(+)**	
Task Characteristics (Table 12)					
Task interdependence (TI)	(+)**		(+)†	(+)**	
Task routineness (TR)	(+)†				
Interactions (Table 12)					
TI × Social cohesion	(-)**	(-)**	(-)**	(+)†	(-)**
TI × Job-related cohesion	(+)**	(+)**	(+)**		
TI × Trust density		(-)**	(-)**		
TI × Cooperative norms	(+)†	(-)**	(-)†	(-)*	
TR × Social cohesion	(+)**	(-)**		(+)**	
TR × Job-related cohesion	(-)**	(+)**		(-)**	
TR × Trust density		(-)**	(-)**	(+)†	(+)†
TR × Group norms for cooperation	(+)**	(-)**			
External Social Capital (Table 8)					
External network size					
External social relations	(+)*	(+)*	(+)**	(-)*	(+)**
External job-related relations					(+)**
Diversity of external sex networks		(-) †	(-) †		
Diversity of external level networks	(+)**		(+) †		(-)*
Diversity of external ethnic networks	(+)*		(+)*		
Diversity of external major networks		(+)**	(+)*		
Diversity of external department networks				(+)*	
Interactions (Table 13)					
TI × External network size	(+)**	(-)**		(-)**	(+)**
TI × External social relations	(+)**	(-)**	(+)**		(-)**
TI × External job-related relations	(+)**	(-)**	(+)**		(-)**
TR × External network size		(-)**			(-)**
TR × External social relations		(-)**	(-)**	(+)**	(-)**
TR × External job-related relations	(-)**	(-)**	(-)**	(+)**	(-)**

Note. N =58. ** p < .01. * p < .05. † p < .10. Two-tailed.

TABLE 6. Summary of Results: The Impact on Internal and External Social Capital

Variable	Internal Social Capital				External Social Capital		
	Social Cohesion	Job-related Cohesion	Trust	Cooperative Norms	External Network Size	External Social Relations	External Job-related Relations
Diversity (Table 9 & 10)							
Sex diversity	(+)*		(+)*	(+)*			
Ethnicity/nationality diversity	(-)*	(-)**	(-)**	(-)**			(+)**
Age diversity			(-)*				
Status diversity	(+)*	(+)*					(+)†
Tenure diversity				(+)*			
Major specialty diversity	(+)*	(+)*		(+)**	(-)*		
Task characteristics (Table 9 & 10)							
Task interdependence (TI)	(+)**	(+)**	(+)**	(+)†		(-)†	(+)*
Task routineness (TR)	(-)†	(-)**					(-)†
Interactions (Table 9 & 10)							
TI × Sex diversity		(+)**	(-)†	(-)**	(-)*	(+)*	(+)**
TI × Ethnicity/nationality diversity		(-)**	(-)*	(+)**		(-)**	(-)*
TI × Age diversity	(-)*	(-)**	(-)**		(-)**		
TI × Status diversity	(-)**	(-)**		(+)**	(+)**	(+)**	
TI × Tenure diversity	(+)**	(+)**		(-)**			(+)**
TI × Major specialty diversity		(+)†		(-)*	(-)**		(+)**
TR × Sex diversity			(-)*	(+)**		(-)**	(+)*
TR × Ethnicity/nationality diversity	(+)**	(+)**		(+)**	(-)*	(+)**	
TR × Age diversity	(-)†		(+)**	(+)**	(+)**	(+)*	
TR × Status diversity	(+)*		(-)**	(-)**	(-)**	(-)**	
TR × Tenure diversity			(-)*	(-)**	(-)**	(-)**	
TR × Major specialty diversity	(+)**	(-)**	(-)**	(-)**		(+)*	

Note. ** p < .01. * p < .05. † p < .10. Two-tailed.

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TABLE 7. The Impact of Diversity and Internal Social Capital on Team Performance

Variable	Perceived Team Performance (by managers)		Perceived Team Performance (by members)		Perceived Team Performance (by both)		Knowledge Availability		Objective Team Performance	
University dummy	-.29†	-.50**	.12	.28	-.15	-.21	-.43**	-.23†	.17	.12
Team size	-.23	-.59**	-.10	.18	-.25	-.35†	-.43**	.04	-.05	-.07
Tenure average	-.12	-.28	.12	.62*	-.01	.19	-.29*	.01	.79**	.75**
Ph.D. proportion	-.25	-.50**	.17	.39*	-.08	-.14	-.32*	-.06	.16	.15
Needs for coworker network	-.19	-.44*	.13	.18	-.06	-.23	-.06	-.09	-.01	.03
Needs for external network	.32†	.40**	-.17	-.12	.14	.24	.44**	.45**	-.14	-.14
Sex diversity	.12	.33	.00	-.51†	.10	-.07	.69**	.05	-.19	-.16
Ethnicity/nationality diversity	-.41†	-.56*	.49*	.93**	.00	.17	-.52**	-.13	.02	.01
Age diversity	.14	.02	.44*	.71**	.40*	.49*	-.27†	-.21†	.03	-.01
Status diversity	-.16	.06	-.45*	-.30	-.42†	-.15	-.37*	-.26†	.17	.12
Tenure diversity	.44*	.64*	-.21	-.76*	.21	.00	.69**	.07	-.07	.00
Major specialty diversity	-.30†	-.28†	.08	-.03	-.18	-.24	.25†	.04	.01	-.01
Social cohesion		-1.08**		.09		-.79**		.45**		-.05
Job-related cohesion		.63**		-.56†		.13		-.36†		.16
Trust density		.26		.64**		.63**		.00		-.02
Group norms for cooperation		.02		.45*		.31†		.69**		-.06†
ΔF	3.48**	8.20**	3.24**	2.80*	.21†	6.42**	3.79**	10.85**	.89	.30
ΔR²	.27	.26	.28	.14	2.28	.27	.21	.21	.03	.01
F	2.67**	5.34**	2.04*	2.47*	1.62	3.41**	5.46**	10.49**	11.90**	8.45**
R²	.42	.68	.35	.49	.30	.76	.59	.80	.76	.77
Adjusted R²	.26	.55	.18	.29	.12	.57	.48	.73	.70	.68

Note. N =58. ** p < .01. * p < .05. † p < .10. Two-tailed.

TABLE 8. The Impact of External Social Capital on Team Performance

Variable	Perceived Team Performance (Rated by Managers)		Perceived Team Performance (Rated by Members)		Perceived Team Performance (Rated by Both)		Knowledge Availability		Objective Team Performance	
University dummy	-.28	-.71*	.39*	-.27	.04	-.74*	-.47**	-.55*	.12	.13
Team size	-.20	.13	.07	.04	-.11	.13	-.50**	-.47**	-.01	-.13
Tenure average	-.12	-.45†	.36**	.13	.14	-.27	-.30†	-.37*	.61**	.67**
Ph.D. proportion	-.22	.24	.34*	.46*	.05	.49†	-.40**	-.20	.18†	-.06
Needs for coworker network	-.19	-.09	.17	.31	-.04	.13	-.05	.23	-.04	-.15
Needs for external network	.32	.42	-.02	-.38	.23	.08	.44*	.10	-.32*	-.29*
Sex diversity	.09	.06	-.16	.17	-.03	.16	.77**	.73**	-.22†	-.10
Ethnicity/nationality diversity	-.40	-.37	.80**	.36	.22	-.06	-.58**	-.47*	-.02	-.13
Age diversity	.17	.07	.51**	.01	.47*	.06	-.33*	-.48**	.04	.05
Status diversity	-.16	-1.00*	-.28	-.80*	-.31	-1.32**	-.37*	-.74*	.06	.29
Tenure diversity	.44†	.90	-.36†	-.10	.11	.64*	.71**	.82**	-.08	-.21
Major specialty diversity	-.34	-.21	.03	-.12	-.25	-.25	.34*	.18	.02	.01
External network size	-.04	.16	-.04	.00	-.06	.13	.09	.15	.11	.07
External social relations	.14	.70**	.24†	.50*	.26†	.88**	-.30*	.09	.24**	-.08
External job-related relations	.04	-.12	-.43*	.01	-.25	-.09	-.05	-.02	.27**	.28*
Diversity of external sex networks		-.30		-.37†		-.48†		.23		-.13
Diversity of external level networks		.84**		-.27		.49†		.27		-.34*
Diversity of external ethnic networks		.69*		.47		.85*		.26		-.11
Diversity of external major networks		.20		.66**		.59*		.17		-.13
Diversity of external department networks		.14		-.24		-.05		.39*		-.08
ΔF	.36	2.61*	4.82*	3.34*	2.41†	2.02†	2.90†	5.78**	5.12**	4.06**
ΔR²	.01	.15	.17	.17	.10	.13	.07	.15	.06	.06
F	2.12*	2.54*	3.01**	3.72**	1.90†	2.10*	5.50**	7.92**	13.16**	14.49**
R²	.43	.58	.52	.67	.40	.53	.66	.81	.82	.89
Adjusted R²	.23	.35	.35	.49	.19	.28	.54	.71	.76	.83

Note. N =58. ** p < .01. * p < .05. † p < .10. Two-tailed.

TABLE 9. The Impact of Diversity and Task Characteristics on Internal Social Capital

Variable	Social Cohesion			Job-related Cohesion			Trust Density			Group Norms for Cooperation		
University dummy	-.01	.02	.04	.28†	.35**	.37**	.09	.16	.13	-.15	-0.10	-.14**
Team size	-.54**	-.59**	-1.35**	-.23	-.32*	-.51**	-.24	-.30*	-.64**	-.45**	-0.47**	-.18**
Tenure average	-.36*	-.39**	-.68**	-.09	-.15	-.29**	-.64**	-.68**	-1.72**	-.25	-0.27†	-.15*
Ph.D. proportion	-.39*	-.57**	-1.31**	-.15	-.47**	-.46**	-.27†	-.46**	-1.07**	-.20	-0.27	.00
Needs for coworker network	-.58**	-.34†	.39†	-.40*	-.01	-.20*	-.50*	-.29	-.98**	.21	0.26	.56**
Needs for external network	.05	-.05	-.95**	-.01	-.19†	-.32**	-.06	-.17	-.07	-.06	-0.11	.12*
Sex diversity	.48*	.76**	.55	.27	.75**	-.52	.43*	.71**	4.34**	.76**	0.85**	2.54**
Ethnicity/nationality diversity	-.48*	-.68**	-6.15**	-.32	-.64**	-1.24**	-.61**	-.78**	1.81†	-.41*	-0.45*	-3.35**
Age diversity	-.05	-.18	4.74*	.21	.01	.13	-.27	-.37*	-7.63**	.06	0.03	-6.70**
Status diversity	.43*	.42*	3.41**	.33†	.32*	2.49**	.19	.21	6.32**	-.28	-0.26	1.98**
Tenure diversity	.22	.18	-.80	-.05	-.14	-1.74**	.26	.19	1.19	.73**	0.67**	3.62**
Major specialty diversity	.29*	.22	4.01**	.36*	.22†	3.39**	.22	.11	4.21**	.32*	0.25†	2.91**
Task interdependence (TI)		.35**	2.68**		.64**	1.08**		.44**	2.47**		0.24†	-.27†
Task routineness (TR)		-.29†	-.93		-.44**	-.56**		-.21	.55†		0.00	-.54**
TI × Sex diversity			.67			1.00**			-1.66†			-3.36**
TI × Ethnicity/nationality diversity			.38			-1.22**			-2.07*			2.76**
TI × Age diversity			-1.49*			-1.00**			-2.84**			-.21
TI × Status diversity			-7.35**			-2.31**			.49			3.06**
TI × Tenure diversity			3.26**			2.03**			1.03			-1.64**
TI × Major specialty diversity			-.03			.33†			-.47			-.41*
TR × Sex diversity			.90			.21			-2.52*			.90**
TR × Ethnicity/nationality diversity			5.75**			2.61**			-.19			1.01*
TR × Age diversity			-3.48†			.75			8.61**			6.03**
TR × Status diversity			2.31*			-.12			-4.45**			-4.09**
TR × Tenure diversity			-1.35			-.11			-2.31*			-1.09**
TR × Major specialty diversity			-4.42**			-4.01**			-4.03**			-2.44**
ΔF	5.73**	5.19**	10.06**	5.05**	23.38**	72.60**	2.58*	6.29**	12.89**	5.86**	1.83	160.04**
ΔR^2	.35	.09	.29	.36	.28	.25	.19	.12	.35	.39	.04	.45
F	4.54**	5.27**	14.65**	3.33**	9.03**	135.48**	3.18**	4.26**	15.86**	3.75**	3.60**	161.73**
R^2	.54	.63	.93	.47	.75	.99	.46	.58	.93	.50	.54	.99
Adjusted R^2	.43	.51	.86	.33	.66	.98	.31	.45	.87	.37	.39	.99

Note. N =58. ** $p < .01$. * $p < .05$. † $p < .10$. Two-tailed.

TABLE 10. The Impact of Diversity and Task Characteristics on External Social Capital (1)

Variable	External Network Size			External Social Relations			External Job-related Relations		
University dummy	-.22	-.20	-.01	-.27	-.30	-.53**	.52	.53**	.84**
Team size	-.17	-.14	-.36*	-.33	-.28	-.20	.22	.18	.43*
Tenure average	.35*	.35*	-.68**	-.02	.00	-.62*	.52**	.50**	.96**
Ph.D. proportion	-.06	.06	-.75**	-.31†	-.14	-.15	.23	.05	.98**
Needs for coworker network	.03	-.17	-.40*	.01	-.22	-1.79**	.09	.34†	-.09
Needs for external network	.57**	.62**	.75**	.11	.21	1.11**	.35*	.26†	.32
Sex diversity	.07	-.13	3.41**	.32	.04	6.62**	-.20	.07	-7.66**
Ethnicity/nationality diversity	-.23	-.07	2.51*	-.36	-.17	-4.36**	.55**	.35	4.91**
Age diversity	.16	.27	-6.79**	-.17	-.05	-7.05**	.04	-.09	5.10†
Status diversity	.12	.15	4.41**	-.03	-.02	1.64	.37†	.34†	-1.11
Tenure diversity	.29	.28	4.27**	.19	.23	6.43**	-.26	-.28	-5.29**
Major specialty diversity	-.41*	-.40*	1.18	.16	.23	-3.47*	.01	-.04	-1.29
Task interdependence (TI)		-.12	2.13**		-.31†	-1.43*		.28*	-1.68*
Task routineness (TR)		.29	1.24**		.29	.61		-.32†	.61
TI × Sex diversity			-2.38*			3.13*			4.37**
TI × Ethnicity/nationality diversity			-.76			-6.79**			-3.03*
TI × Age diversity			-2.80**			.16			-.95
TI × Status diversity			3.64**			3.85**			.26
TI × Tenure diversity			-.90			1.29			3.22**
TI × Major specialty diversity			-2.16**			.50			2.23**
TR × Sex diversity			-1.14			-10.04**			2.99*
TR × Ethnicity/nationality diversity			-2.76*			9.28**			-1.25
TR × Age diversity			8.32**			6.32*			-3.62
TR × Status diversity			-5.28**			-3.70**			.66
TR × Tenure diversity			-3.60**			-6.34**			1.90
TR × Major specialty diversity			.76			3.20*			-.55
ΔF	3.50**	1.41	17.41**	.56	2.25	14.08**	2.62*	3.39*	6.03**
ΔR²	.26	.03	.45	.06	.08	.61	.18	.07	.32
F	3.03**	2.85**	16.58**	.96	1.19	9.49**	3.43**	3.73**	7.92**
R²	.45	.48	.93	.20	.28	.89	.48	.55	.87
Adjusted R²	.30	.31	.88	-.01	.05	.80	.34	.40	.75

Note. N =58. ** p < .01. * p < .05. † p < .10. Two-tailed.

TABLE 11. The Impact of Diversity and Task Characteristics on External Social Capital (2)

Variable	Diversity of External Sex Networks			Diversity of External Level Networks			Diversity of External Ethnic Networks			Diversity of External Major Networks			Diversity of External Department Networks		
University dummy	-.18	-.12	-.20	.10	.08	.07	.80**	.86**	.82**	.13	.20	.15†	-.08	-.04	-.46**
Team size	.11	.08	-.07	-.15	-.21	.41**	.06	.03	-.13	.08	.05	-.21†	.23†	.22†	-.32**
Tenure average	-.39	-.42*	-.05	.31*	.31*	1.18**	-.07	-.10	.27	.00	-.03	.09	.15	.14	-.01
Ph.D. proportion	-.22	-.31	-.37	-.25†	-.50**	.53*	-.12	-.22	.16	-.24	-.30	-1.30**	.29*	.30*	-.22†
Needs for coworker network	-.58*	-.51*	1.34**	.16	.56**	.80**	-.50**	-.41*	.74**	-.22	-.21	1.52**	-.09	-.14	-.08
Needs for external network	.20	.13	-1.28**	-.43*	-.54**	-.68**	.04	-.03	-.86**	.37*	.31†	-.63**	.62**	.61**	.45**
Sex diversity	.08	.20	1.26	.21	.61**	-5.16**	-.49*	-.34†	-2.99†	-.04	.04	5.15**	-.06	-.08	2.26**
Ethnicity/nationality diversity	-.01	-.07	-1.65	-.06	-.38†	6.62**	.59**	.52*	-.49	-.07	-.08	-2.75**	-.25	-.21	-6.12**
Age diversity	-.06	-.09	5.54†	-.17	-.39*	3.83*	.21	.17	4.81*	.62**	.62**	1.91	.25†	.27†	2.50*
Status diversity	-.05	-.02	-.67	.37†	.30†	-6.73**	.76**	.78**	4.62**	.18	.22	-2.94**	.10	.13	-1.25*
Tenure diversity	.06	.00	-5.52**	-.46*	-.45*	-6.44**	-.35†	-.42*	-6.04**	-.18	-.25	.17	.07	.03	3.93**
Major specialty diversity	.02	-.05	5.00*	-.32*	-.36*	2.84*	.10	.02	-.25	.13	.05	7.88**	.38**	.35*	1.39*
Task interdependence (TI)		.28†	1.61*		.28*	-1.79**		.30*	1.25*		.28†	2.35**		.10	1.14**
Task routineness (TR)		-.04	-.70		-.57**	.20		-.06	-1.45**		.06	-.02		.11	.04
TI × Sex diversity			-7.28**			-1.56*			-2.57*			-8.71**			1.20*
TI × Ethnicity/nationality diversity			8.85**			1.97*			4.59**			10.71**			-2.96**
TI × Age diversity			2.39**			2.66**			-.46			1.99**			-2.15**
TI × Status diversity			-5.28**			1.94*			-4.95**			-2.57**			-1.18*
TI × Tenure diversity			-.14			-.32			.79			-4.13**			2.18**
TI × Major specialty diversity			-2.32**			-.89*			.79			-3.38**			1.10**
TR × Sex diversity			6.45**			5.98**			5.91**			3.43**			-2.88**
TR × Ethnicity/nationality diversity			-5.01*			-7.82**			-1.98			-6.10**			8.16**
TR × Age diversity			-7.01*			-5.28**			-4.17†			-3.05*			-.81
TR × Status diversity			3.18*			4.44**			-1.04			4.77**			2.34**
TR × Tenure diversity			5.16**			5.43**			4.85**			2.48**			-4.57**
TR × Major specialty diversity			-3.00†			-2.36*			-.20			-5.34**			-2.51**
ΔF	.06	1.56	8.63**	3.61**	7.98**	17.33**	7.63**	3.43*	5.73**	3.75**	2.13	30.83**	4.65**	.97	36.44**
ΔR^2	.01	.05	.53	.25	.14	.32	.44	.06	.25	.31	.06	.52	.20	.01	.29
F	1.38	1.43	6.40**	3.59	5.17**	23.46**	5.02**	5.26**	9.21**	2.29*	2.36*	26.08**	7.86**	6.87**	57.10**
R^2	.27	.32	.84	.49	.63	.95	.57	.63	.86	.38	.44	.96	.68	.69	.98
Adjusted R^2	.07	.10	.71	.35	.51	.91	.46	.51	.79	.21	.25	.92	.59	.59	.96

Note. N =58. ** p < .01. * p < .05. † p < .10. Two-tailed.

TABLE 12. The Impact of Internal Social Capital and Task Characteristics on Performance

Variable	Perceived Team Performance (Rated by Managers)			Perceived Team Performance (Rated by Members)			Perceived Team Performance (Rated by Both)			Knowledge Availability			Objective Team Performance		
University dummy	-.33*	-.73**	-.51**	.31	.34†	.16	-.06	-.35*	-.29**	-.10	-.25**	-.47**	.04	.28†	.28*
Team size	-.70**	-.45**	-.82**	.16	-.63*	.48**	-.45*	-.77**	-.33**	-.05	.01	-.28*	-.01	.02	-.07
Tenure average	-.42*	.20	-.06	.63*	-.43	1.04**	.08	-.12	.64**	-.05	.22	-.41*	.78**	.59*	.85**
Ph.D. proportion	-.57**	-.08	-.29**	.31	.03	.73**	-.25	-.05	.25*	-.22†	-.20	-.19†	.28†	.10	.08
Needs for coworker network	-.59**	-.07	-.65**	.26	-1.53**	1.43**	-.29	-1.06*	.43**	-.04	.25	-.48**	-.06	.06	.25
Needs for external network	.32**	.20*	.25**	-.15	.24	-.27*	.15	.32*	.02	.36**	.31**	.58**	-.07	-.12	-.10
Sex diversity	.48*	.55**	.44**	-.39	-.54*	-.55**	.13	.07	-.01	.32	.37**	.42**	-.38†	-.33	-.25†
Ethnicity/nationality diversity	-.63**	-.52**	-.16*	.84**	.64	.88**	.06	.02	.45**	-.32†	-.33*	-.23†	.18	.28	.15
Age diversity	.09	.32*	.29**	.68**	-.31	.74**	.52**	.05	.72**	-.22†	.10	-.52†	.02	.18	.21†
Status diversity	.16	-.32**	-.28**	-.29	-.23	-.64**	-.06	-.40†	-.64**	-.18	-.19†	-.15	.08	.29	.21†
Tenure diversity	.59**	.52**	.91**	-.78*	.56	-.59**	-.05	.78*	.33*	.02	-.15	.71**	.04	-.30	-.48*
Major specialty diversity	-.30*	-.65**	-.51**	-.02	.43*	-.01	-.24	-.23	-.41**	.05	-.03	.15†	-.02	.04	-.20*
Social cohesion	-1.02**	-5.79**	2.65**	.11	8.85**	2.87**	-.73**	1.27	3.98**	.51**	-5.29**	-.75	-.10	1.65	2.38**
Job-related cohesion	.47*	7.34**	-4.49**	-.67†	-12.80**	-4.86**	-.07	-2.65	-6.75**	-.62**	4.88**	-.89	.38	-.38	.76
Trust density	.16	-.54	.14	.66**	7.03**	5.58**	.56**	4.20**	3.79**	-.03	-1.07	-.84*	-.02	-2.17*	-.08
Group norms for cooperation	-.08	-3.14**	-.50*	.46	7.89**	1.95**	.24	2.73	.89*	.65**	-.66	1.29**	-.05	.00	.67†
Task interdependence (TI)	.38**	.54**	-1.07†	.09	-.90**	6.61**	.35†	-.17	3.51**	.33**	.61**	1.53	-.22	-.09	2.71*
Task routineness (TR)	.25†	-6.00	.63**	-.14	17.69**	-.52*	.11	6.93†	.15	-.11	-4.00	.42**	.17	-.03	-.35**
TI ×Social cohesion			-5.77**			-3.91**			-7.13**			1.84†			-3.86**
TI ×Job-related cohesion			7.46**			7.09**			10.56**			.98			-.38
TI ×Trust density			.28			-6.67**			-4.18**			.56			.34
TI ×Group norms for cooperation			1.31†			-4.94**			-2.22†			-3.40*			-.96
TR ×Social cohesion		5.79**			-10.27**			-2.21			6.19**			-1.82	
TR ×Job-related cohesion		-6.97**			11.89**			2.34			-5.36**			.91	
TR ×Trust density		1.00			-7.43**			-4.11**			1.43†			2.15†	
TR ×Group norms for cooperation		7.48**			-17.58**			-5.70			3.10			-.36	
ΔF	10.11**	17.60**	94.33**	.23	8.03**	41.63**	3.51*	5.14**	43.82**	4.01*	14.03**	10.79**	1.48	3.35*	17.20**
ΔR²	.11	.14	.20	.01	.24	.42	.07	.13	.30	.03	.10	.09	.02	.06	.14
F	7.96**	20.80**	86.05**	2.14*	4.73**	16.62**	3.79**	5.35**	24.68**	11.04**	23.66**	20.06**	7.85**	8.58**	20.23**
R²	.79	.93	.98	.50	.74	.91	.64	.77	.94	.84	.94	.93	.68	.75	.93
Adjusted R²	.69	.88	.97	.26	.57	.86	.47	.63	.90	.76	.90	.88	.84	.76	.88

Note. N =58. ** p < .01. * p < .05. † p < .10. Two-tailed.

TABLE 13. The Impact of External Social Capital and Task Characteristics on Performance

Variable	Perceived Team Performance (Rated by Managers)		Perceived Team Performance (Rated by Members)		Perceived Team Performance (Rated by Both)		Knowledge Availability		Objective Team Performance	
University dummy	-.10	.42*	.52**	-.18	.26	.22	-.38*	-.80**	.11	.22*
Team size	-.21	.43**	.07	-.44**	-.11	.05	-.51**	-.62**	-.01	.07
Tenure average	-.12	-.13	.38*	-.02	.16	-.11	-.30†	-.02	.61**	.22**
Ph.D. proportion	-.22	-1.12**	.21	.89**	-.04	-.30†	-.42**	-.40*	.19†	.29**
Needs for coworker network	-.27	-.53**	.41*	.65**	.06	.01	-.04	.42*	-.06	.17*
Needs for external network	.30	1.92**	-.11	-.91**	.16	.92**	.42*	-.56†	-.31*	-.34*
Sex diversity	.09	-.50*	.08	-.01	.12	-.40*	.80**	1.26**	-.25	-.23*
Ethnicity/nationality diversity	-.28	.53*	.71**	.89**	.25	1.00**	-.56**	-1.17**	-.01	-.08
Age diversity	.25	.03	.40*	.14*	.46**	.11	-.32*	-.70**	.05	.42**
Status diversity	-.03	1.43**	-.24	-1.14**	-.18	.37	-.32†	-.75**	.06	-.11
Tenure diversity	.29	-1.73**	-.45*	.67**	-.07	-.92*	.64**	1.26**	-.07	-.15
Major specialty diversity	-.50**	-1.02**	-.05	-.10*	-.43**	-.87**	.27†	.26*	.03	.17**
External network size	-.09	-1.98*	-.01	4.95**	-.08	1.70†	.07	1.93*	.11	1.40**
External social relations	.19	-5.90**	.31*	5.92**	.36**	-.75	-.27*	-2.71**	.23**	3.80**
External job-related relations	-.04	1.97†	-.55**	3.75**	-.39*	4.02**	-.10	-3.16**	.28*	4.28**
Task interdependence (TI)	.43**	-9.23**	.35*	5.75**	.57**	-3.48*	.21†	1.46	-.04	1.75*
Task routineness (TR)	.26	4.20**	-.28	5.38**	.02	6.86**	.05	-4.43**	.03	4.77**
TI ×External network size		2.88**		-4.53**		-.72		-2.77**		1.51**
TI ×External social relations		7.26**		-4.19**		2.96**		-.85		-2.42**
TI ×External job-related relations		5.25**		-1.34**		3.26**		.78		-1.12*
TR ×External network size		.32		-1.07**		-.45		.35		-2.45**
TR ×External social relations		-.16		-2.76**		-1.94*		4.07**		-1.84**
TR ×External job-related relations		-7.12**		-3.97**		-8.23**		3.56*		-3.68**
ΔF	8.56**	11.62**	3.54*	108.79**	10.09**	11.46**	2.05	7.39**	.08	29.75**
ΔR^2	.17	.27	.07	.39	.20	.26	.03	.17	.00	.15
F	3.55**	9.88**	3.39**	71.41**	3.59**	9.81**	5.34**	9.65**	11.11**	51.4**
R^2	.60	.87	.59	.98	.60	.87	.69	.87	.83	.97
Adjusted R^2	.43	.78	.42	.97	.44	.78	.56	.78	.75	.95

Note. N =58. ** $p < .01$. * $p < .05$. † $p < .10$. Two-tailed.

FIGURE 1. Causal Links of Diversity to Team Performance through the Mediation of
External Social Capital
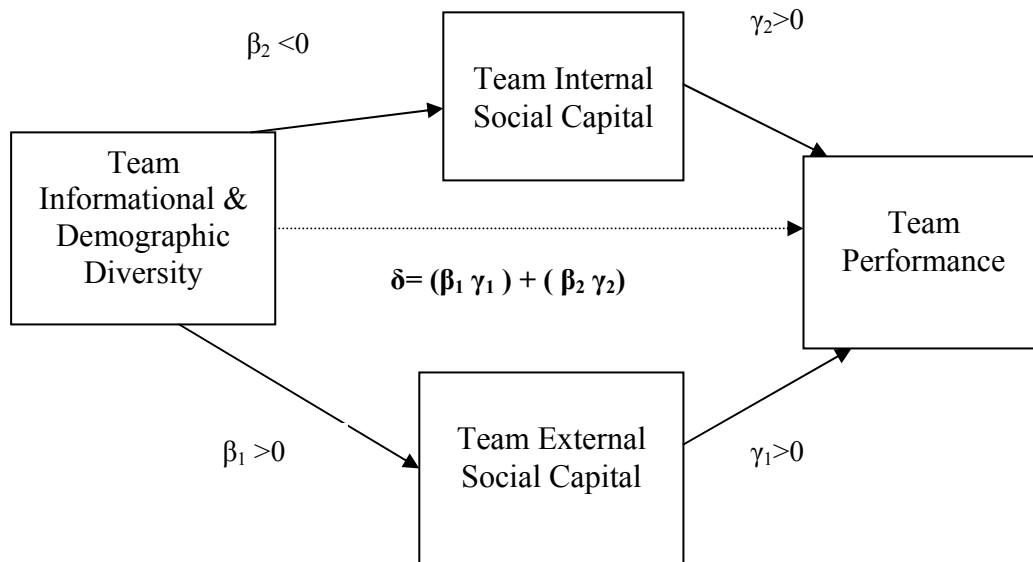
FIGURE 2. Expected Effects of Diversity on Performance through the Mediation of
Internal and External Social Capital

Hypothesized Relationships	The link of Diversity-External Social Capital-Performance $(\beta_1 \gamma_1) = positive$	The link of Diversity-Internal Social Capital-Performance $(\beta_2 \gamma_2) = negative$	Overall Effects of Diversity on Performance $\delta = (\beta_1 \gamma_1) + (\beta_2 \gamma_2)$
	$|\beta_1 \gamma_1| > |\beta_2 \gamma_2|$		Positive
	$|\beta_1 \gamma_1| < |\beta_2 \gamma_2|$		Negative
	$|\beta_1 \gamma_1| = |\beta_2 \gamma_2|$		Non-significant

FIGURE 3. Hypothesized Model and Sources of Data

Team Diversity (EE)

- Demographic diversity (gender, ethnicity /nationality, and age)
- Informational diversity (status, major, and tenure)

Internal Social Capital (EE)

- Social cohesion
- Job-related cohesion
- Norms for cooperation
- Trust

External Social Capital (EE) (Informational Networks)

- Size
- Strength of social and job-relationships
- Demographic network diversity (ethnicity and gender)
- Informational network diversity (level, department, major)

Team Performance

- Perceived team performance (EE & MGR)
- Knowledge availability (EE)
- Objective team performance (EE)

Task Characteristics

- Task interdependence (MGR)
- Task routineness (EE)

Note: EE denotes measures reported by team members and MGR denotes measures reported by team mangers.

FIGURE 4. Task Interdependence as a Moderator of the Relationship between Age Diversity and Social Cohesion
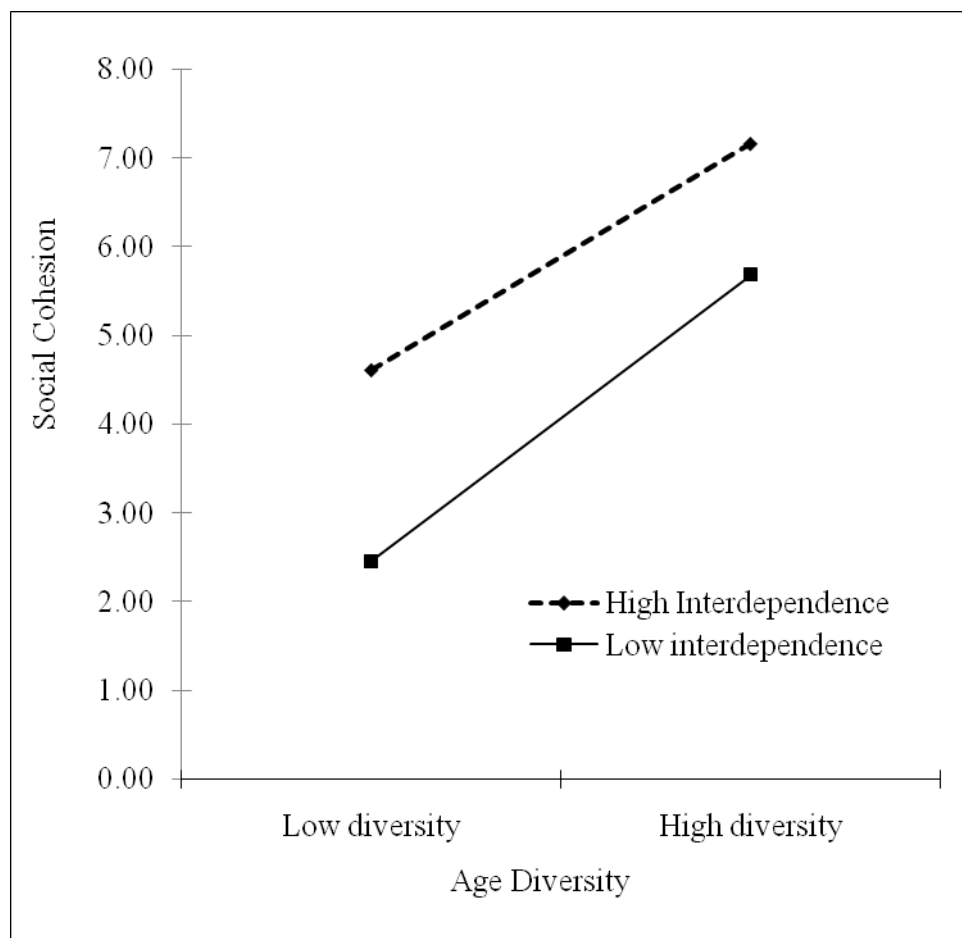
FIGURE 5. Task Interdependence as a Moderator of the Relationship between Status Diversity and Social Cohesion
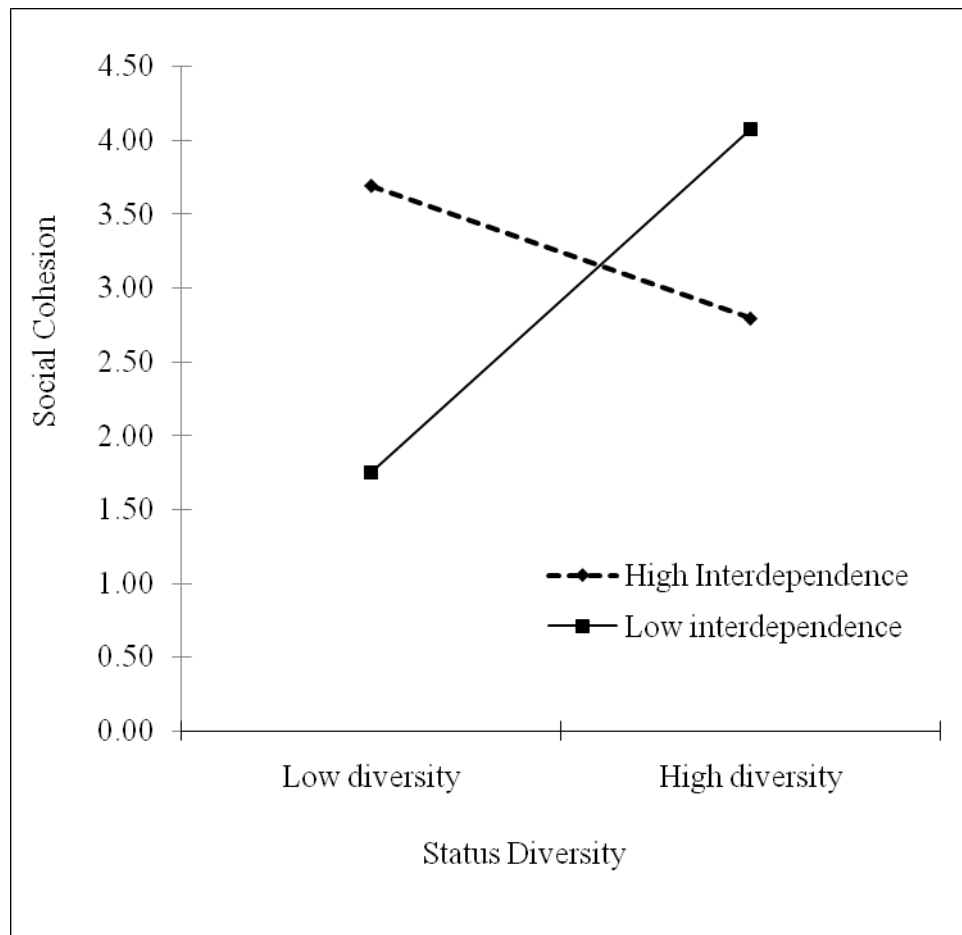
FIGURE 6. Task Interdependence as a Moderator of the Relationship between Tenure Diversity and Social Cohesion
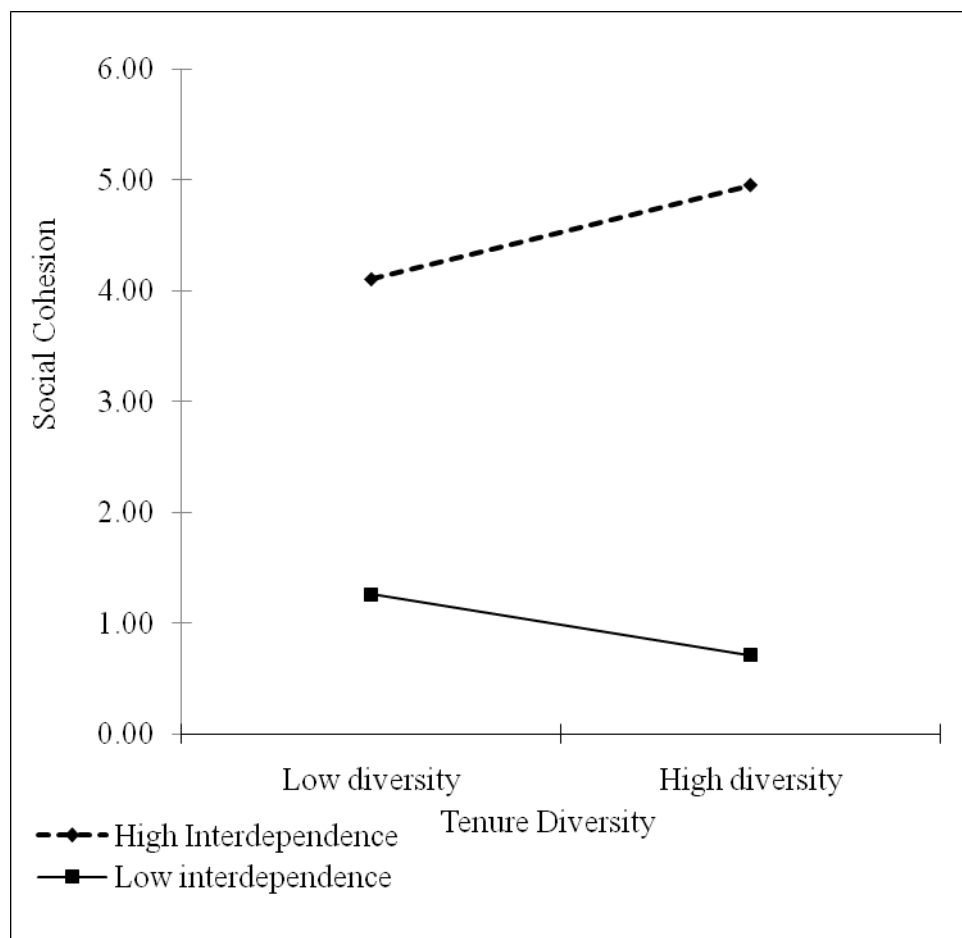
FIGURE 7. Task Interdependence as a Moderator of the Relationship between Sex Diversity and Job-related Cohesion
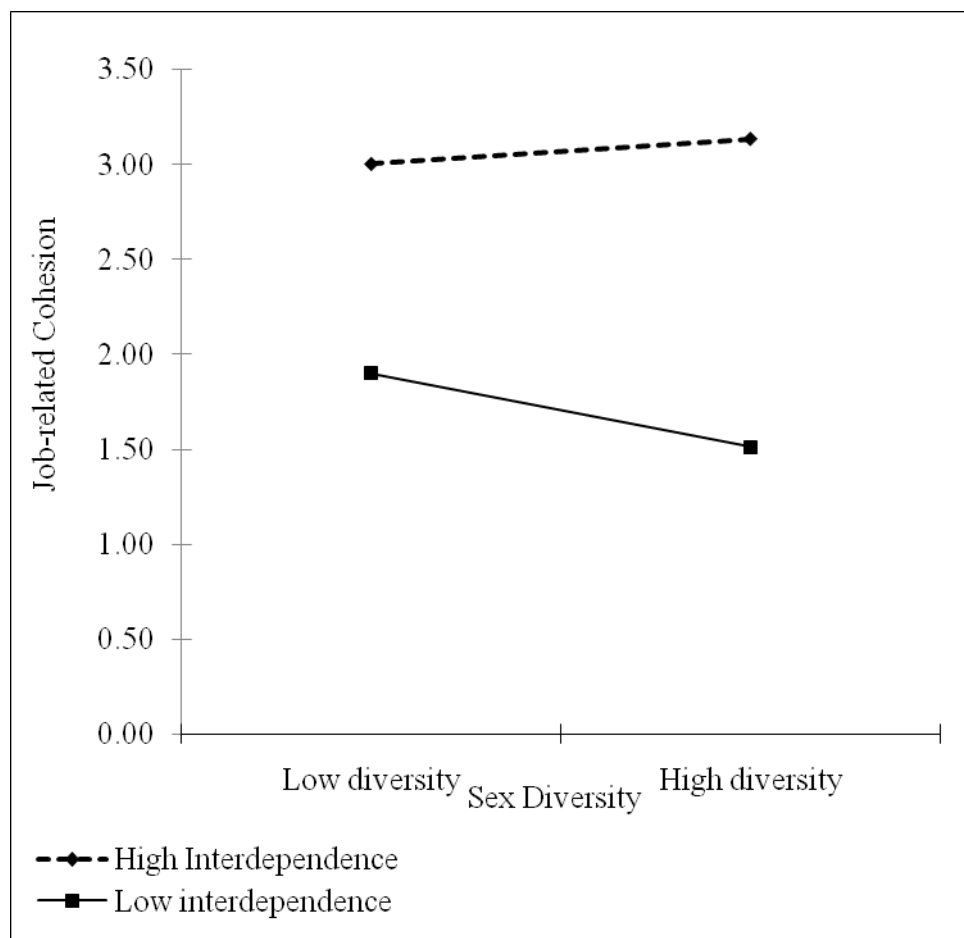
FIGURE 8. Task Interdependence as a Moderator of the Relationship between
Ethnicity/nationality Diversity and Job-related Cohesion
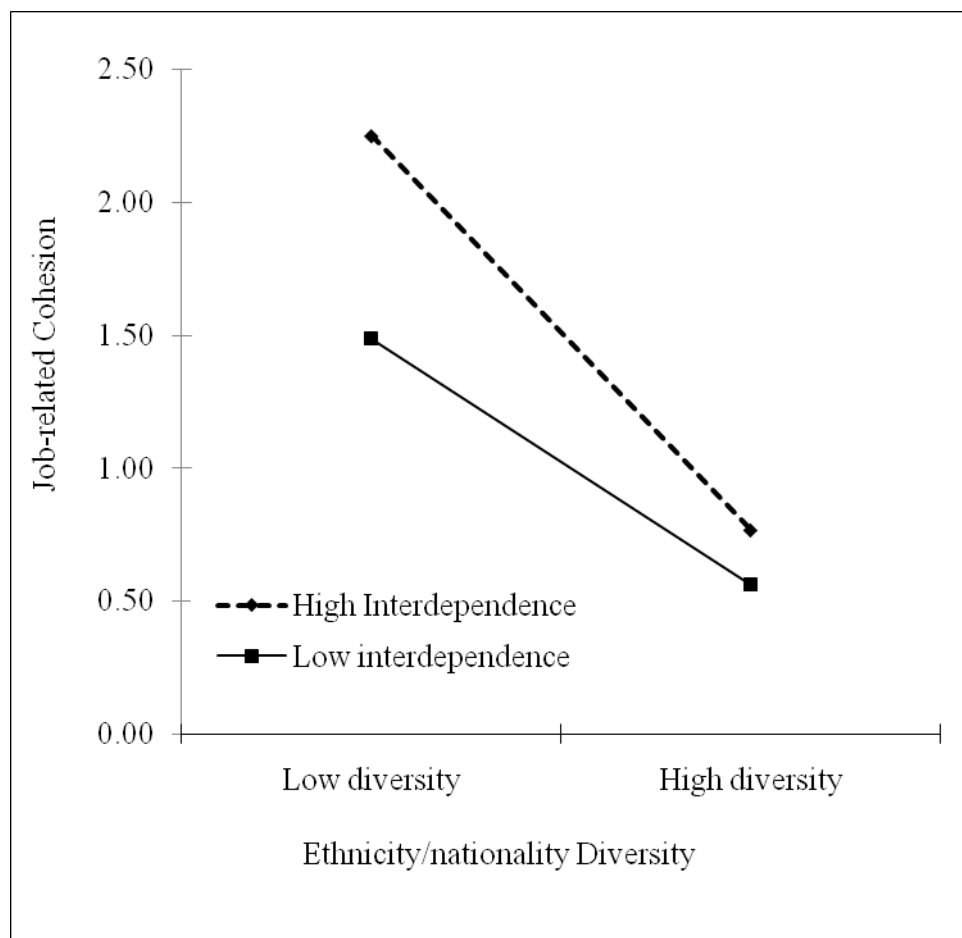
FIGURE 9. Task Interdependence as a Moderator of the Relationship between Age Diversity and Job-related Cohesion
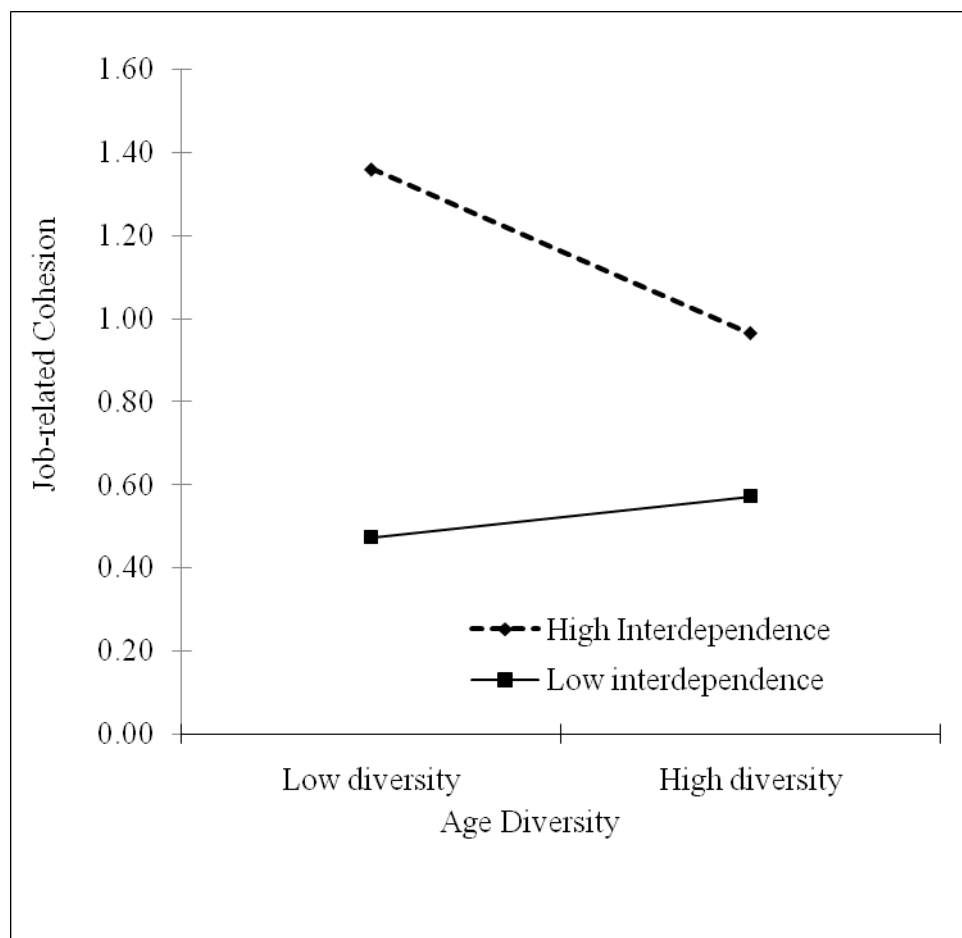
FIGURE 10. Task Interdependence as a Moderator of the Relationship between Status Diversity and Job-related Cohesion
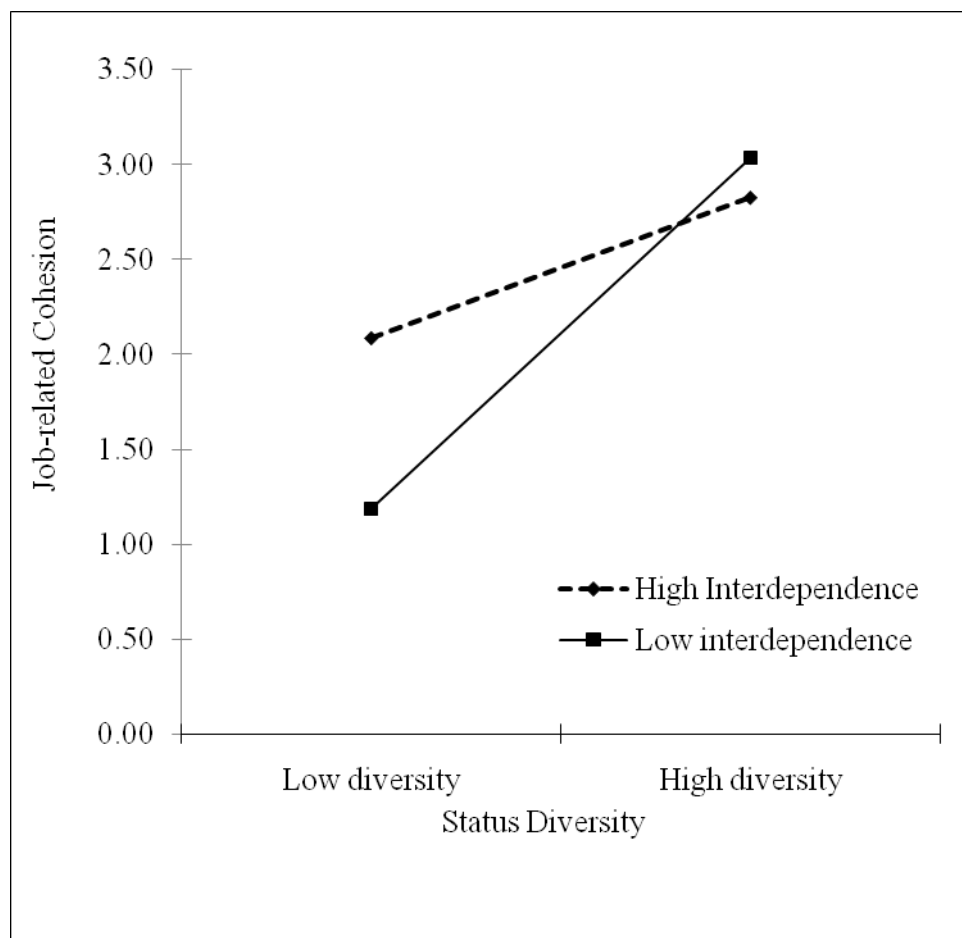
FIGURE 11. Task Interdependence as a Moderator of the Relationship between
Tenure Diversity and Job-related Cohesion
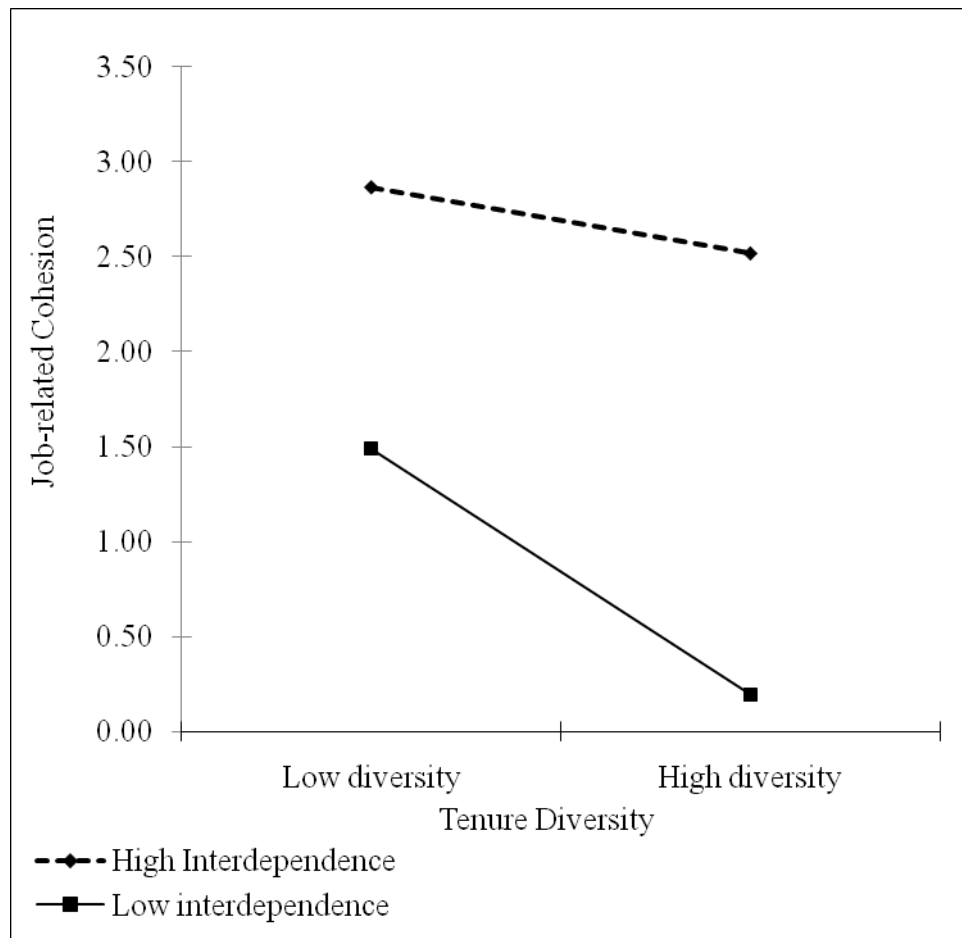
FIGURE 12. Task Interdependence as a Moderator of the Relationship between
Ethnicity/nationality Diversity and Trust
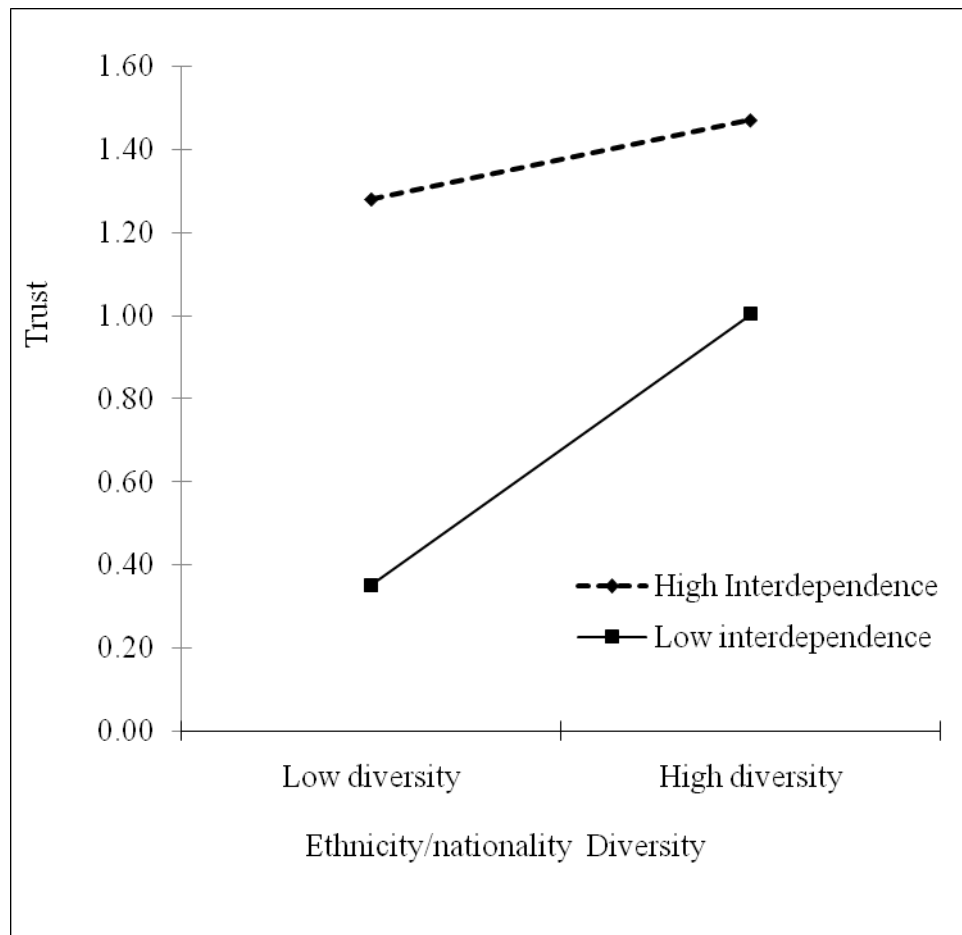
FIGURE 13. Task Interdependence as a Moderator of the Relationship between Age Diversity and Trust
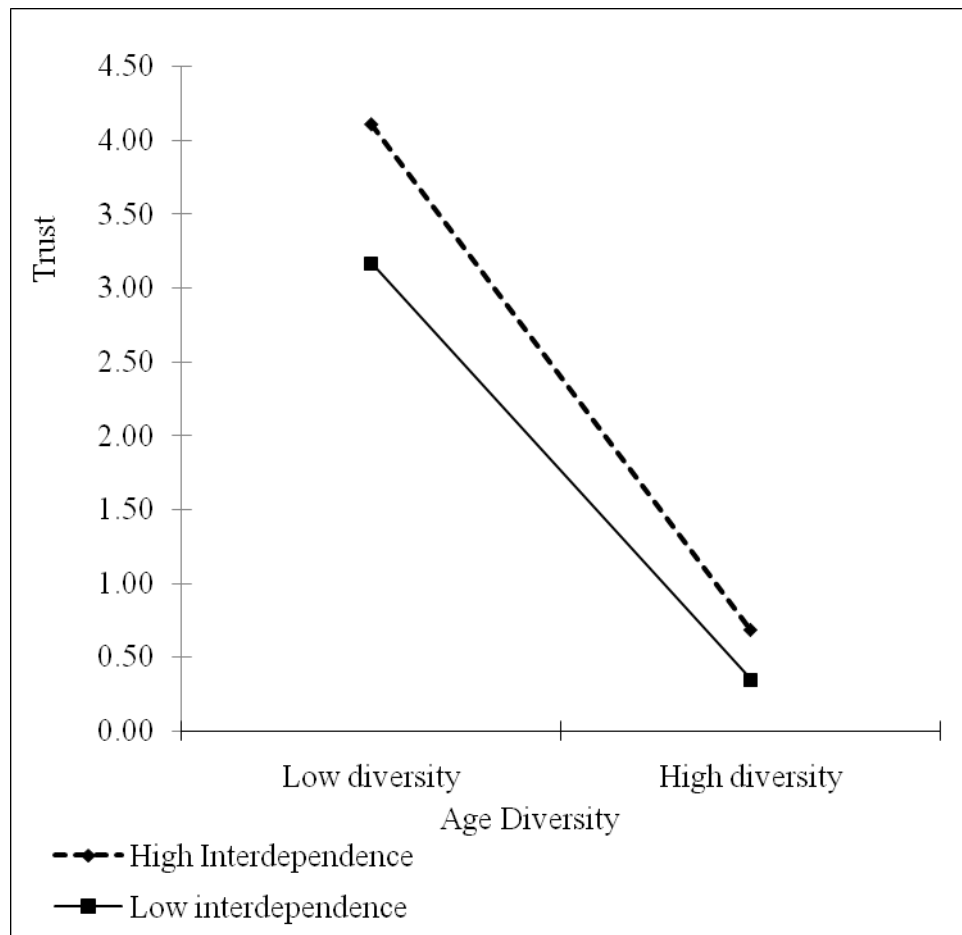
FIGURE 14. Task Interdependence as a Moderator of the Relationship between Sex
Diversity and Cooperative Norm
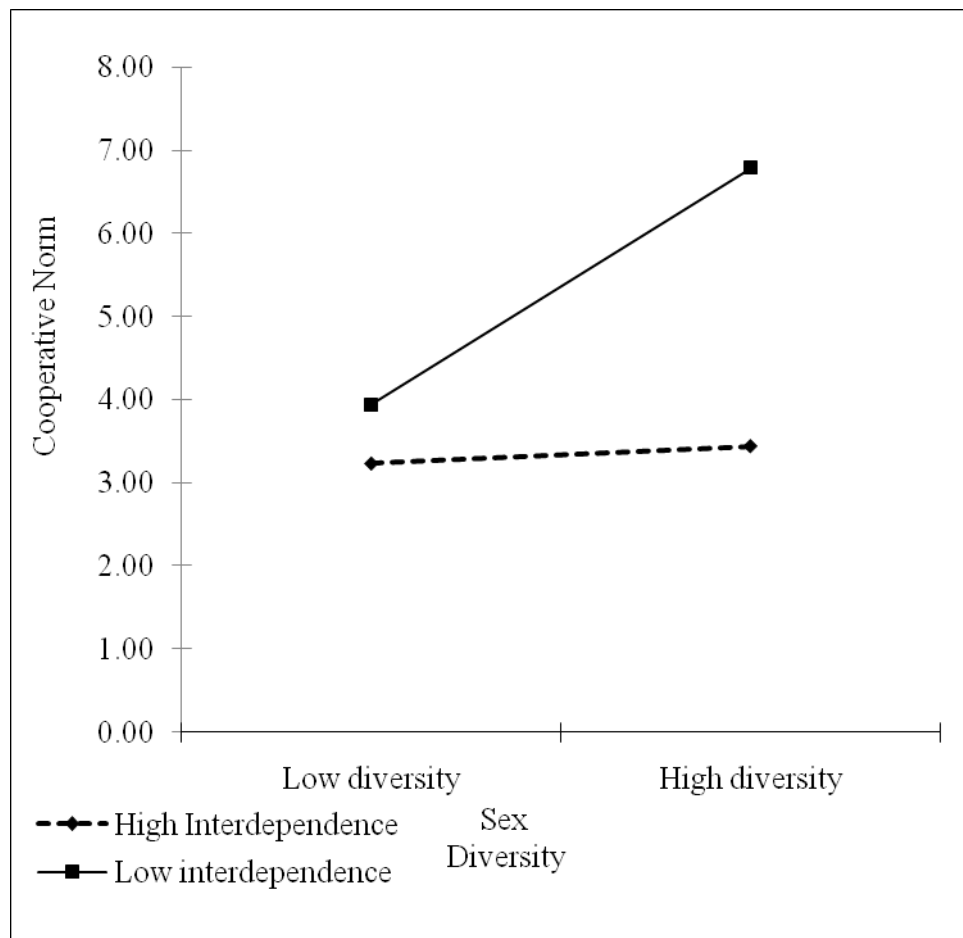
FIGURE 15. Task Interdependence as a Moderator of the Relationship between Ethnicity/nationality Diversity and Cooperative Norm
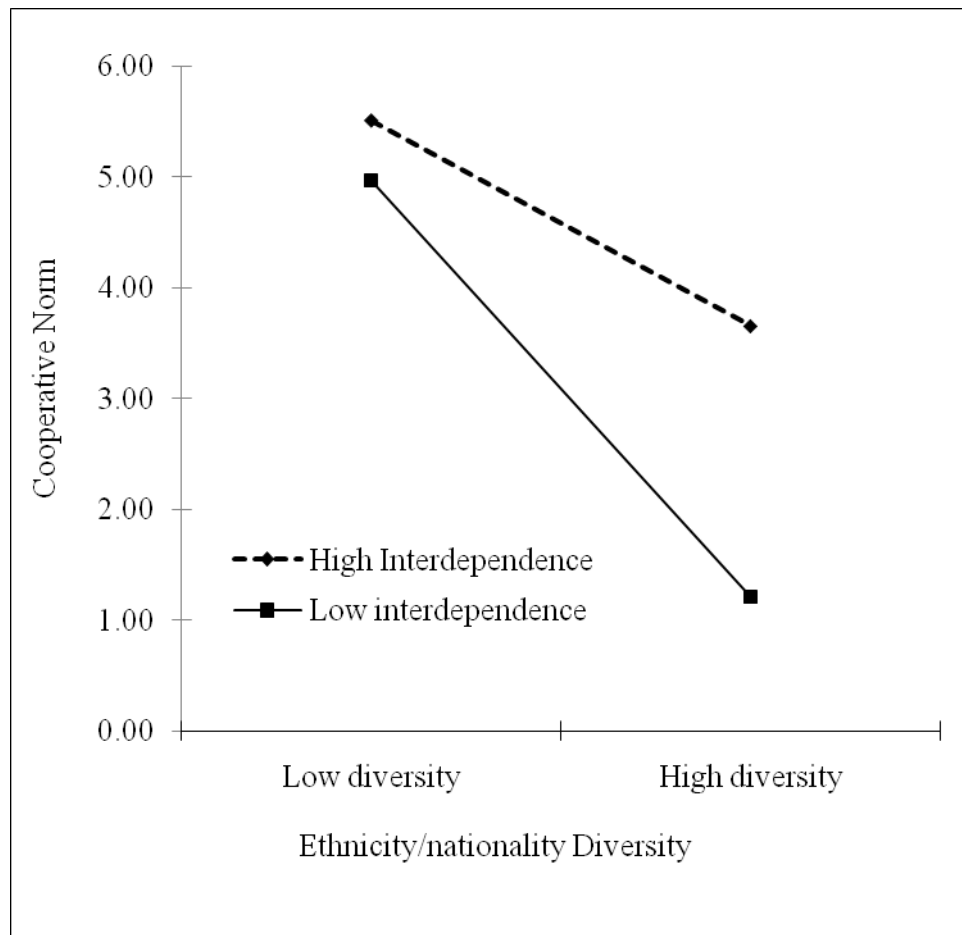
FIGURE 16. Task Interdependence as a Moderator of the Relationship between Status Diversity and Cooperative Norm
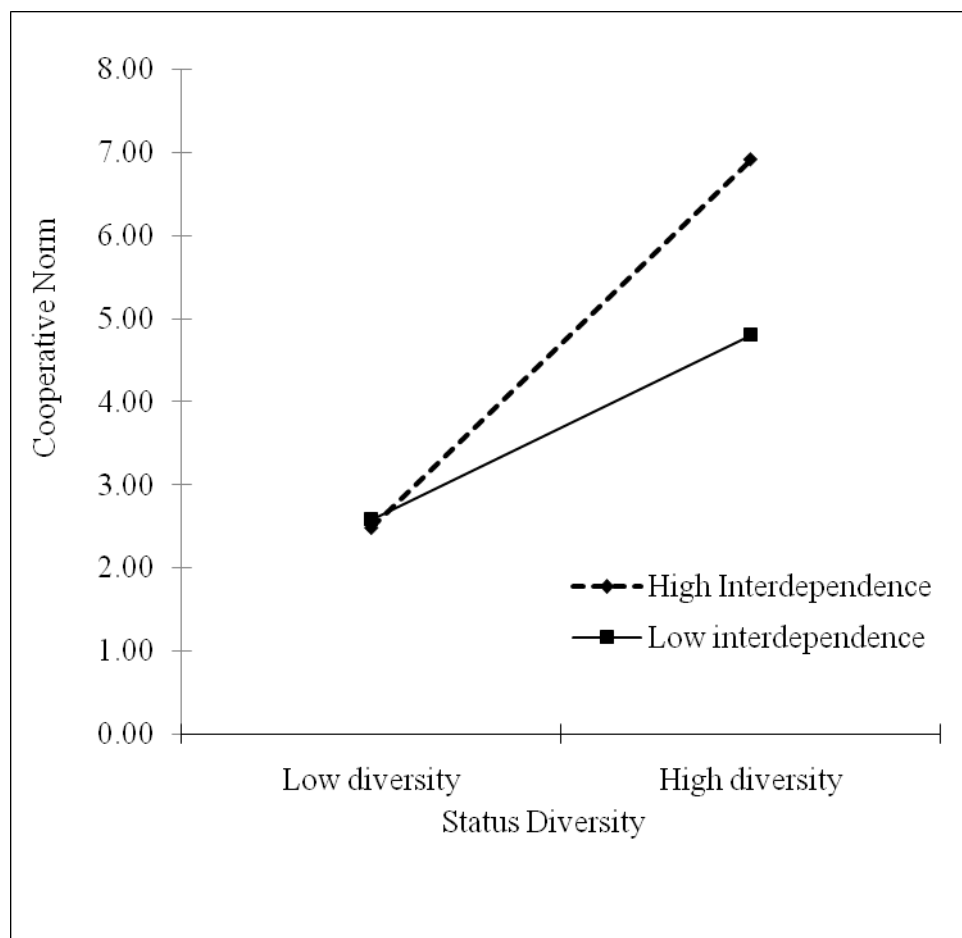
FIGURE 17. Task Interdependence as a Moderator of the Relationship between
Tenure Diversity and Cooperative Norm
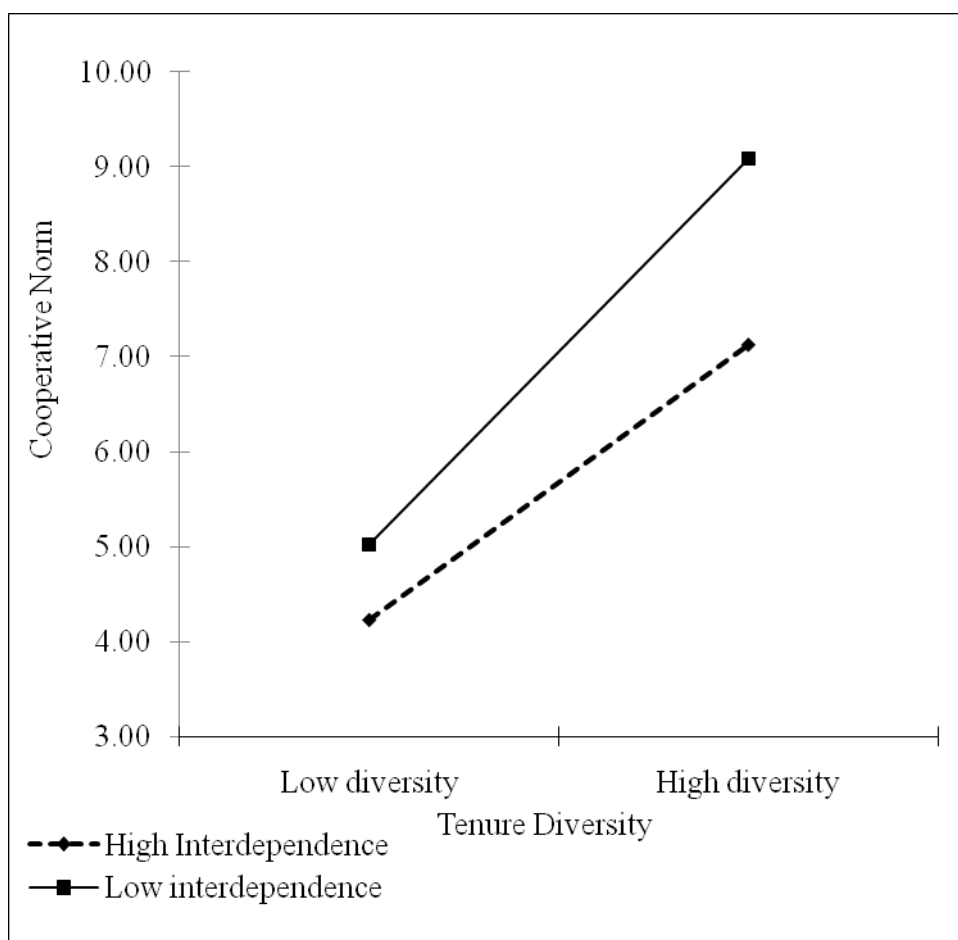
FIGURE 18. Task Interdependence as a Moderator of the Relationship between Major Diversity and Cooperative Norm
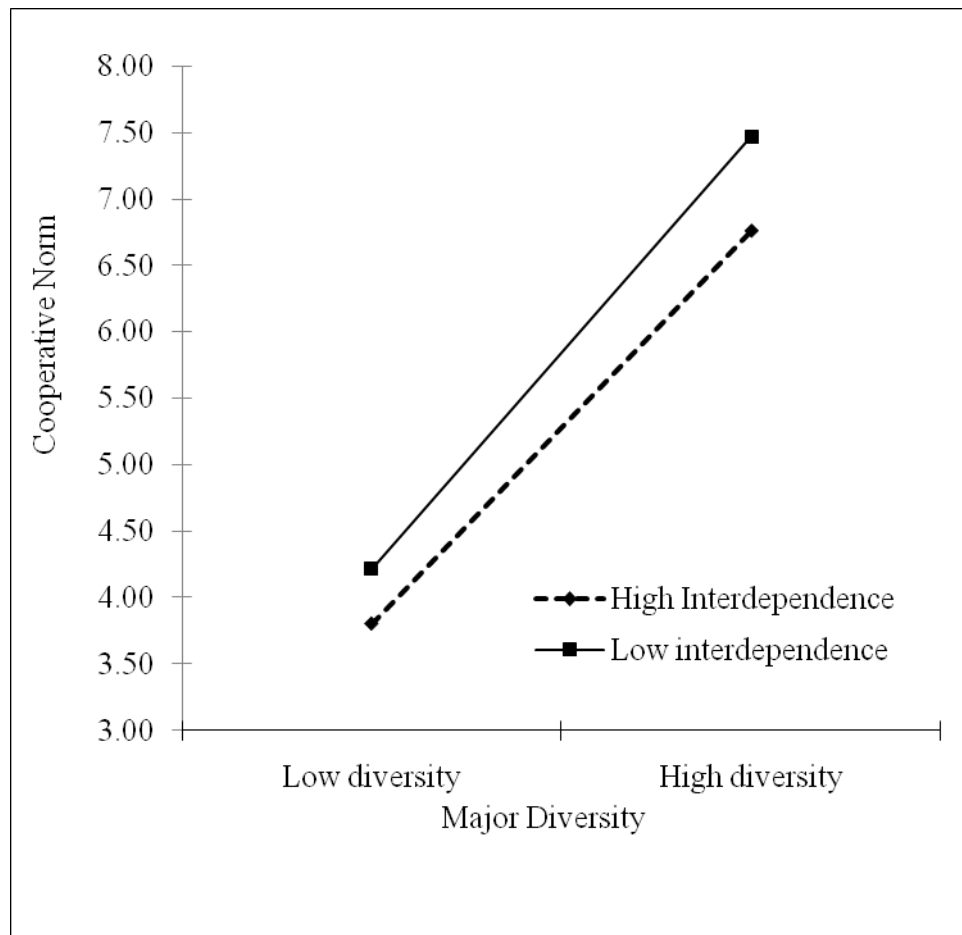
FIGURE 19. Task Interdependence as a Moderator of the Relationship between Sex Diversity and External Network Size
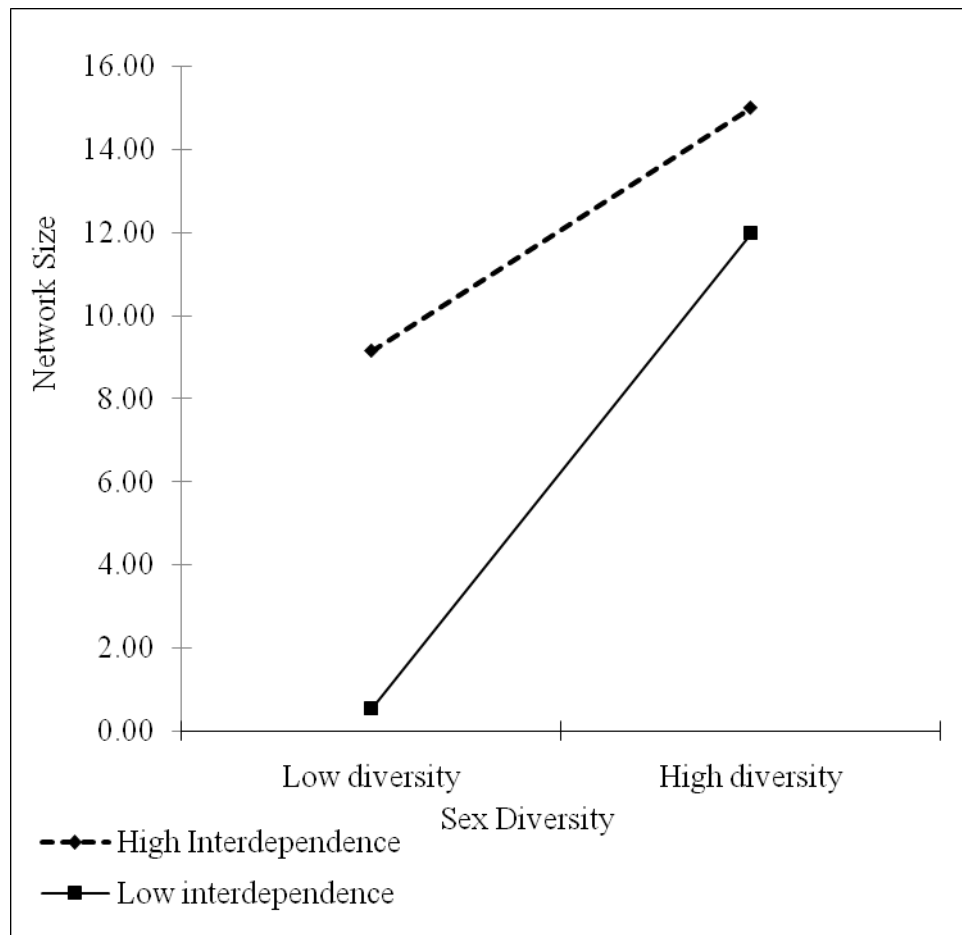
FIGURE 20. Task Interdependence as a Moderator of the Relationship between Age Diversity and External Network Size
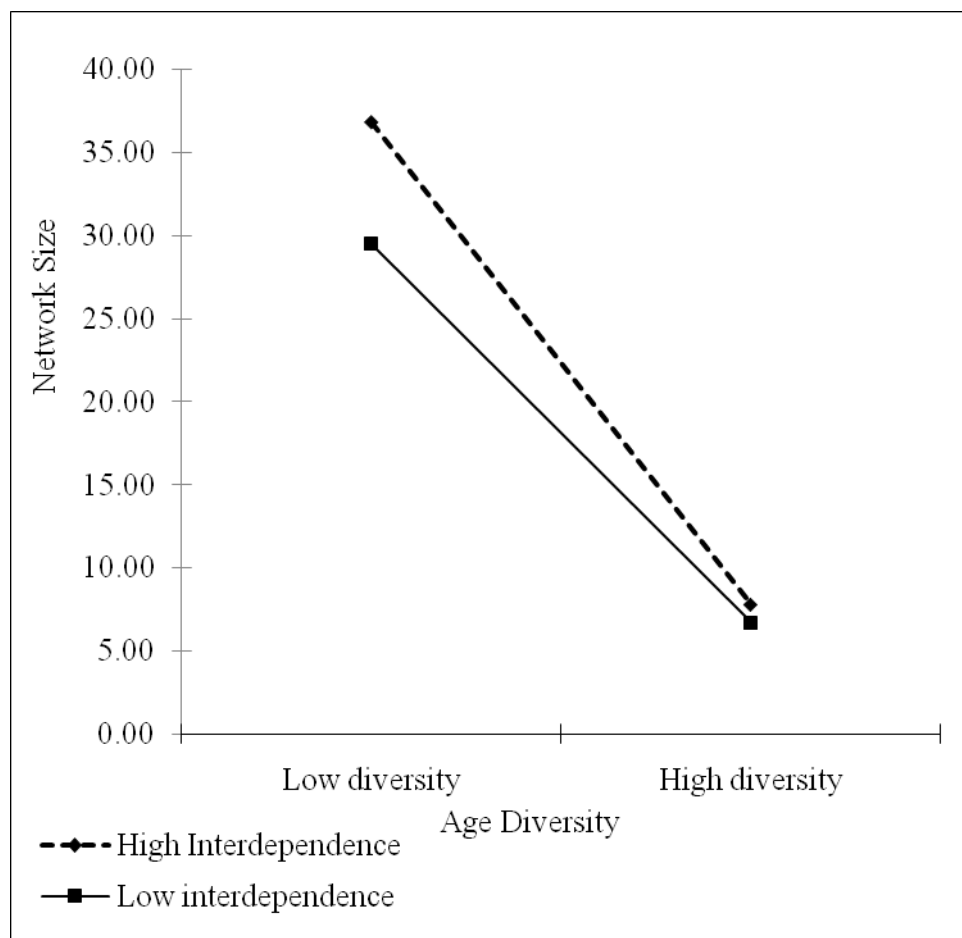
FIGURE 21. Task Interdependence as a Moderator of the Relationship between Status Diversity and External Network Size
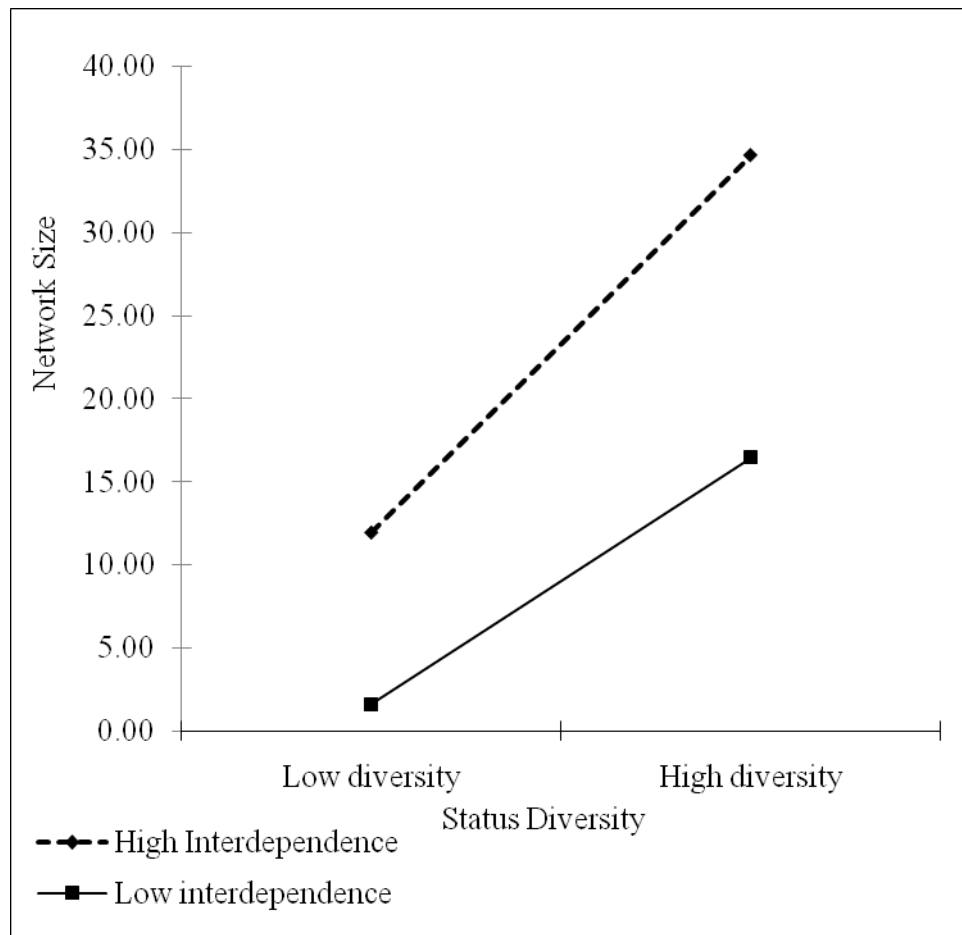
FIGURE 22. Task Interdependence as a Moderator of the Relationship between Major Diversity and External Network Size
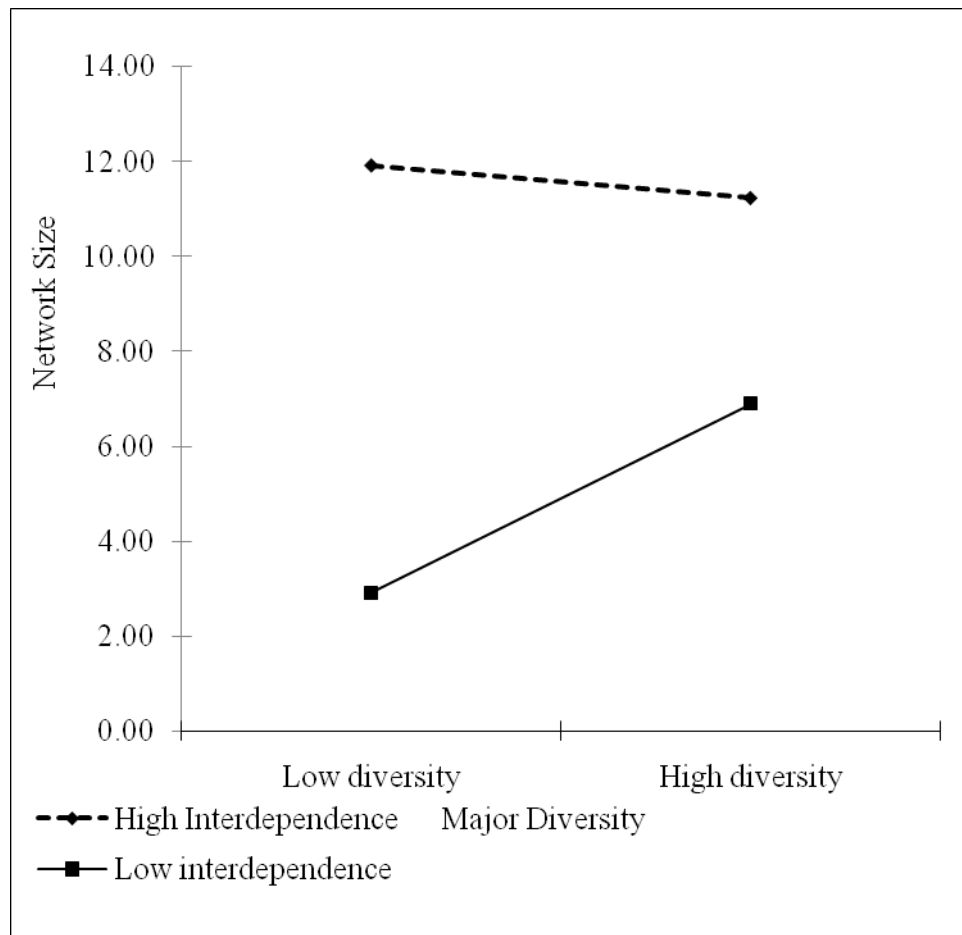
FIGURE 23. Task Interdependence as a Moderator of the Relationship between Sex Diversity and External Social Relations
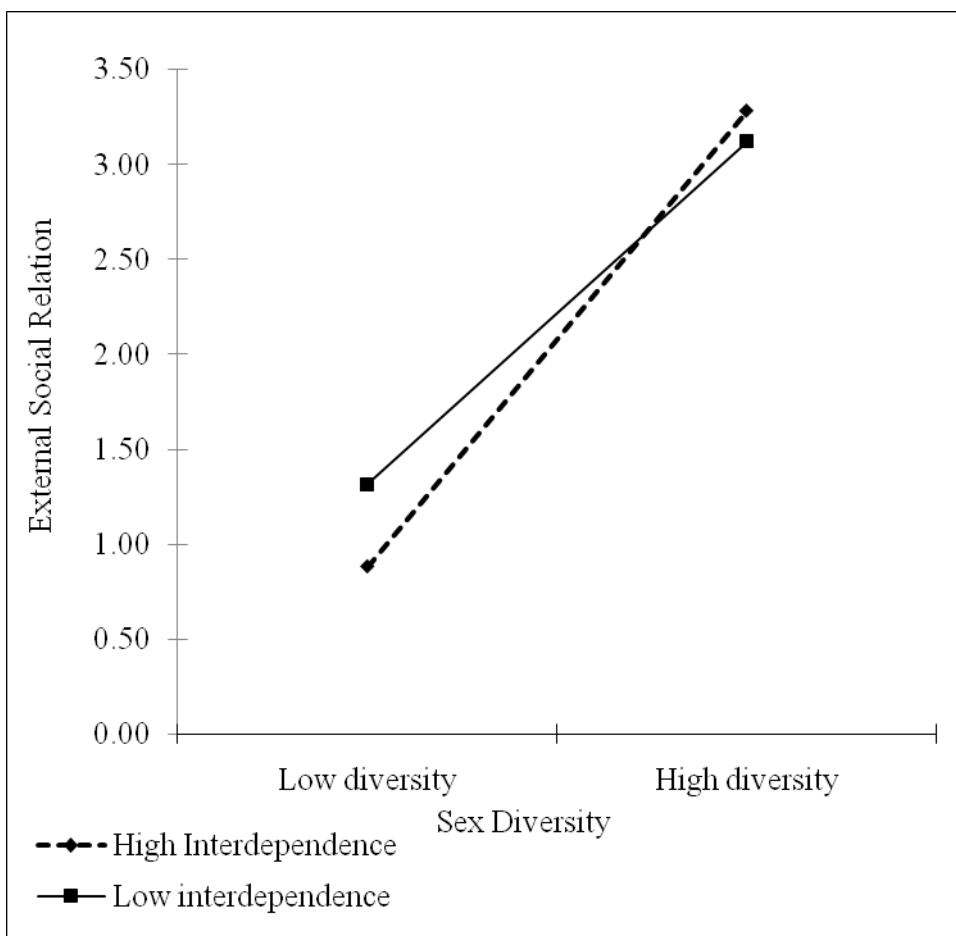
FIGURE 24. Task Interdependence as a Moderator of the Relationship between Ethnicity/nationality Diversity and External Social Relations
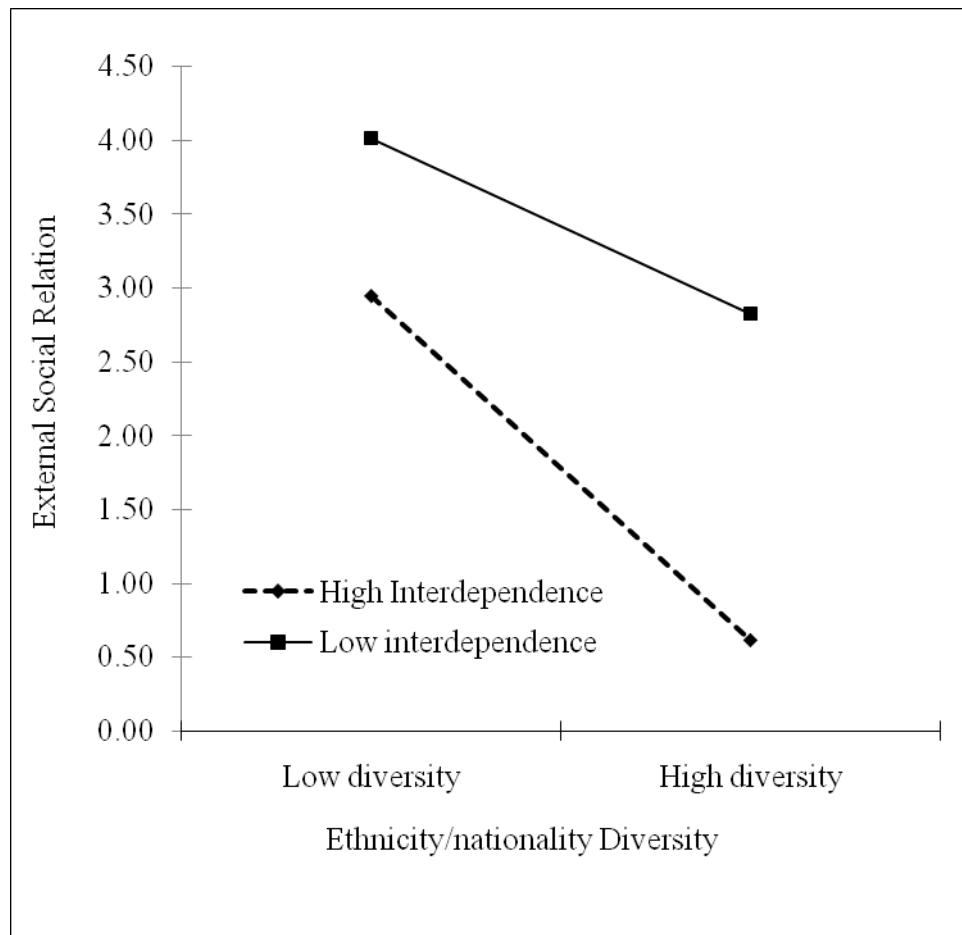
FIGURE 25. Task Interdependence as a Moderator of the Relationship between Status Diversity and External Social Relations
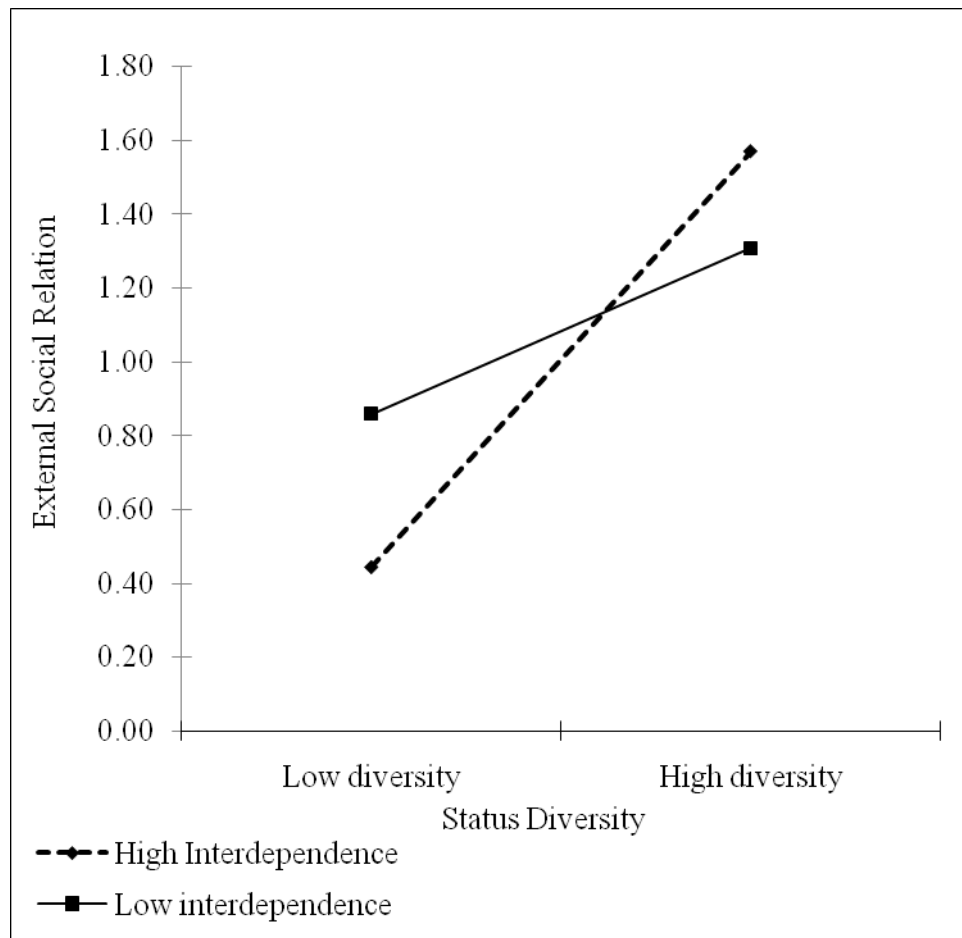
FIGURE 26. Task Interdependence as a Moderator of the Relationship between Sex Diversity and External Job-related Relations
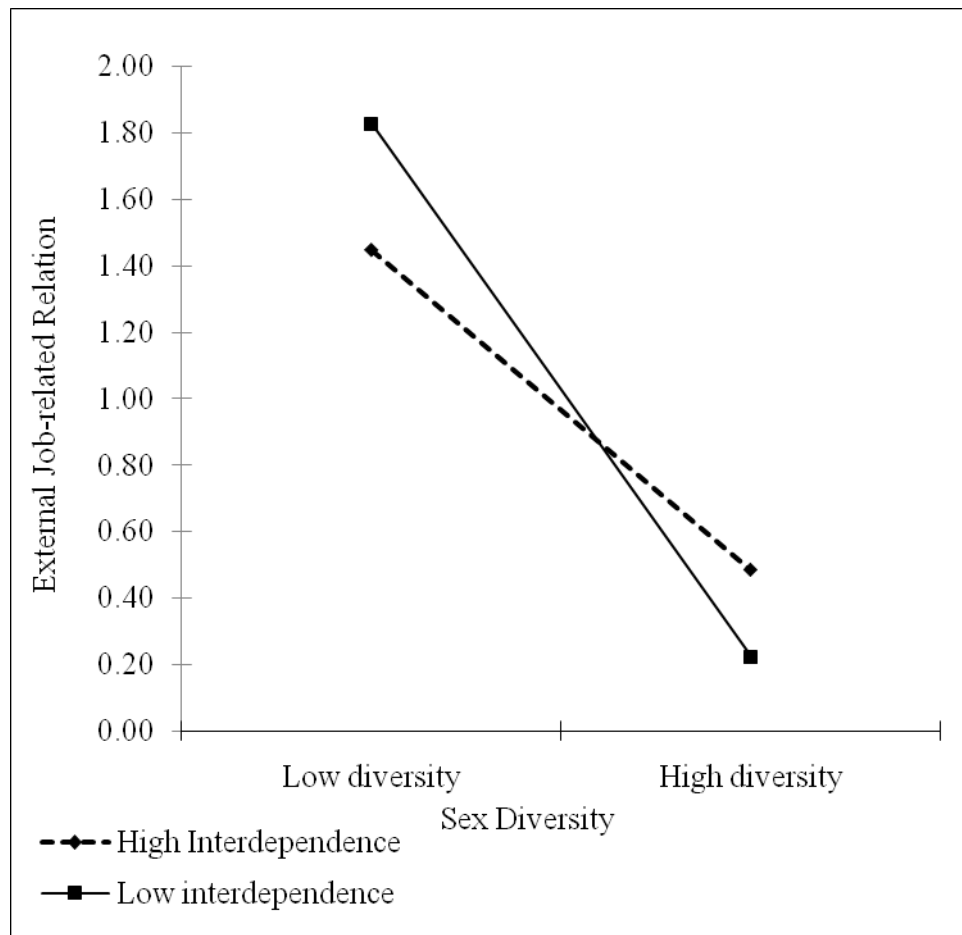
FIGURE 27. Task Interdependence as a Moderator of the Relationship between Ethnicity/nationality Diversity and External Job-related Relations
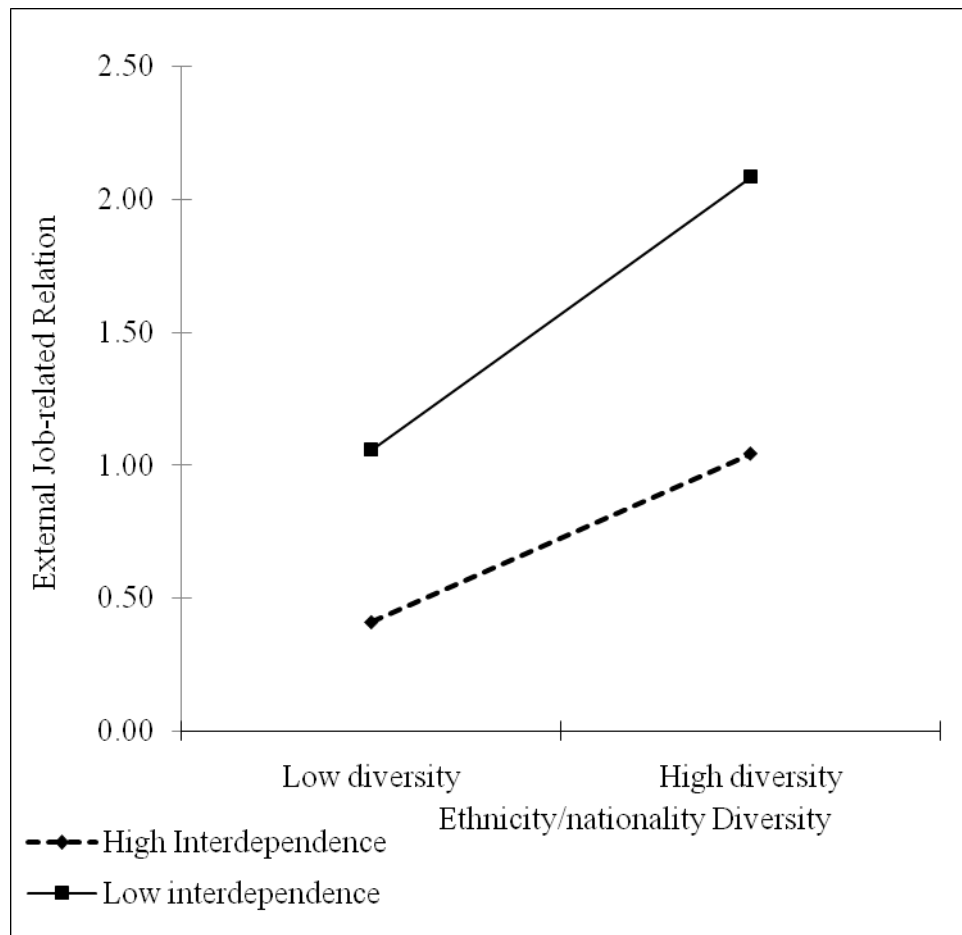
FIGURE 28. Task Interdependence as a Moderator of the Relationship between Tenure Diversity and External Job-related Relations
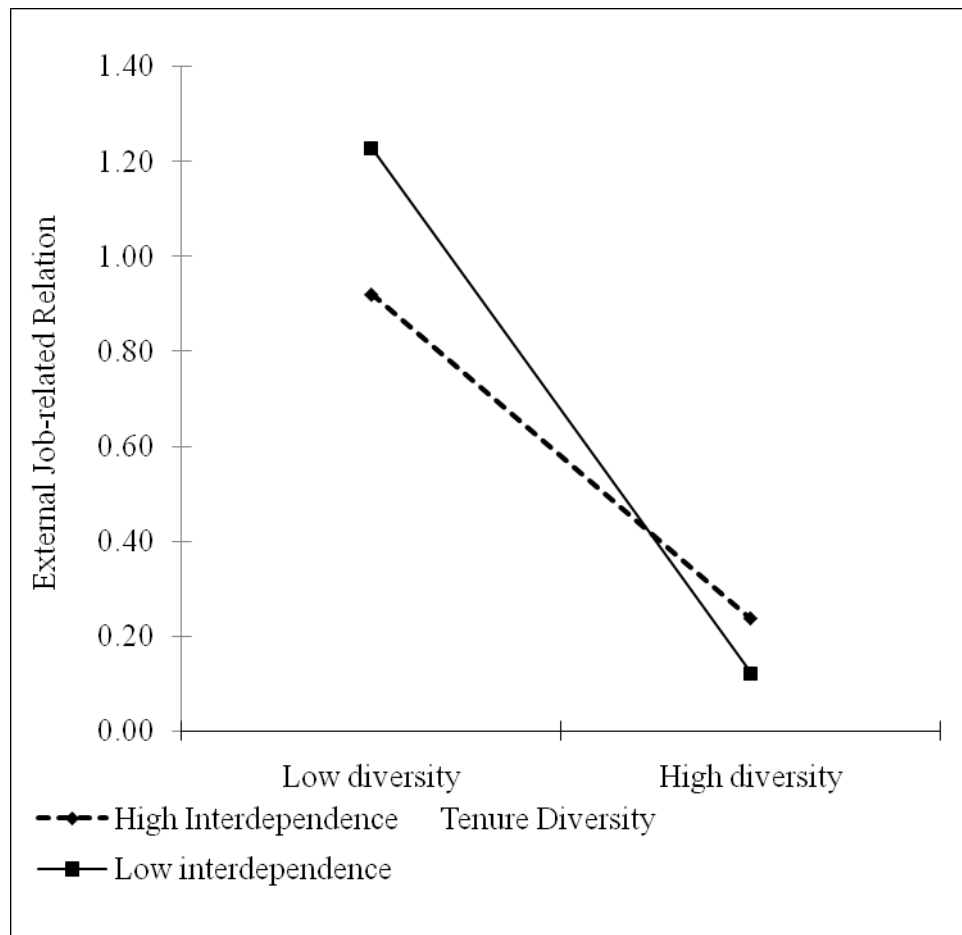
FIGURE 29. Task Interdependence as a Moderator of the Relationship between Major Diversity and External Job-related Relations
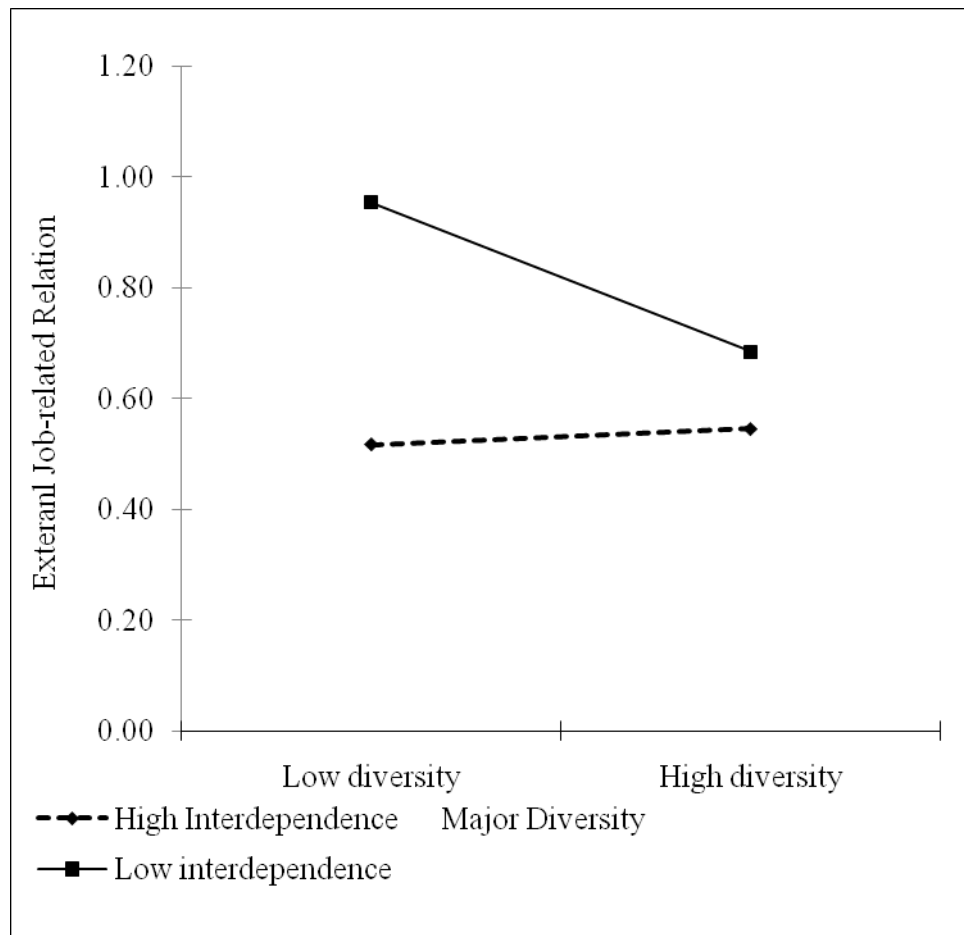
FIGURE 30. Task Interdependence as a Moderator of the Relationship between Sex Diversity and Diversity of External Sex Networks
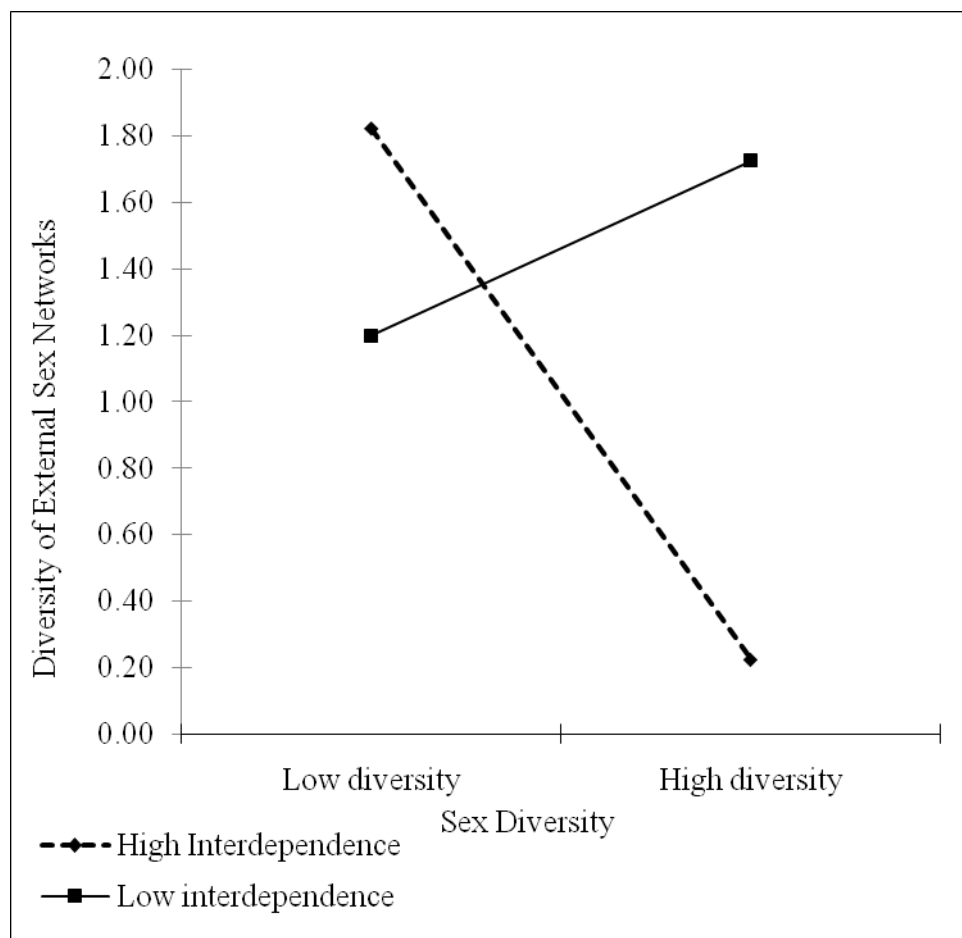
FIGURE 31. Task Interdependence as a Moderator of the Relationship between Status Diversity and Diversity of External Level Networks
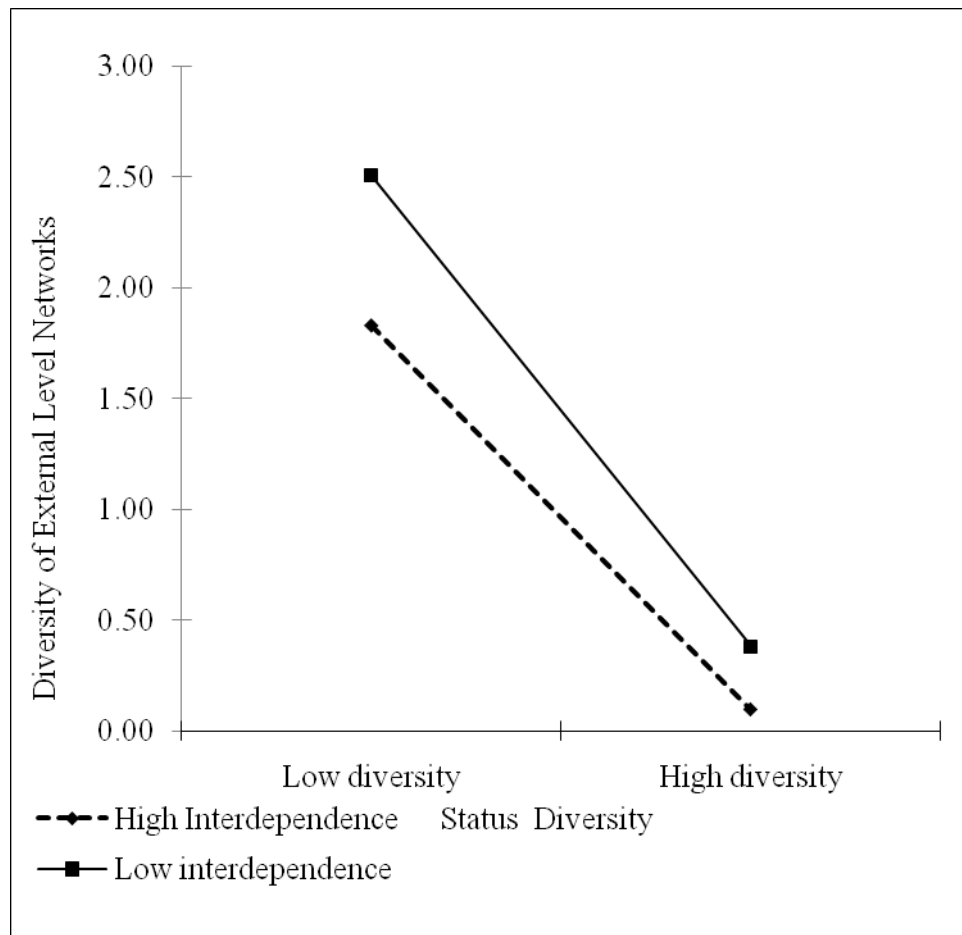
FIGURE 32. Task Interdependence as a Moderator of the Relationship between Ethnicity/nationality Diversity and Diversity of External Ethnic Networks
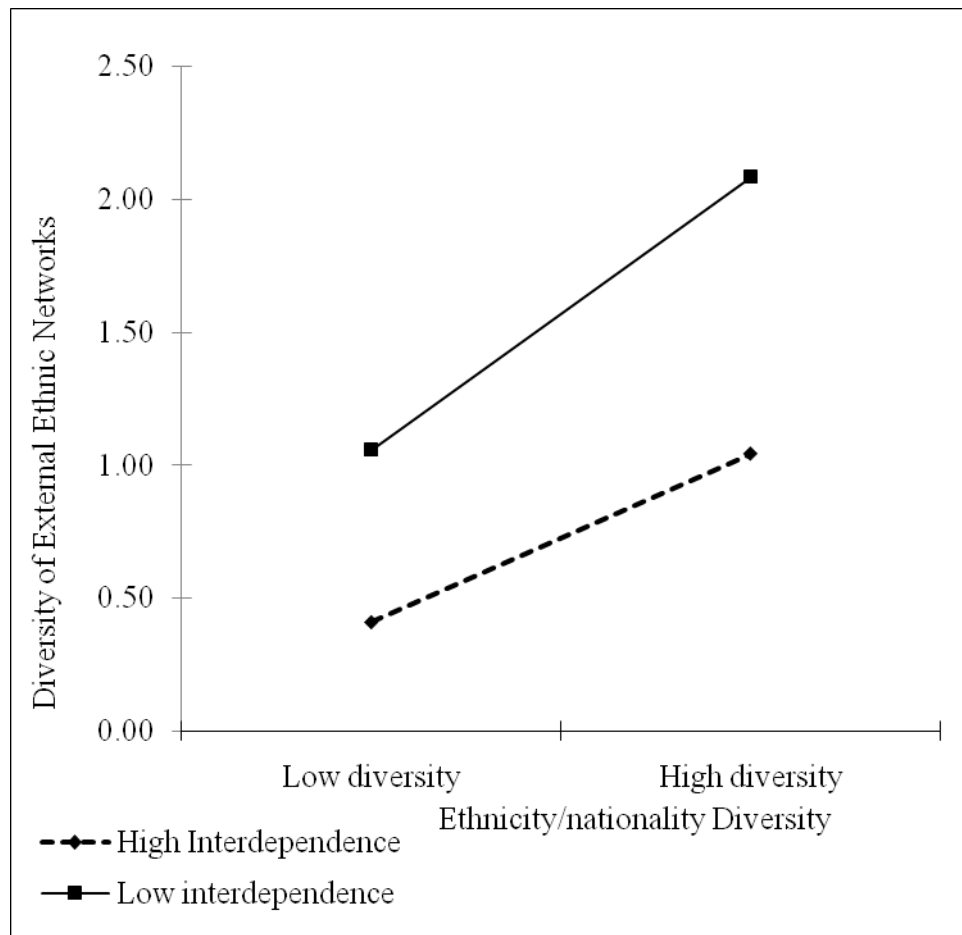
FIGURE 33. Task Interdependence as a Moderator of the Relationship between Major Diversity and Diversity of External Major Networks
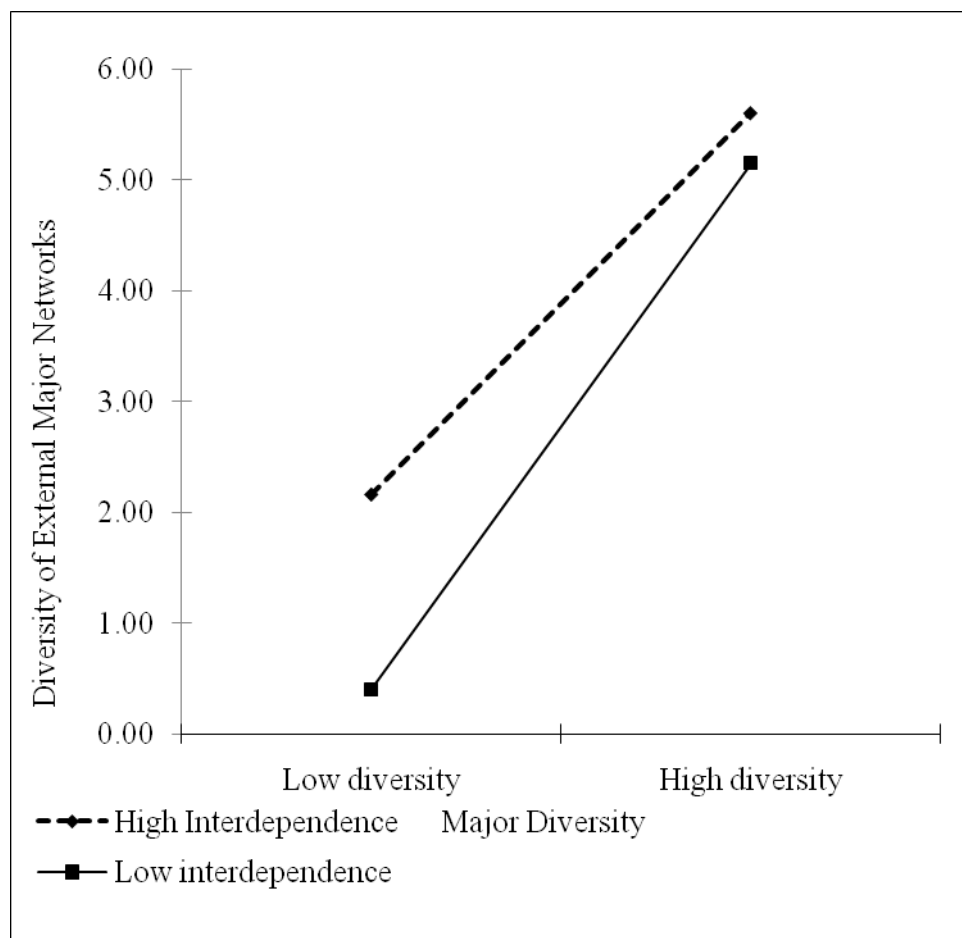
FIGURE 34. Task Interdependence as a Moderator of the Relationship between Major Diversity and Diversity of External Department Networks
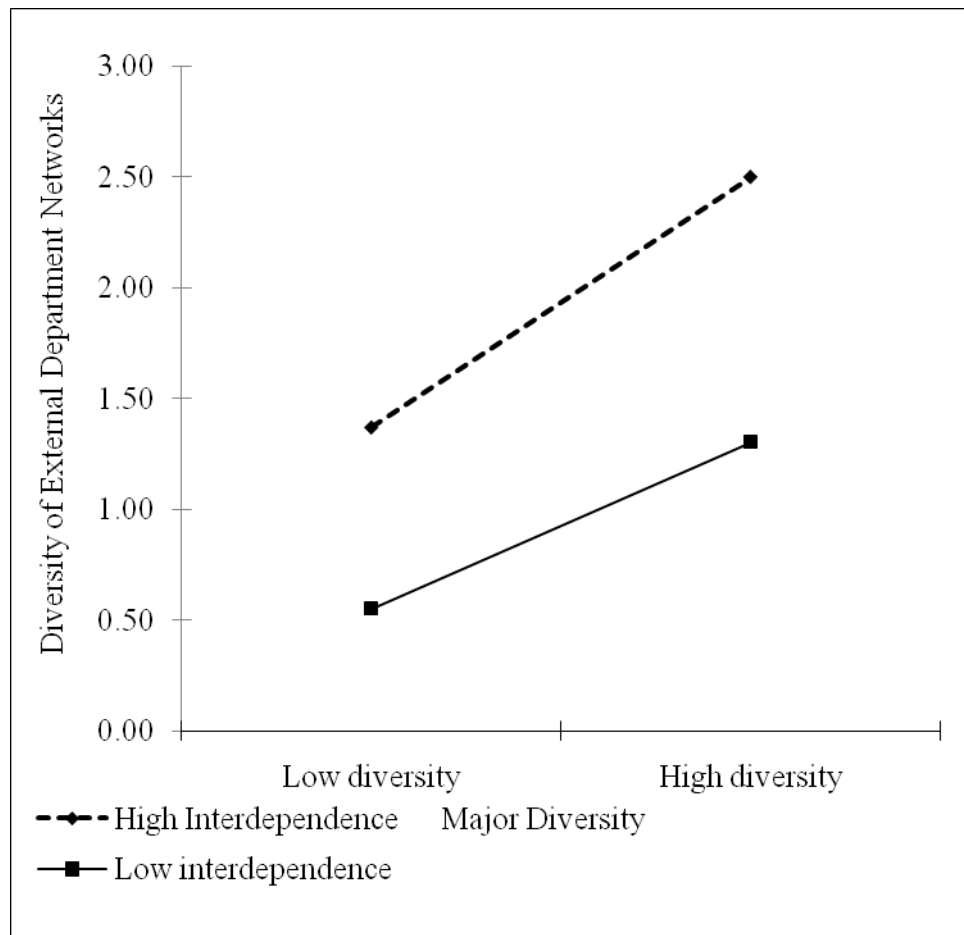
FIGURE 35. Task Interdependence as a Moderator of the Relationship between Social Cohesion and Performance (Manager)
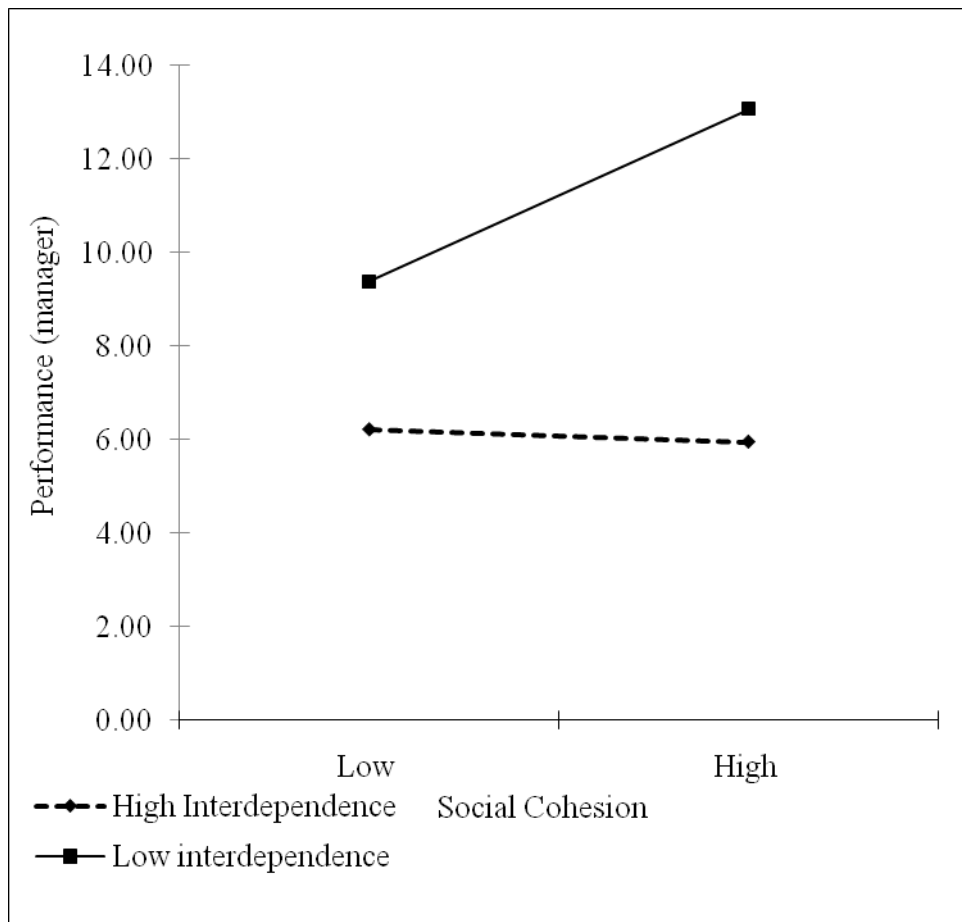
FIGURE 36. Task Interdependence as a Moderator of the Relationship between Job-related Cohesion and Performance (Manager)
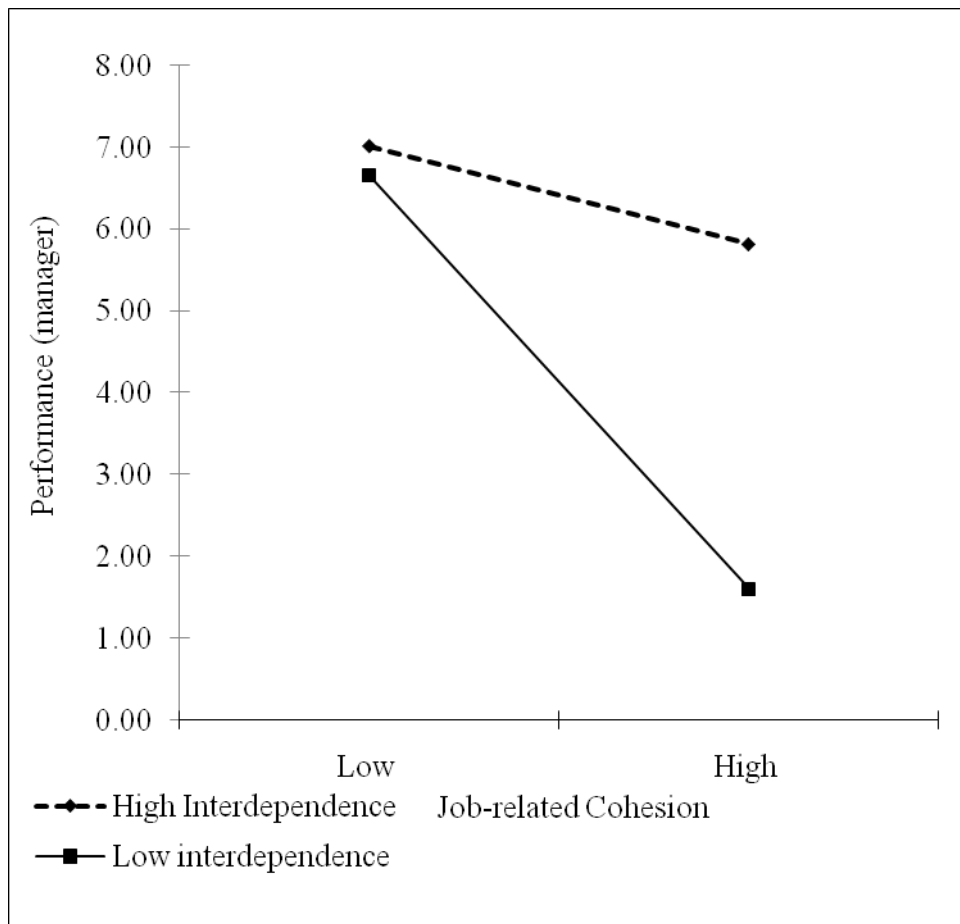
FIGURE 37. Task Interdependence as a Moderator of the Relationship between
Social Cohesion and Performance (Member)
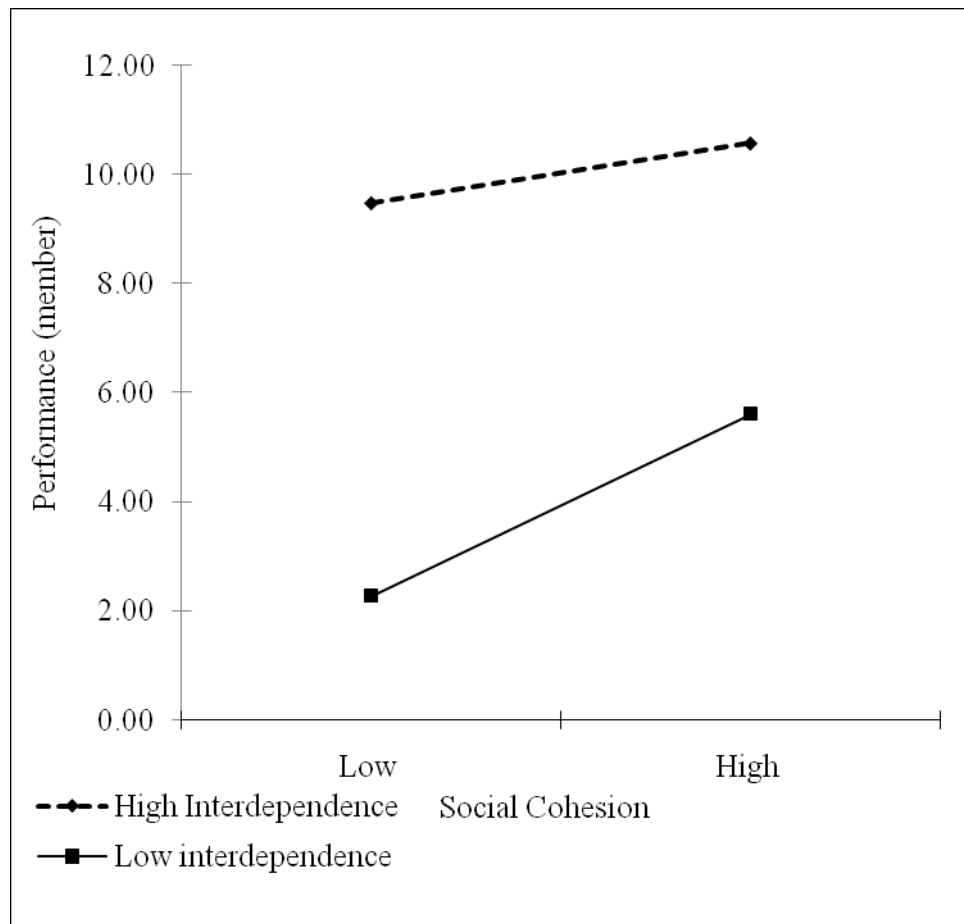
FIGURE 38. Task Interdependence as a Moderator of the Relationship between Job-related Cohesion and Performance (Member)
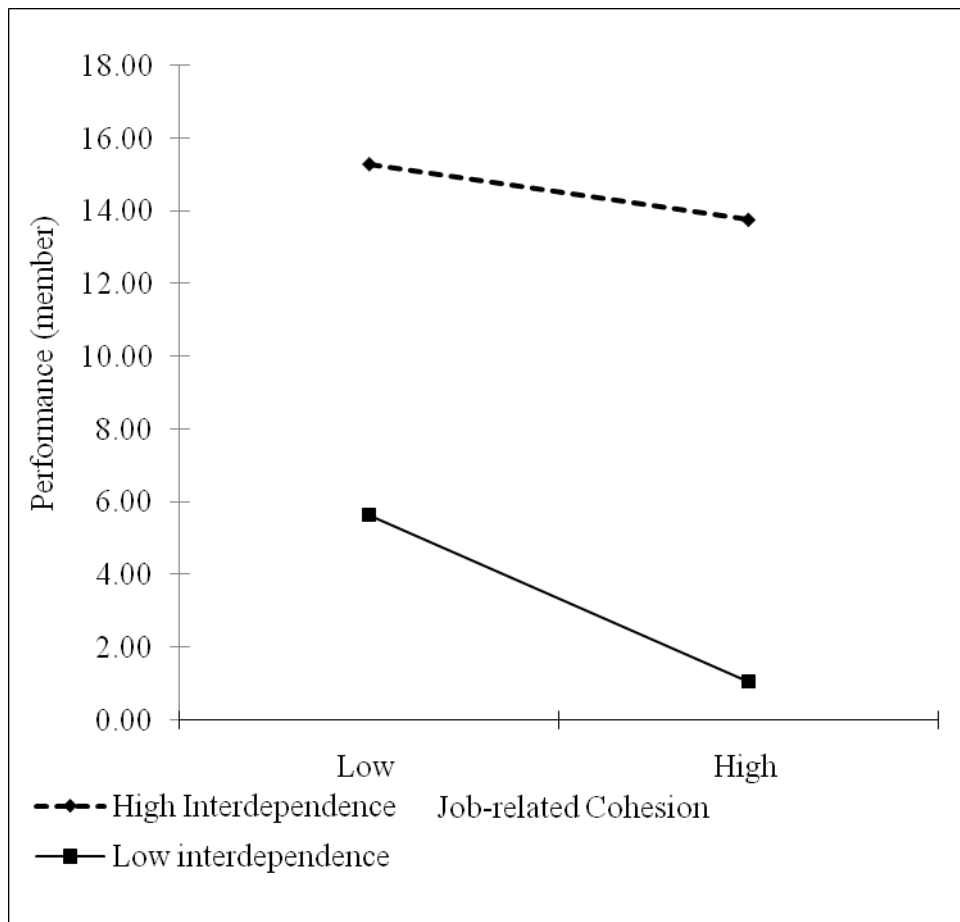
FIGURE 39. Task Interdependence as a Moderator of the Relationship between Trust
and Performance (Member)
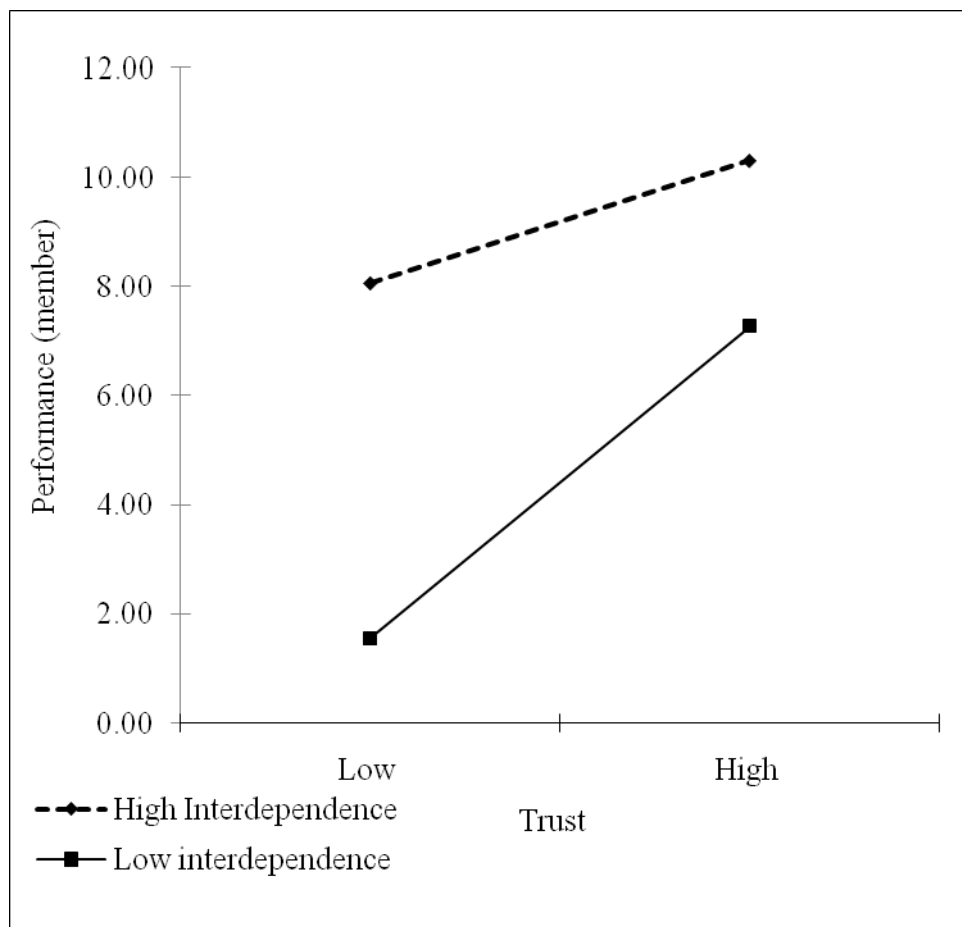
FIGURE 40. Task Interdependence as a Moderator of the Relationship between Cooperative Norm and Performance (Member)
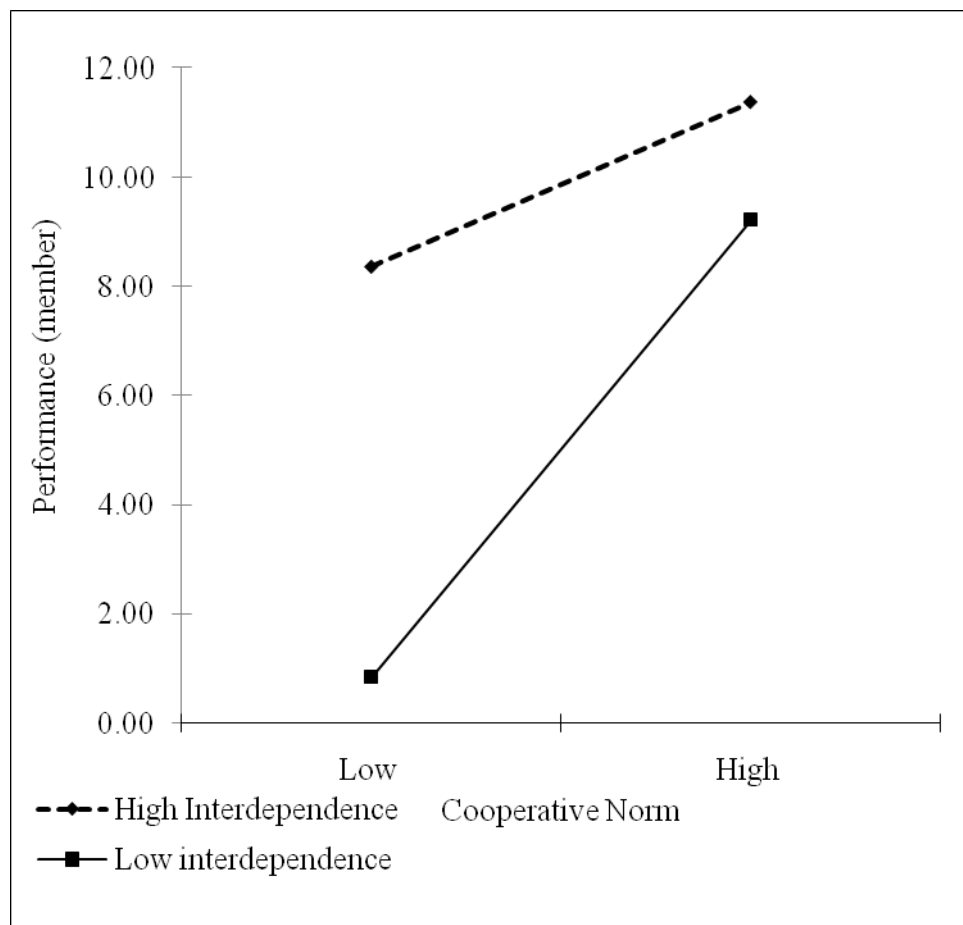
FIGURE 41. Task Interdependence as a Moderator of the Relationship between Social Cohesion and Performance (Both)
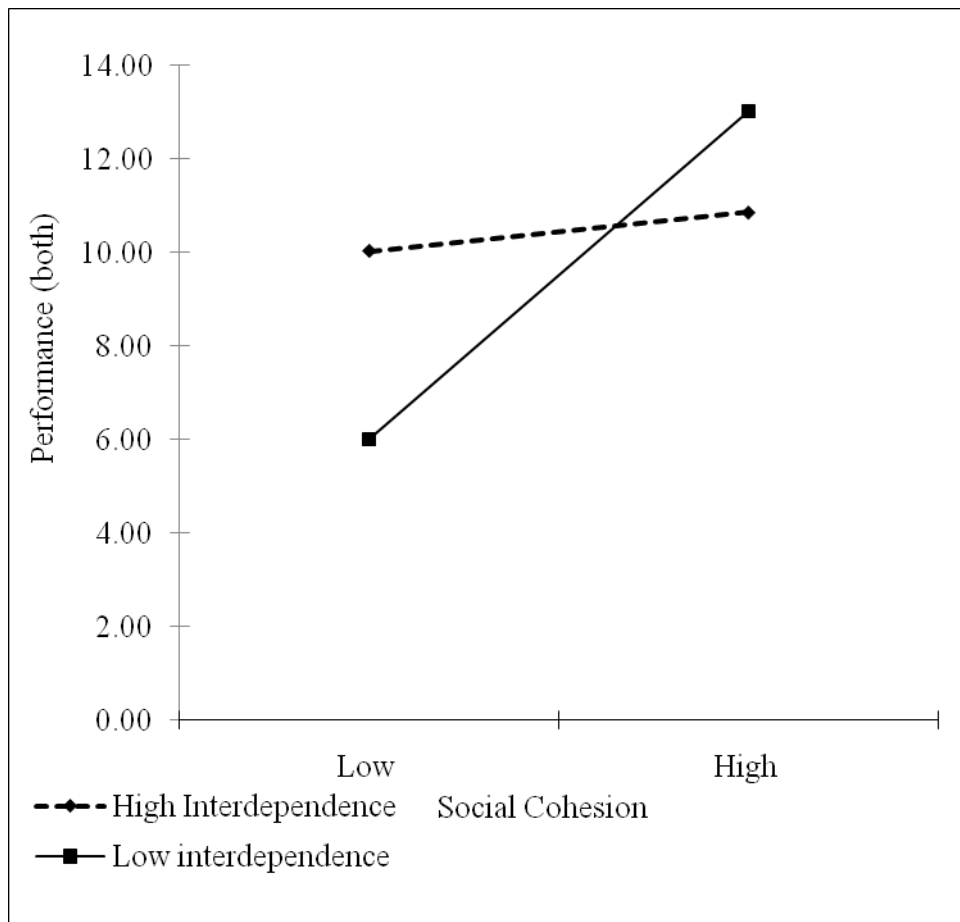
FIGURE 42. Task Interdependence as a Moderator of the Relationship between Job-related Cohesion and Performance (Both)
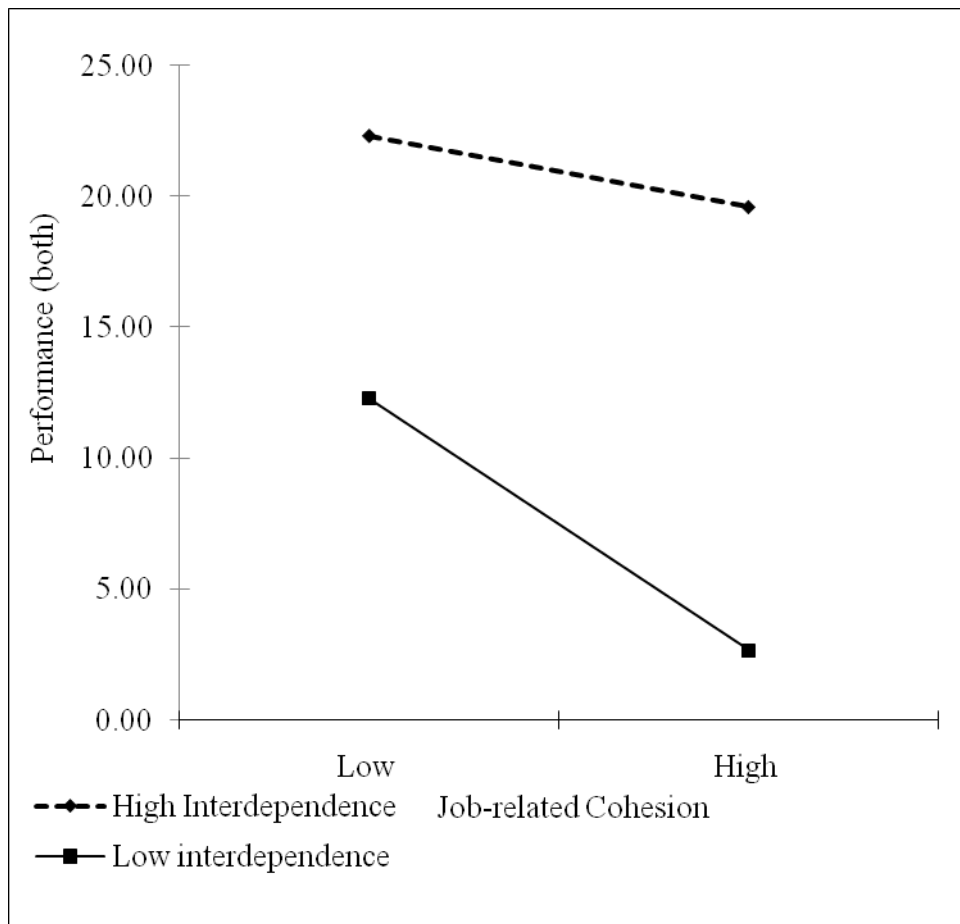
FIGURE 43. Task Interdependence as a Moderator of the Relationship between Trust and Performance (Both)
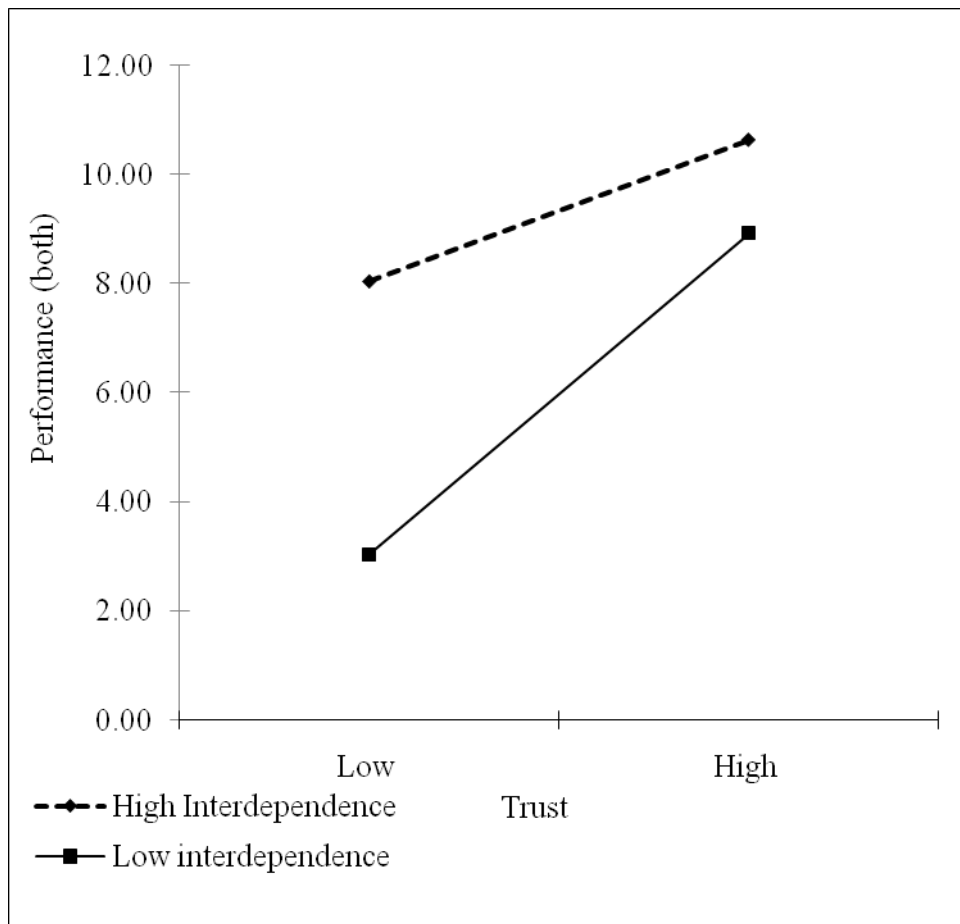
FIGURE 44. Task Interdependence as a Moderator of the Relationship between Cooperative Norm and Knowledge Availability
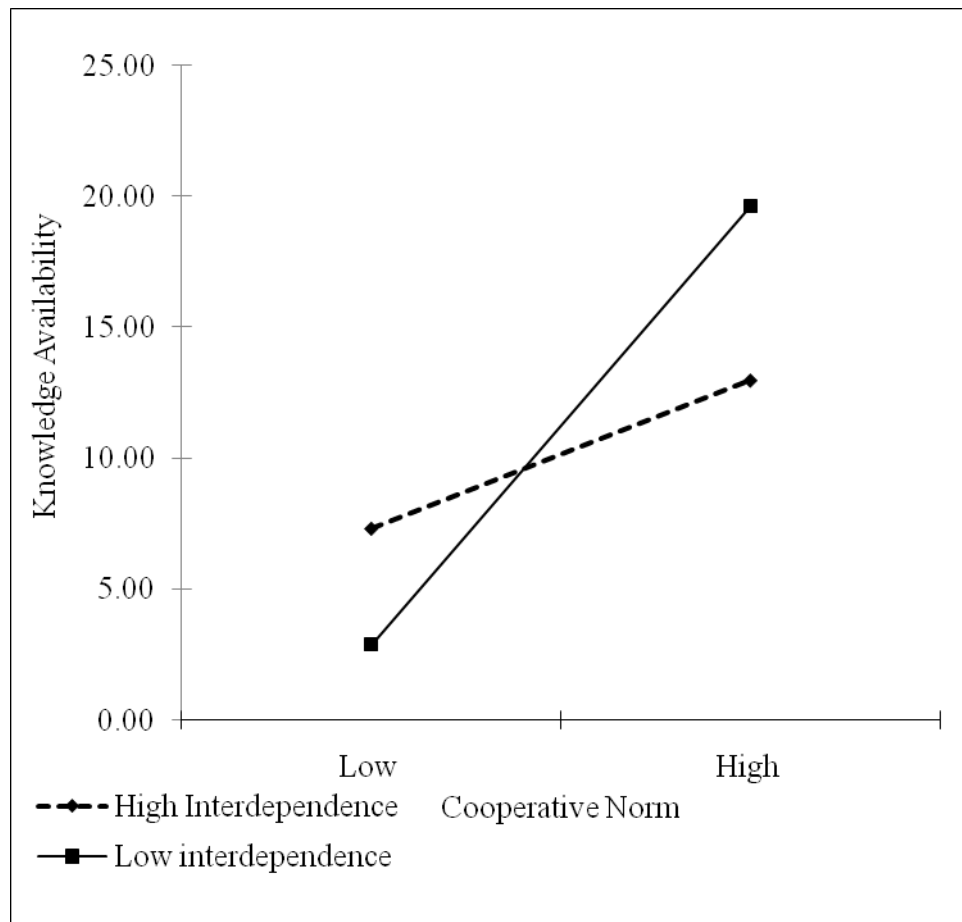
FIGURE 45. Task Interdependence as a Moderator of the Relationship between Social Cohesion and Objective Team Performance
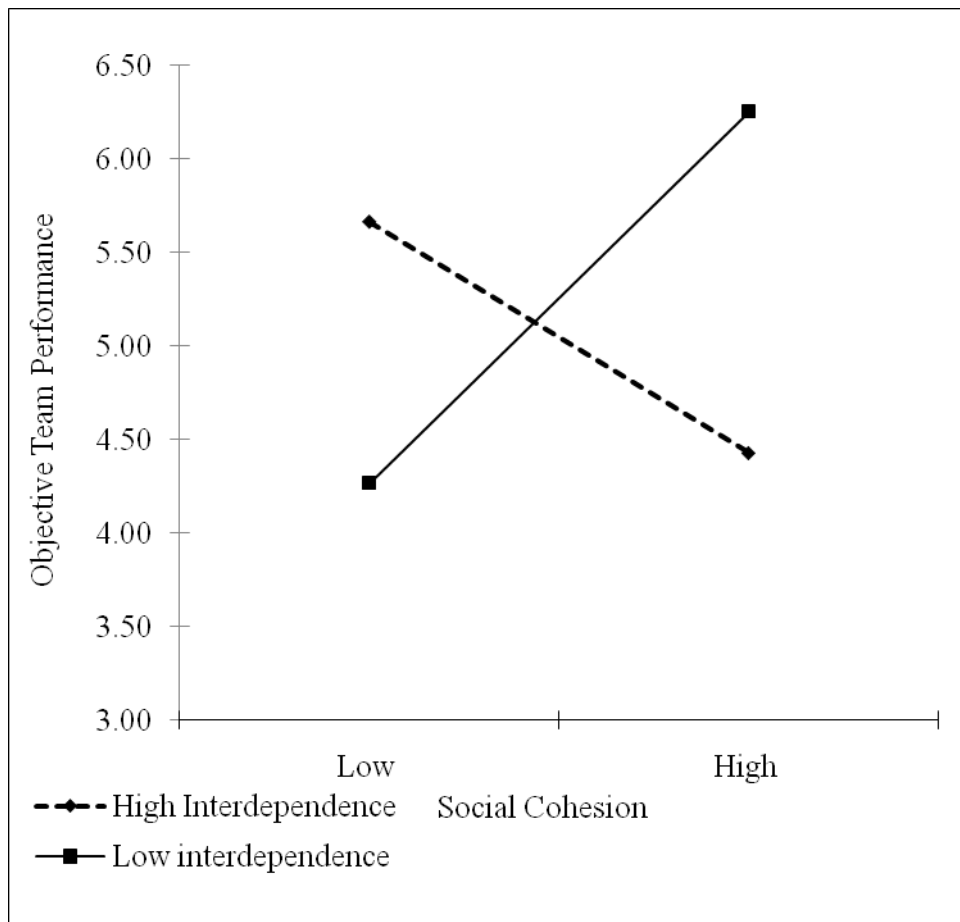
FIGURE 46. Task Interdependence as a Moderator of the Relationship between
External Network Size and Performance (Manager)
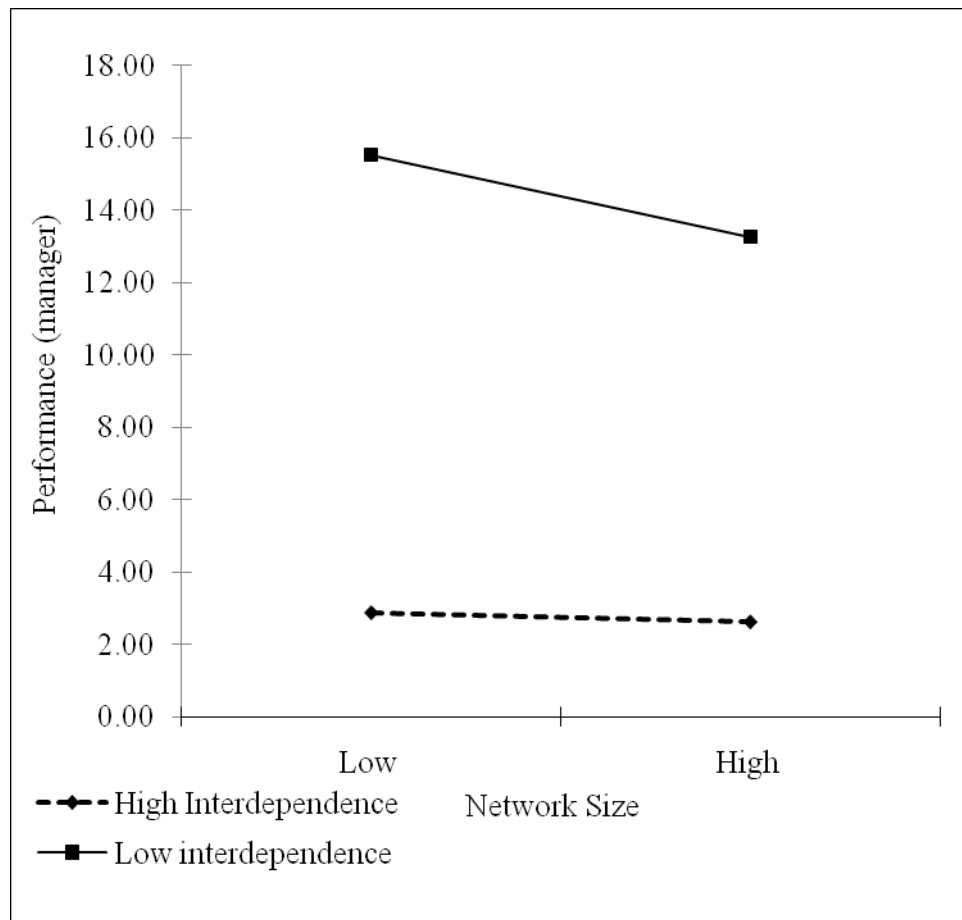
FIGURE 47. Task Interdependence as a Moderator of the Relationship between External Social Relations and Performance (Manager)
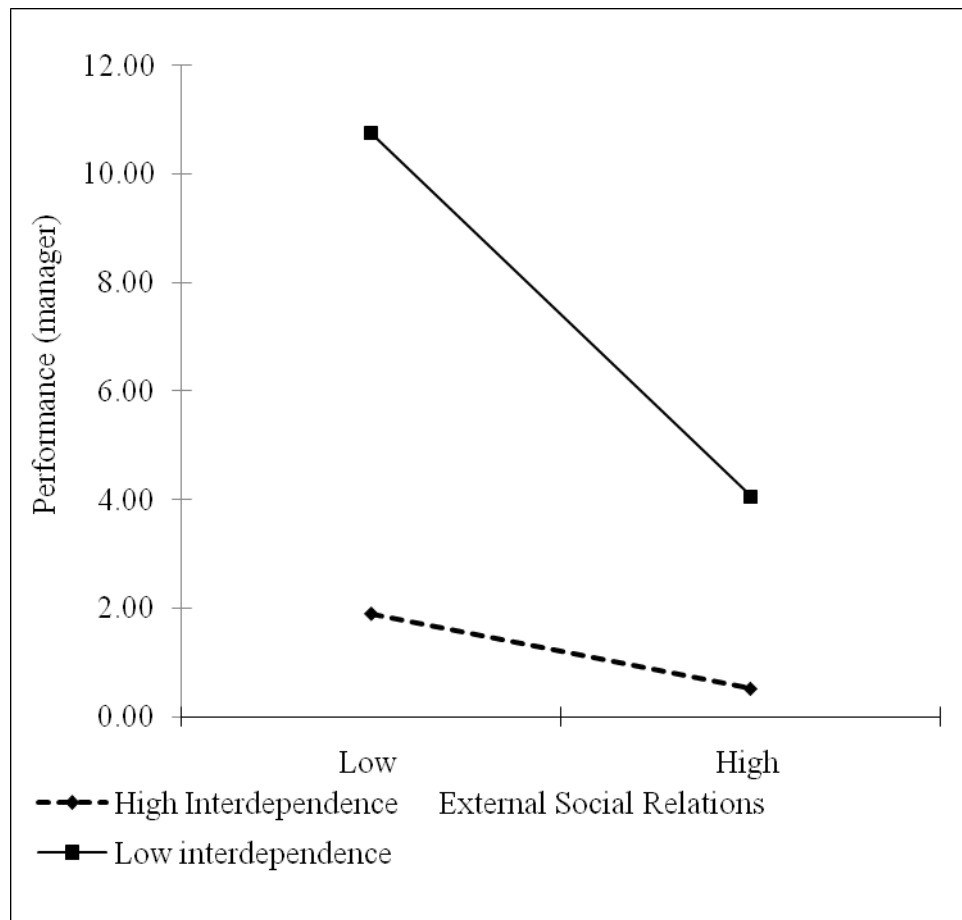
FIGURE 48. Task Interdependence as a Moderator of the Relationship between
External Job-related relations and Performance (manager)
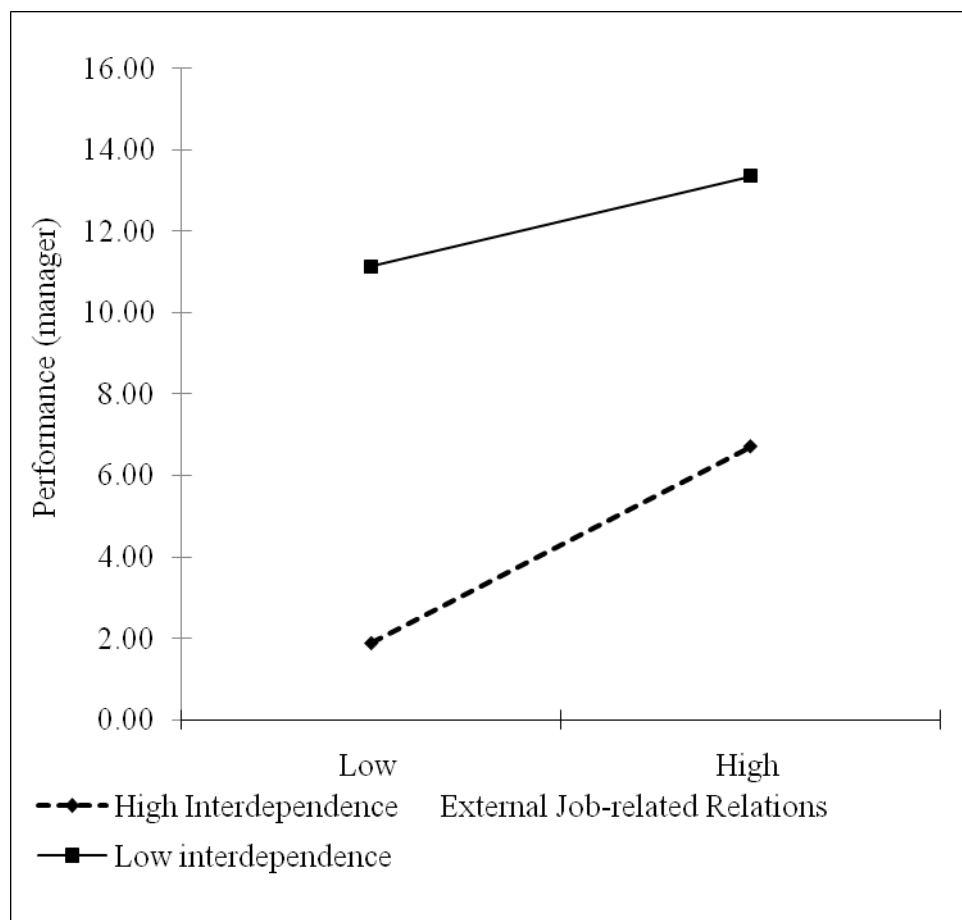
FIGURE 49. Task Interdependence as a Moderator of the Relationship between External Network Size and Performance (Member)
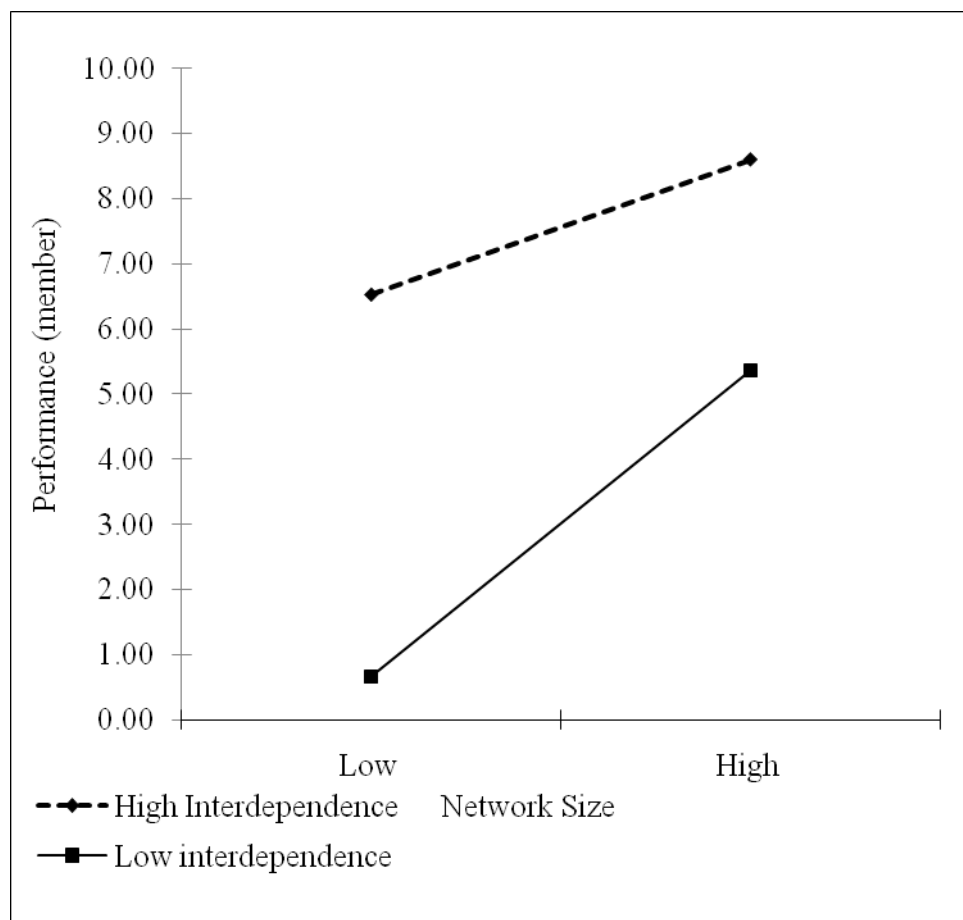
FIGURE 50. Task Interdependence as a Moderator of the Relationship between External Social Relations and Performance (Member)
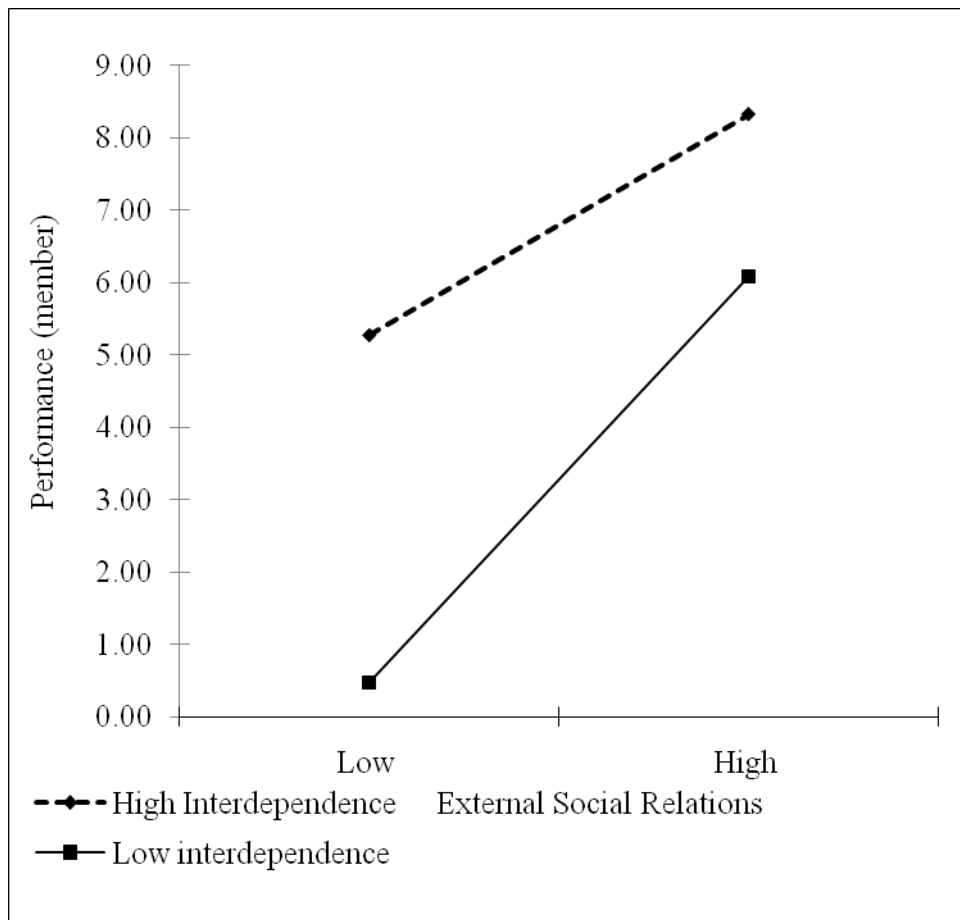
FIGURE 51. Task Interdependence as a Moderator of the Relationship between
External Job-related and Performance (Member)
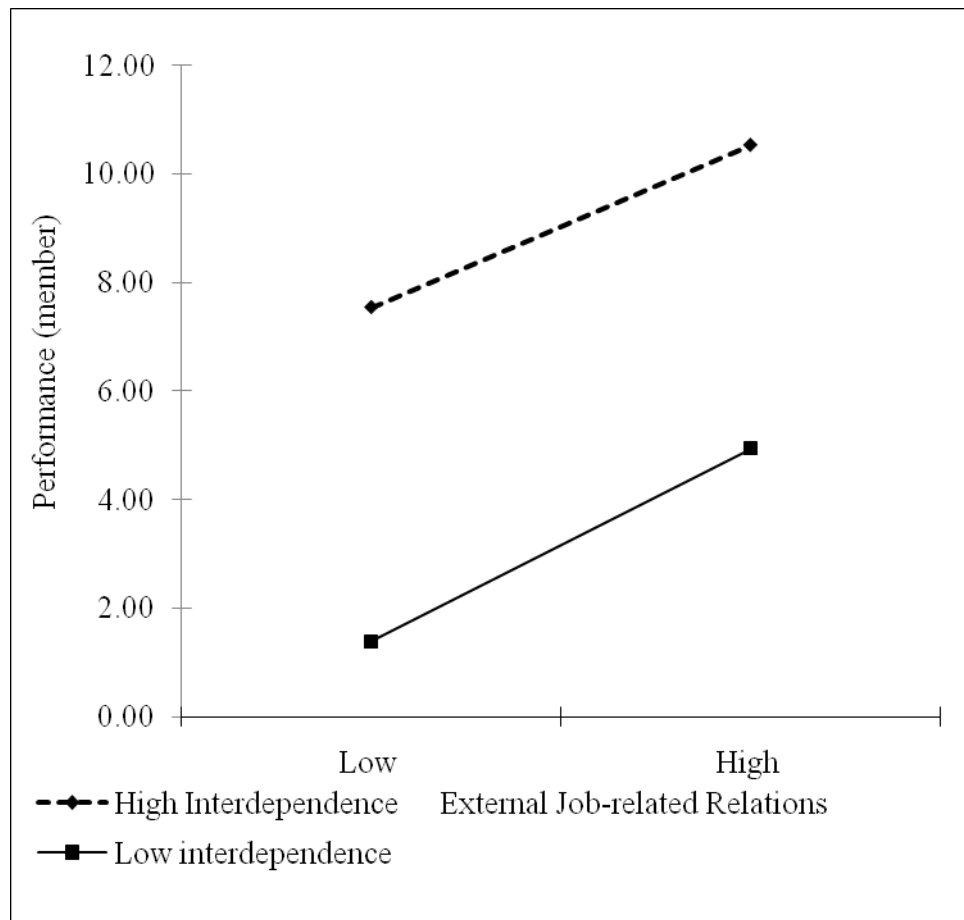
FIGURE 52. Task Interdependence as a Moderator of the Relationship between
External Social Relations and Performance (Both)
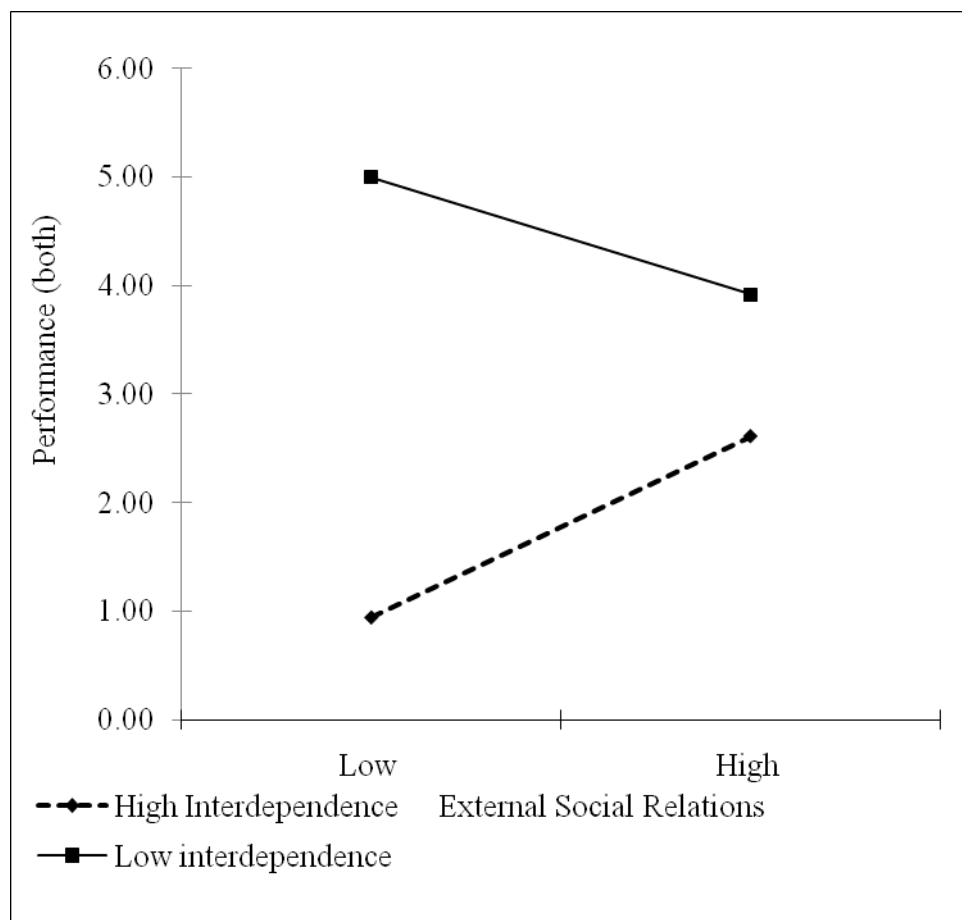
FIGURE 53. Task Interdependence as a Moderator of the Relationship between
External Job-related Relations and Performance (Both)
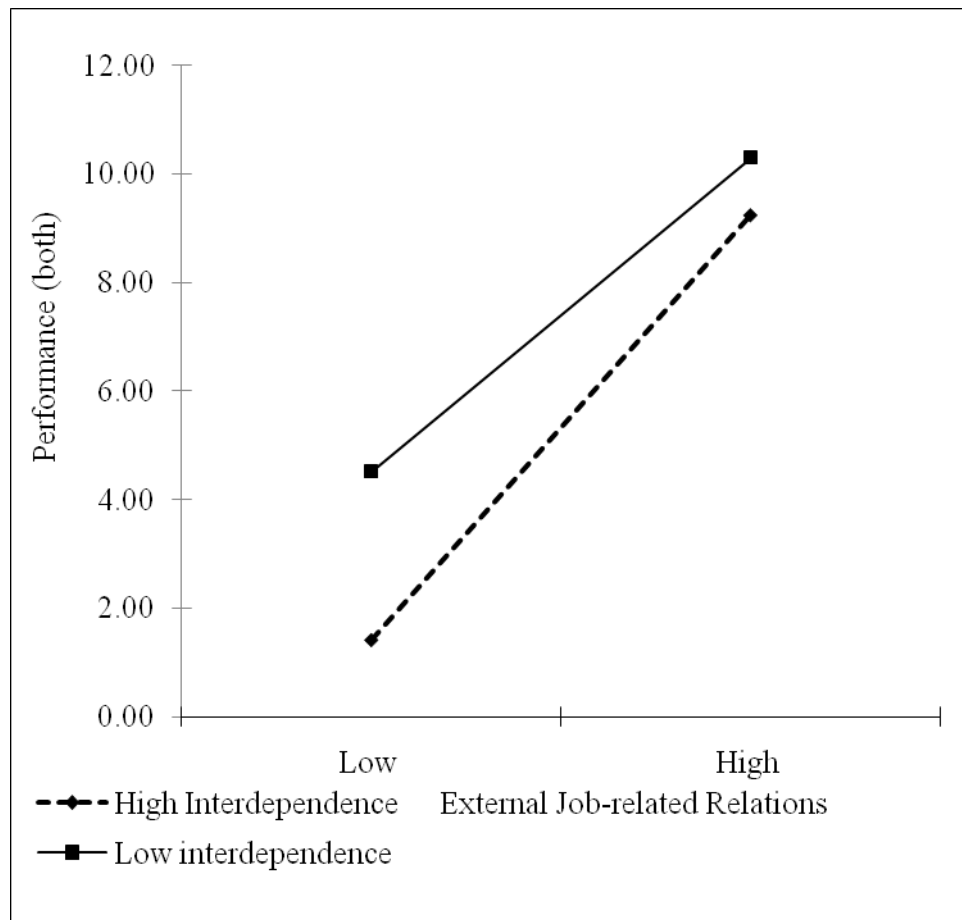
FIGURE 54. Task Interdependence as a Moderator of the Relationship between
External Network Size and Knowledge Availability
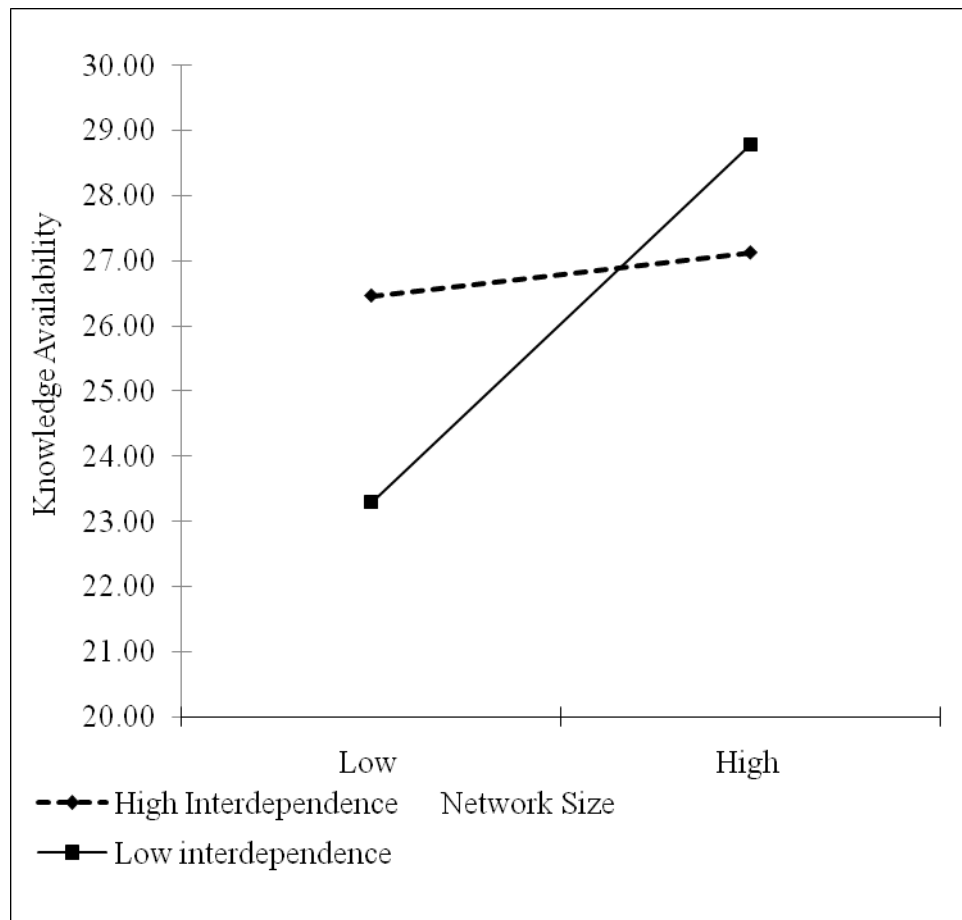
FIGURE 55. Task Interdependence as a Moderator of the Relationship between
External Network Size and Objective Team Performance
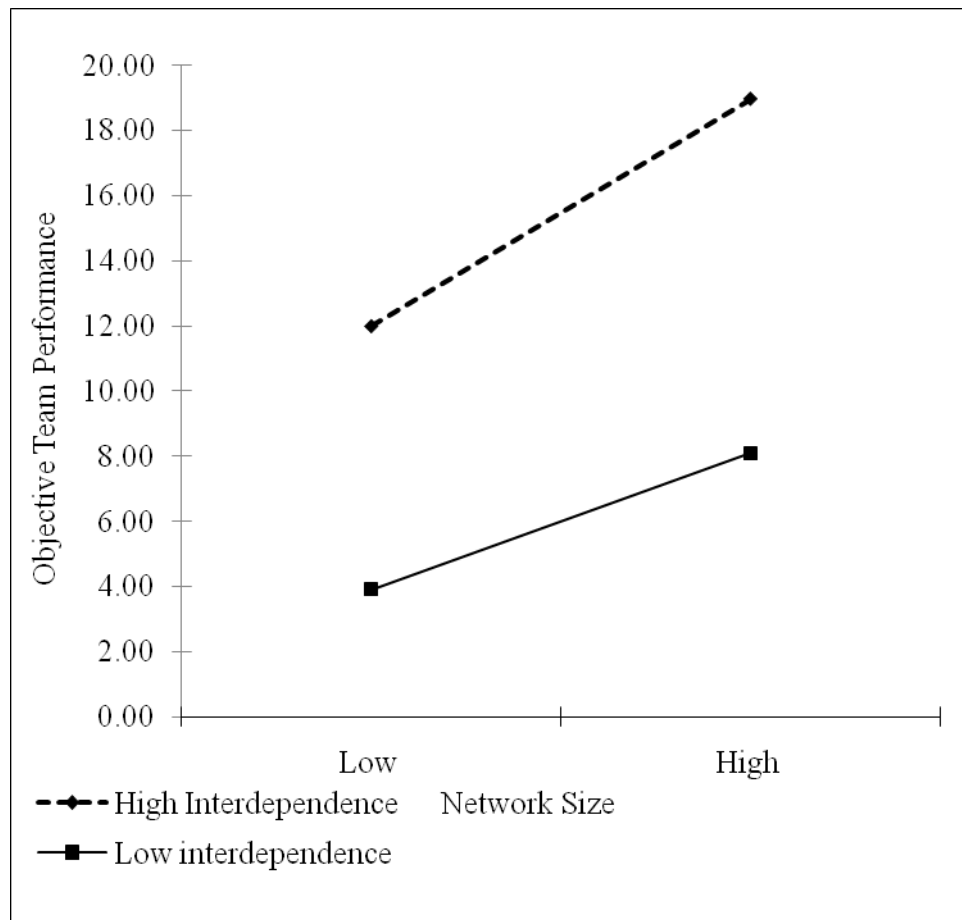
FIGURE 56. Task Interdependence as a Moderator of the Relationship between
External Social Relations and Objective Team Performance
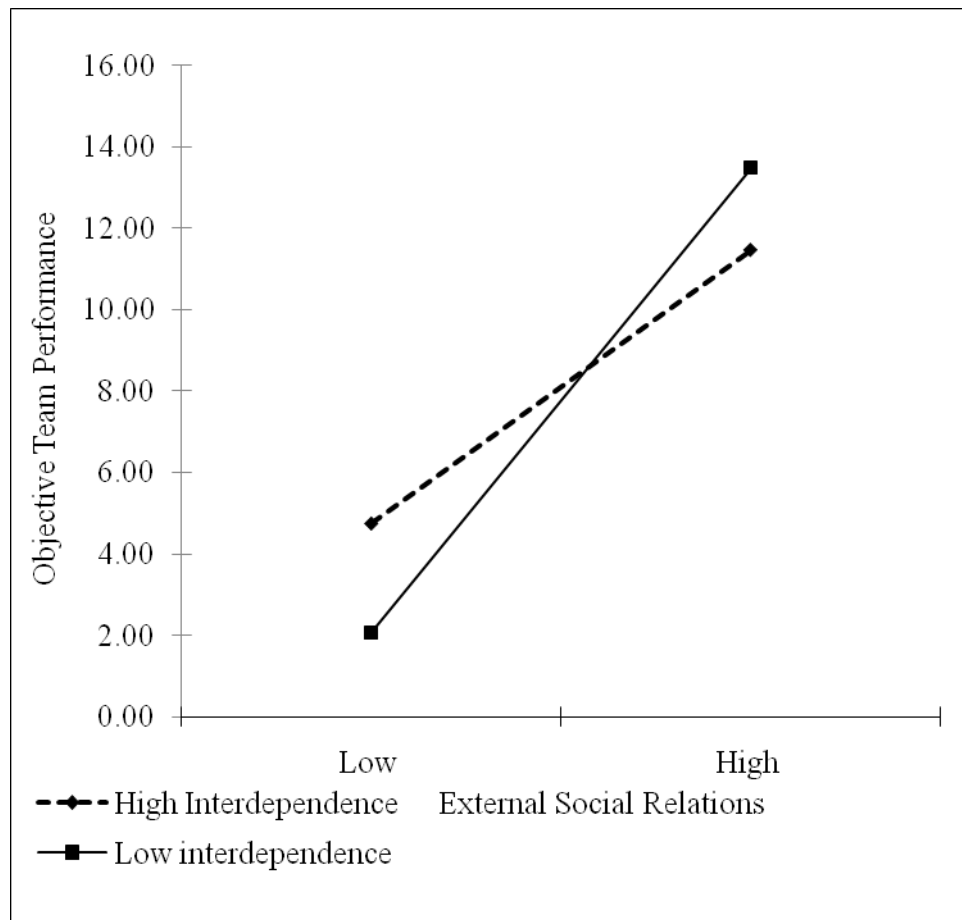
FIGURE 57. Task Interdependence as a Moderator of the Relationship between
External Job-related Relations and Objective Performance
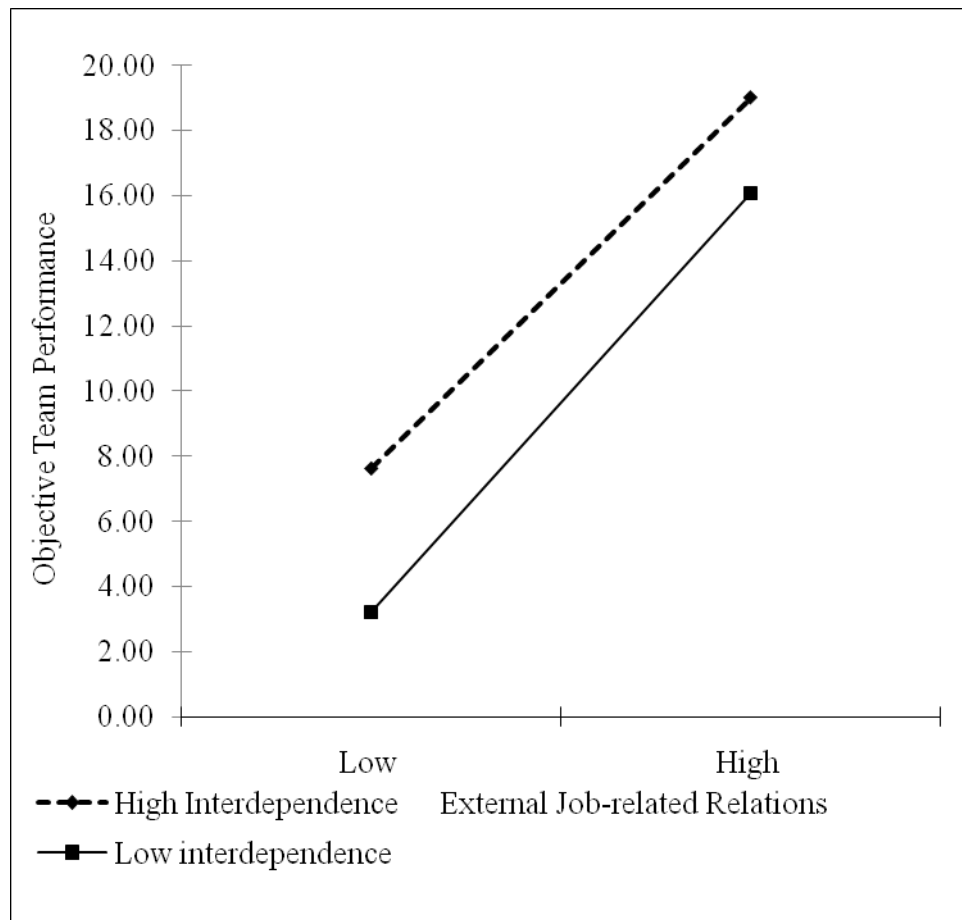
FIGURE 58. Task Routineness as a Moderator of the Relationship between Ethnicity/nationality Diversity and Social Cohesion
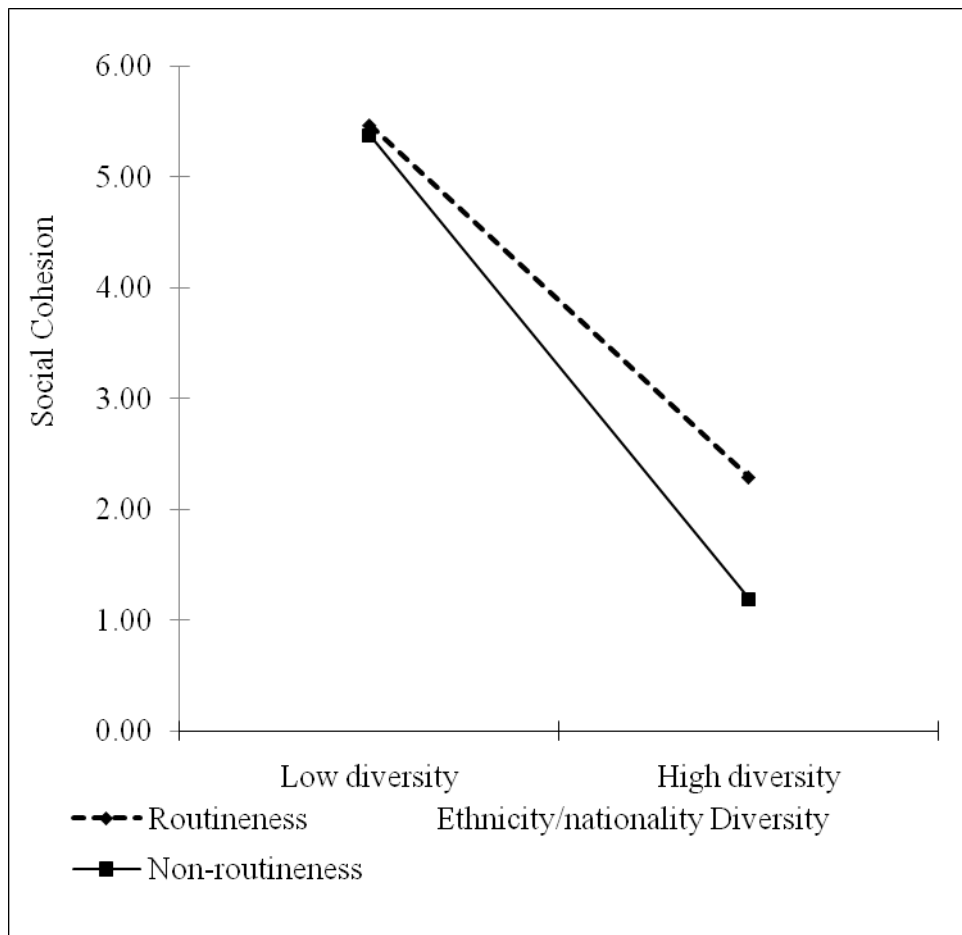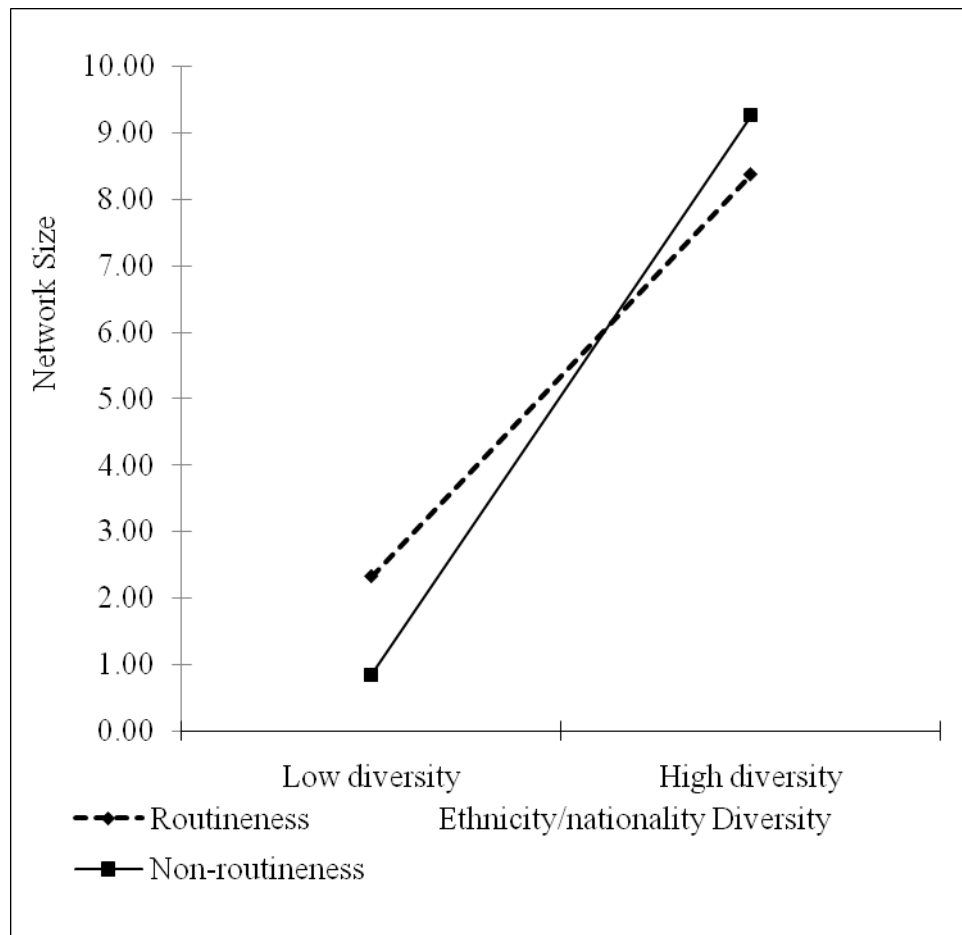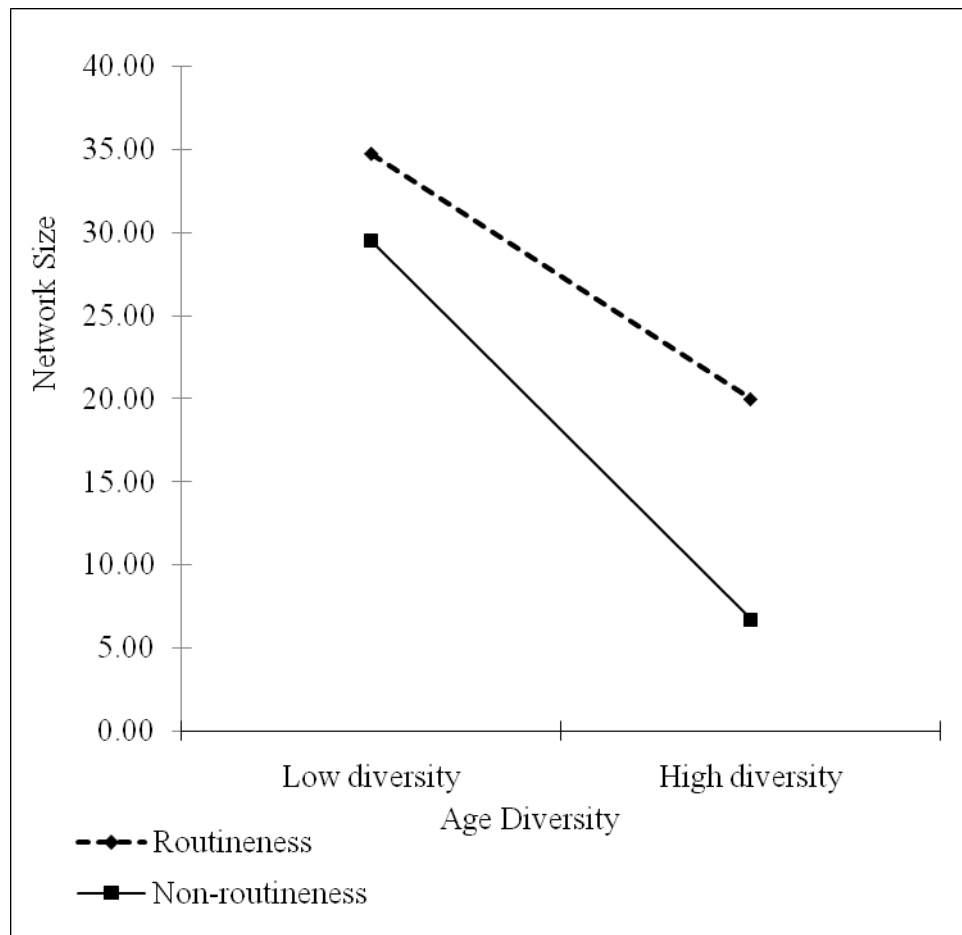
FIGURE 59. Task Routineness as a Moderator of the Relationship between Status Diversity and Social Cohesion
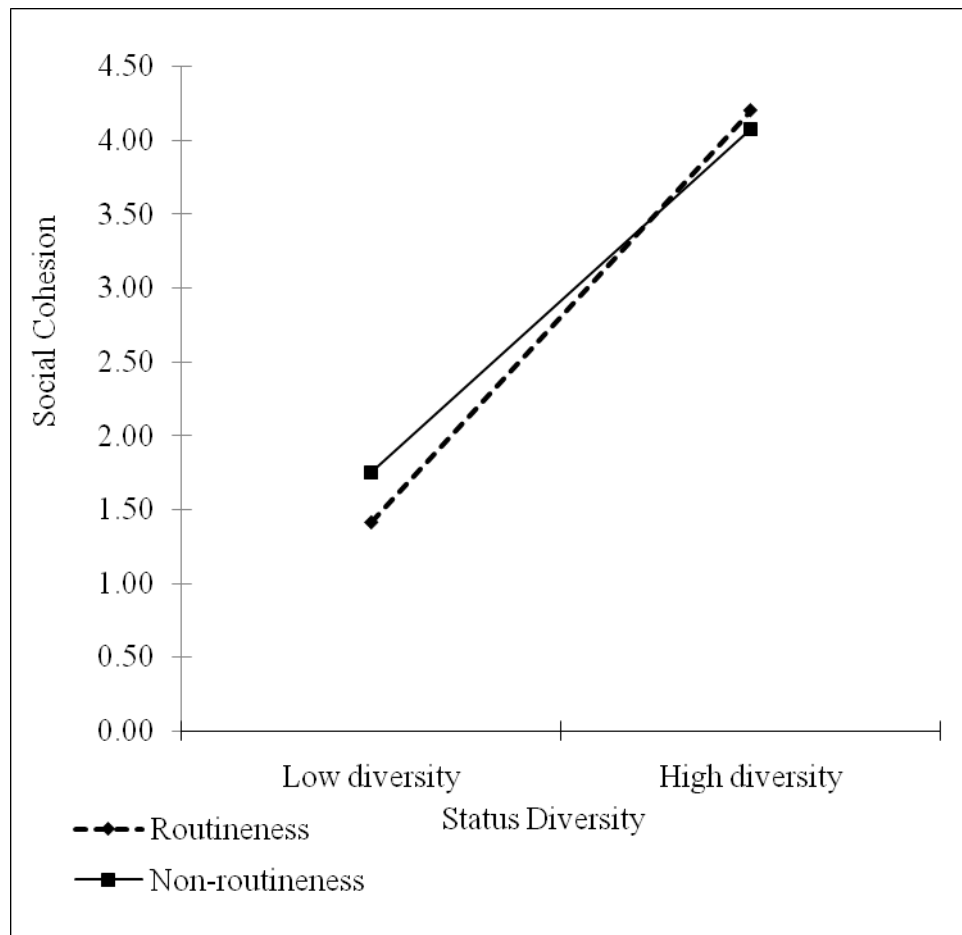
FIGURE 60. Task Routineness as a Moderator of the Relationship between Major Diversity and Social Cohesion
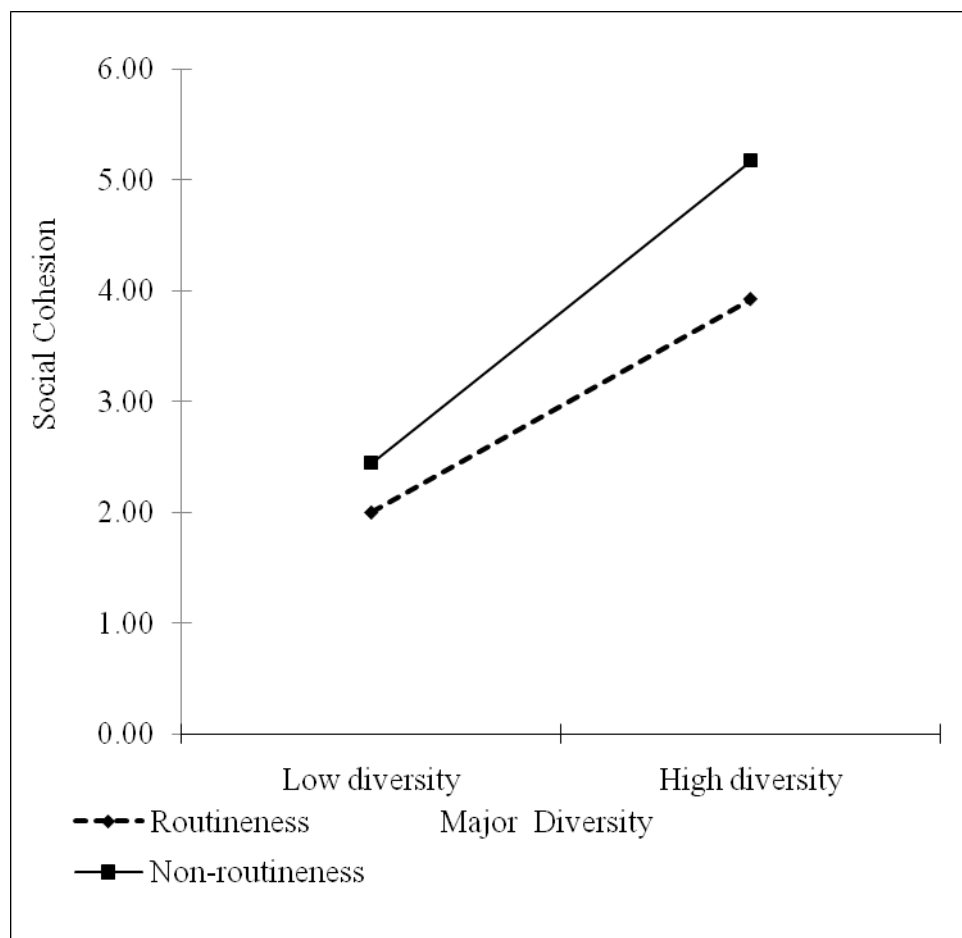
FIGURE 61. Task Routineness as a Moderator of the Relationship between Ethnicity/nationality Diversity and Job-related Cohesion
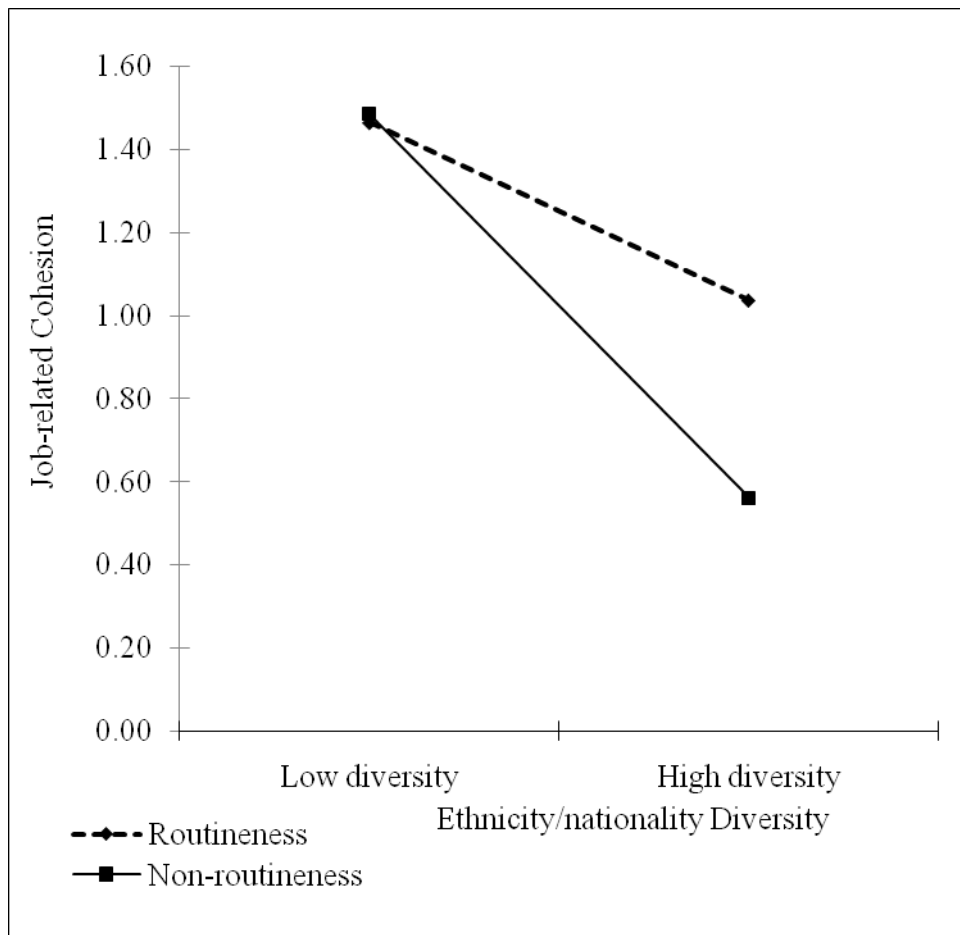
FIGURE 62. Task Routineness as a Moderator of the Relationship between Major
Diversity and Job-related Cohesion
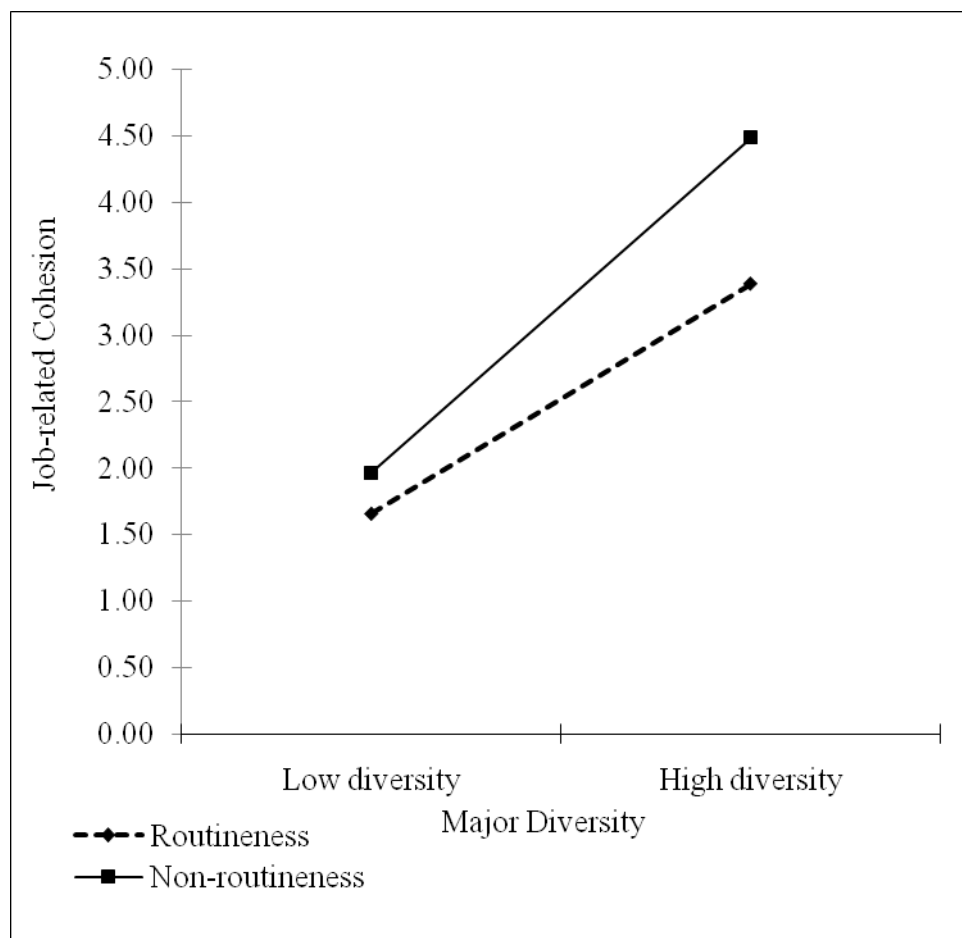
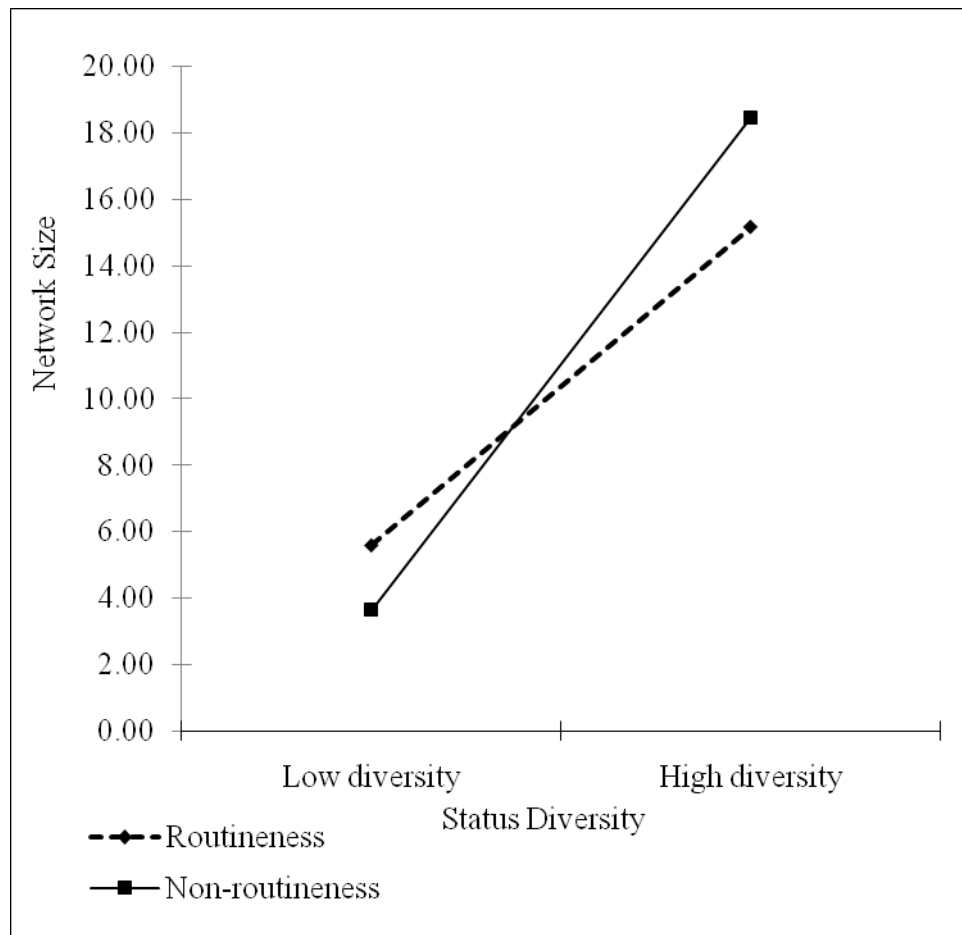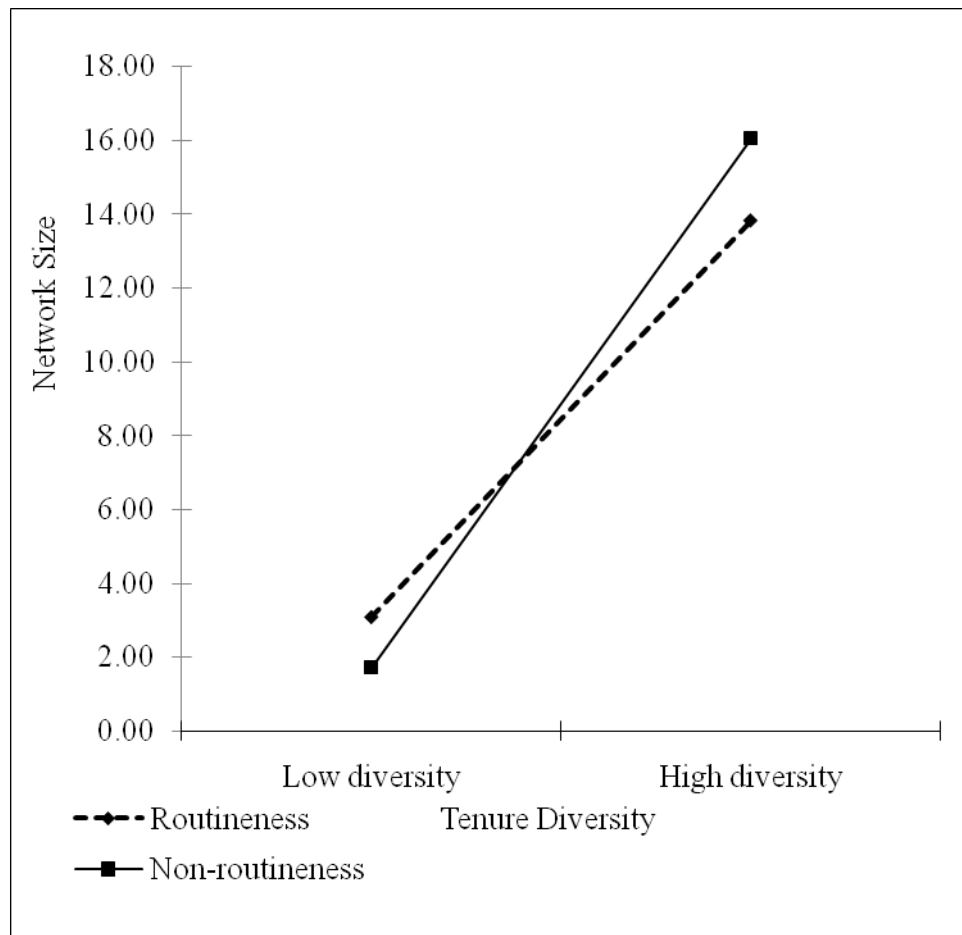FIGURE 63. Task Routineness as a Moderator of the Relationship between Sex Diversity and Trust
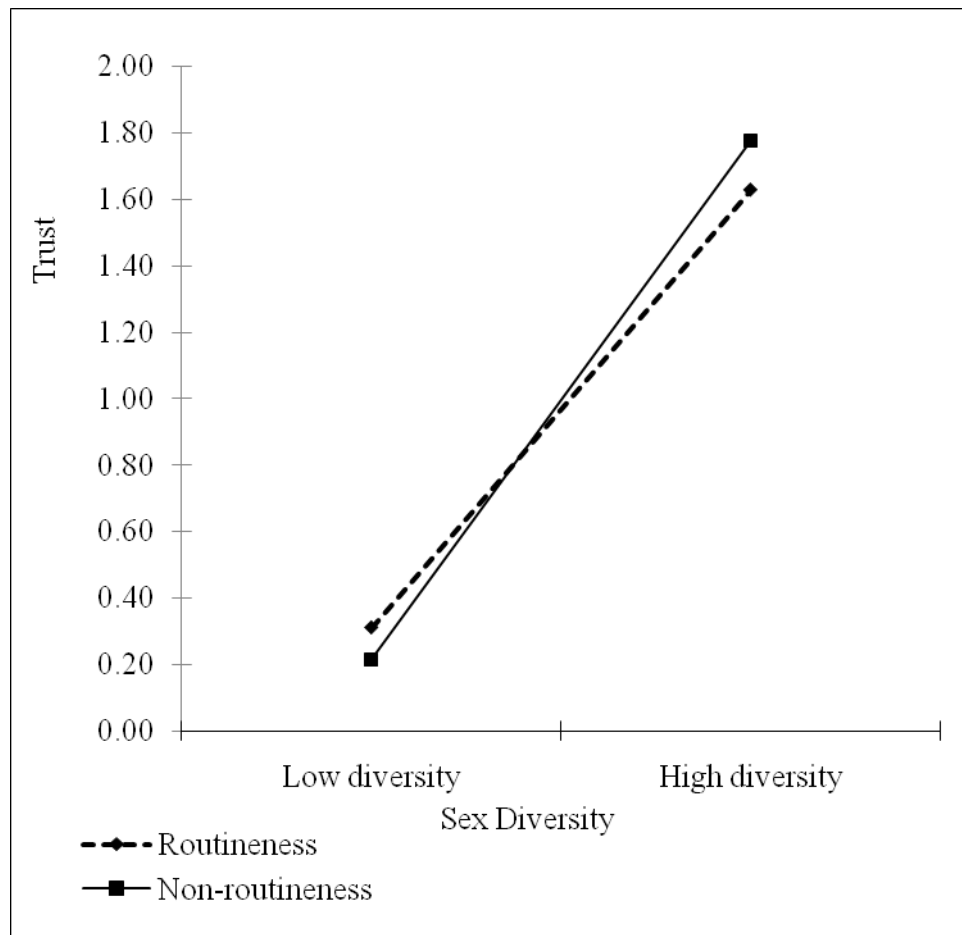
FIGURE 64. Task Routineness as a Moderator of the Relationship between Age Diversity and Trust
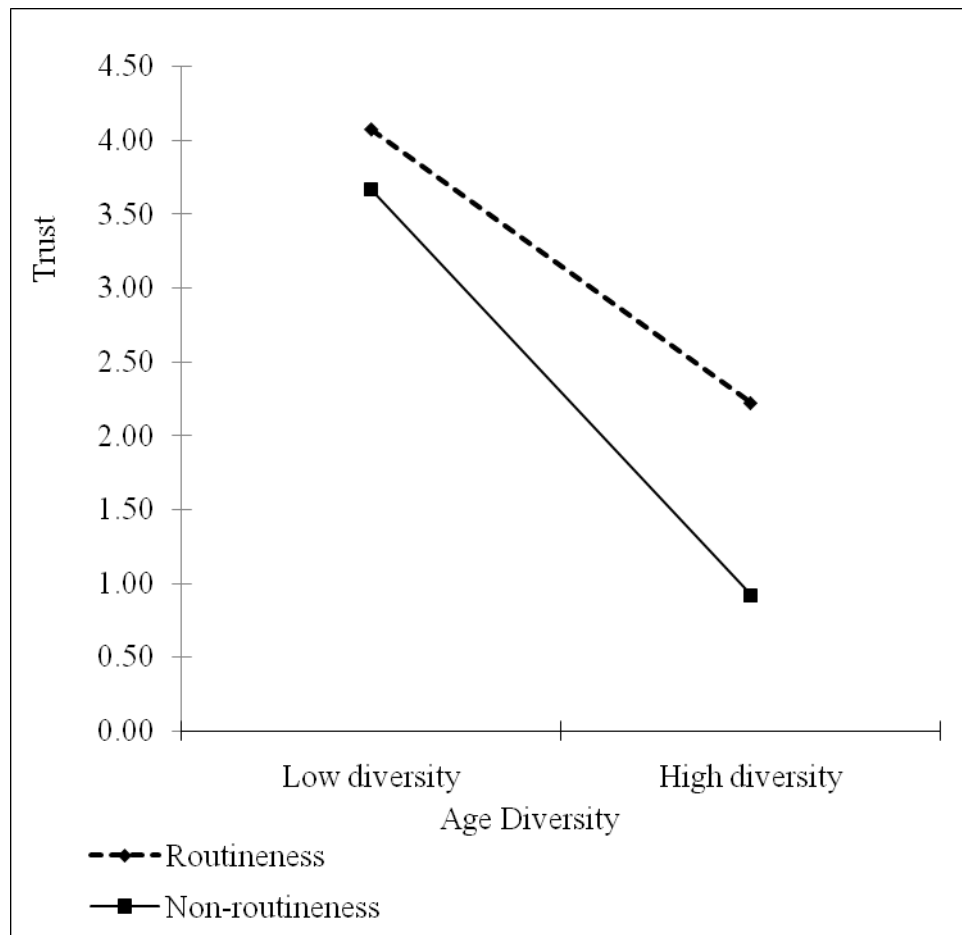
FIGURE 65. Task Routineness as a Moderator of the Relationship between Status Diversity and Trust
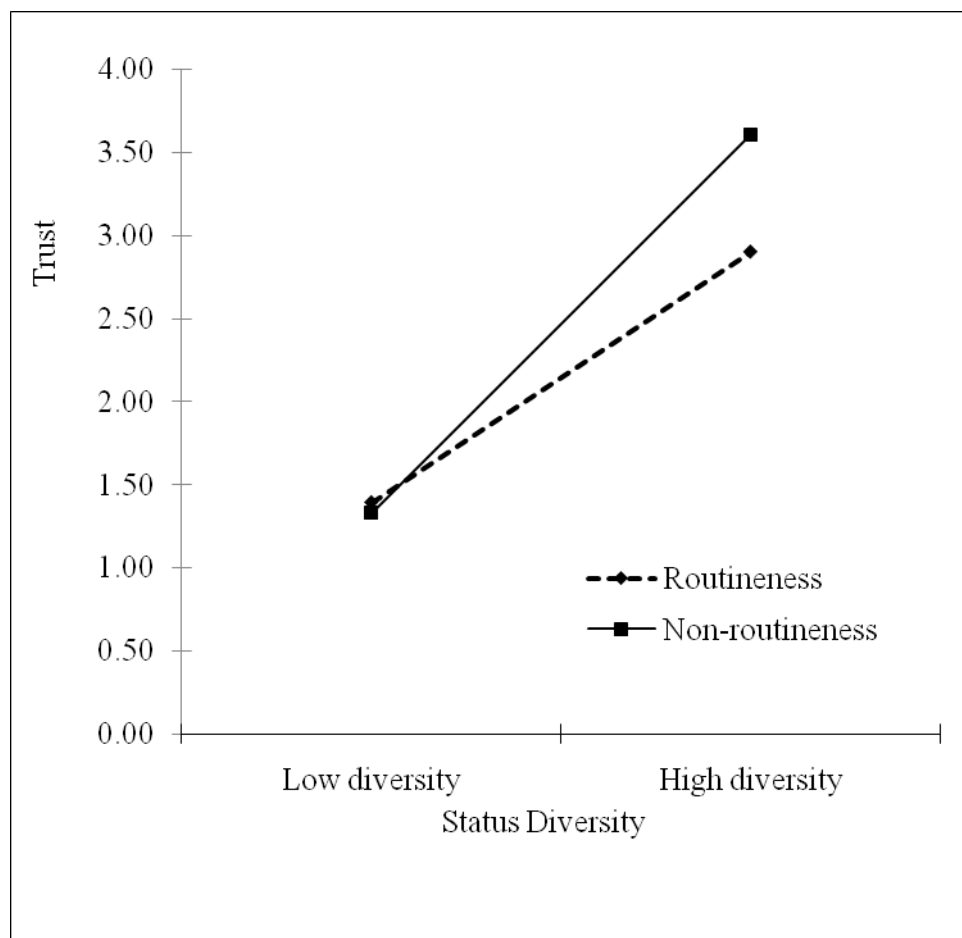
FIGURE 66. Task Routineness as a Moderator of the Relationship between Tenure Diversity and Trust
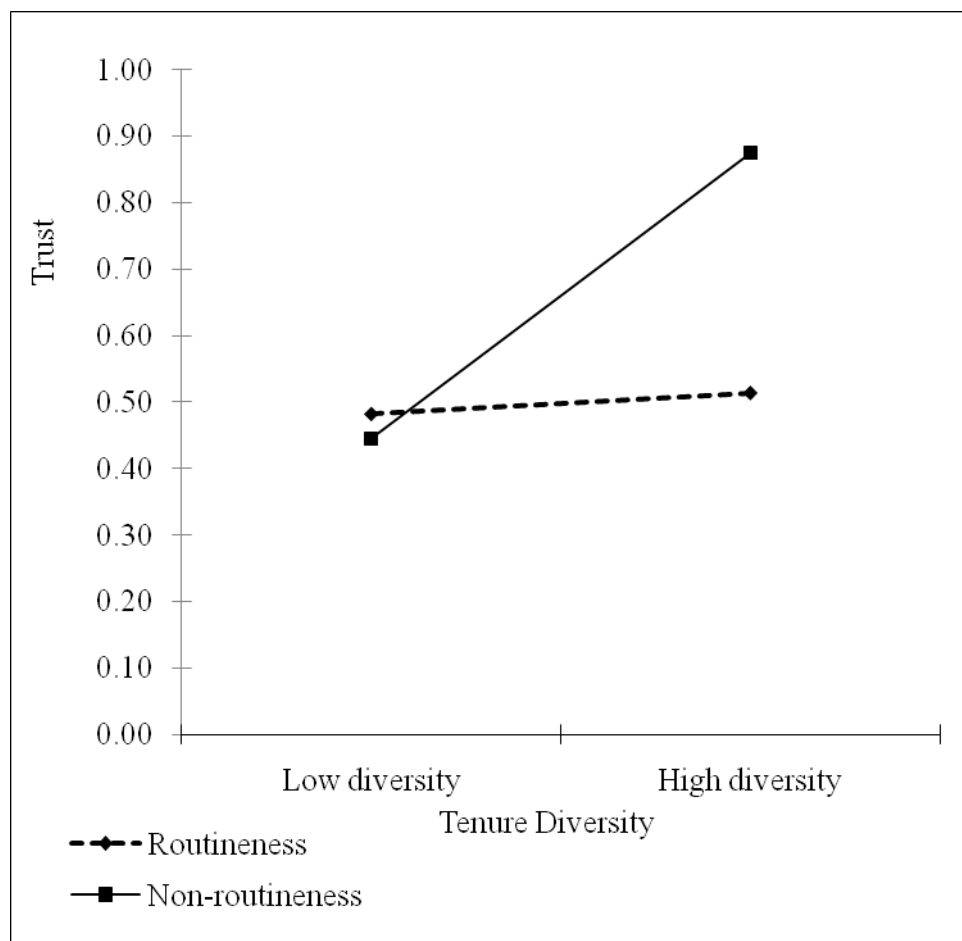
FIGURE 67. Task Routineness as a Moderator of the Relationship between Major Diversity and Trust
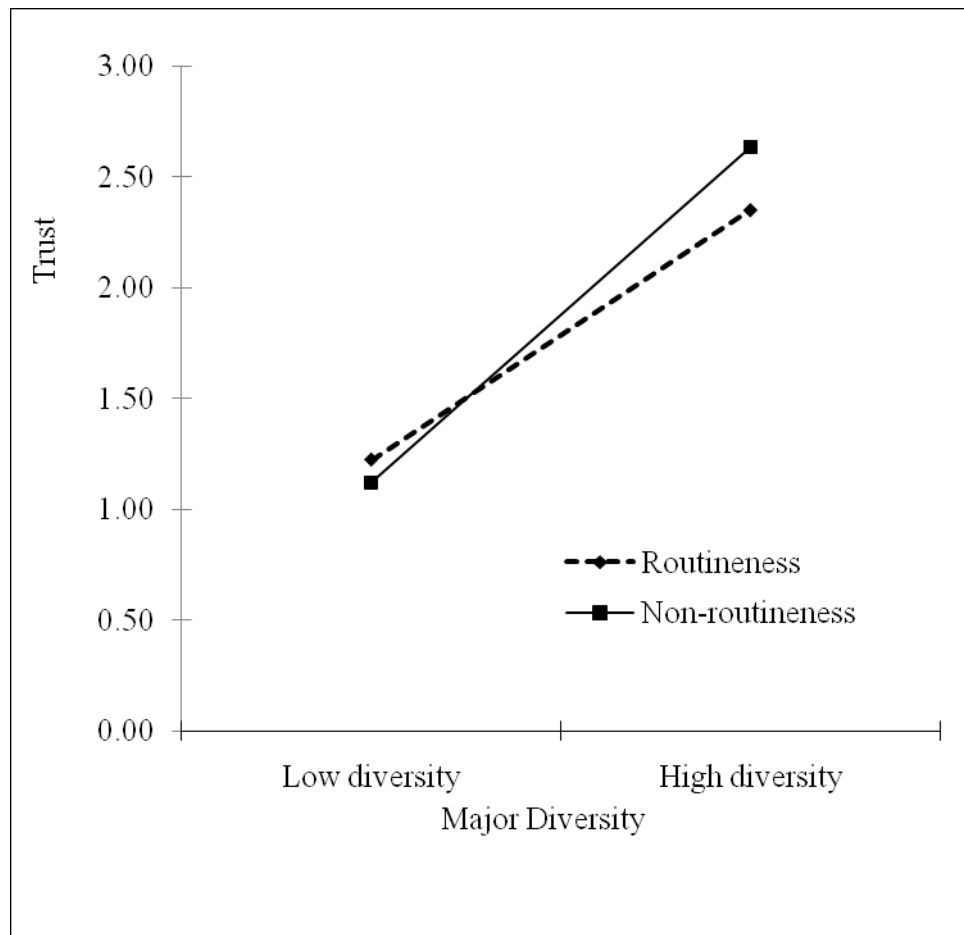
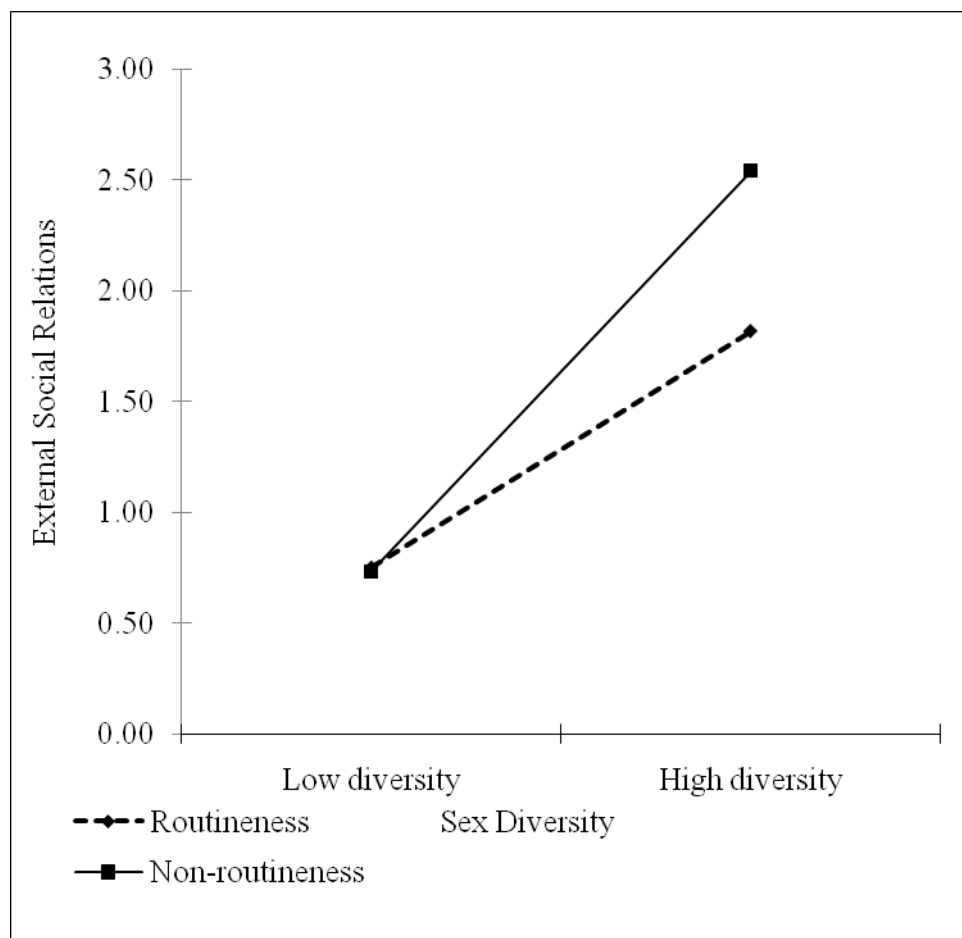FIGURE 68. Task Routineness as a Moderator of the Relationship between Sex Diversity and Cooperative Norm
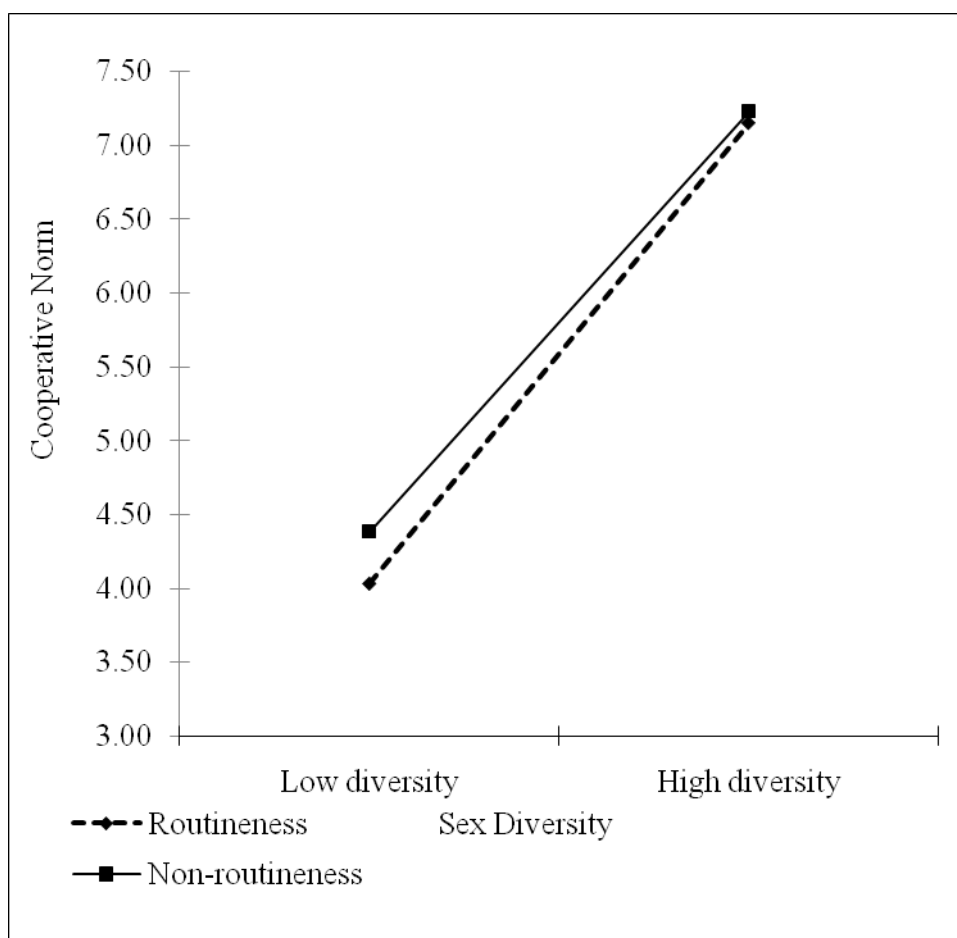
FIGURE 69. Task Routineness as a Moderator of the Relationship between
Ethnicity/nationality Diversity and Trust
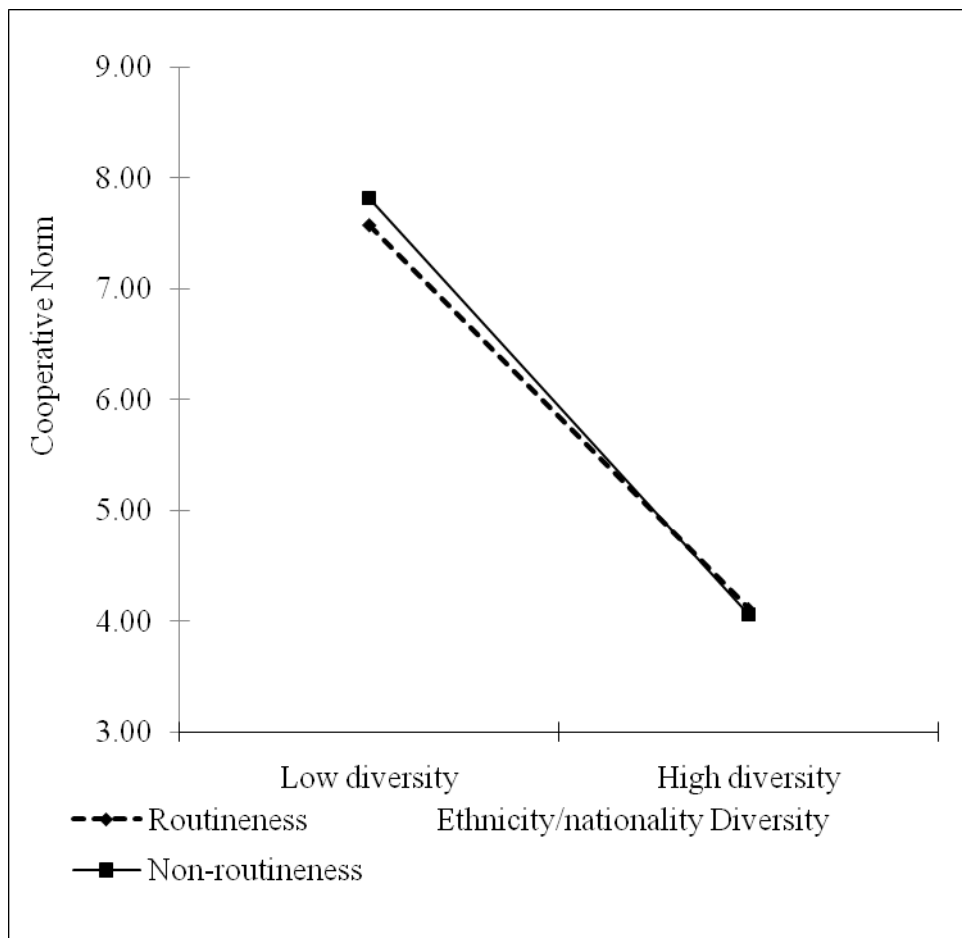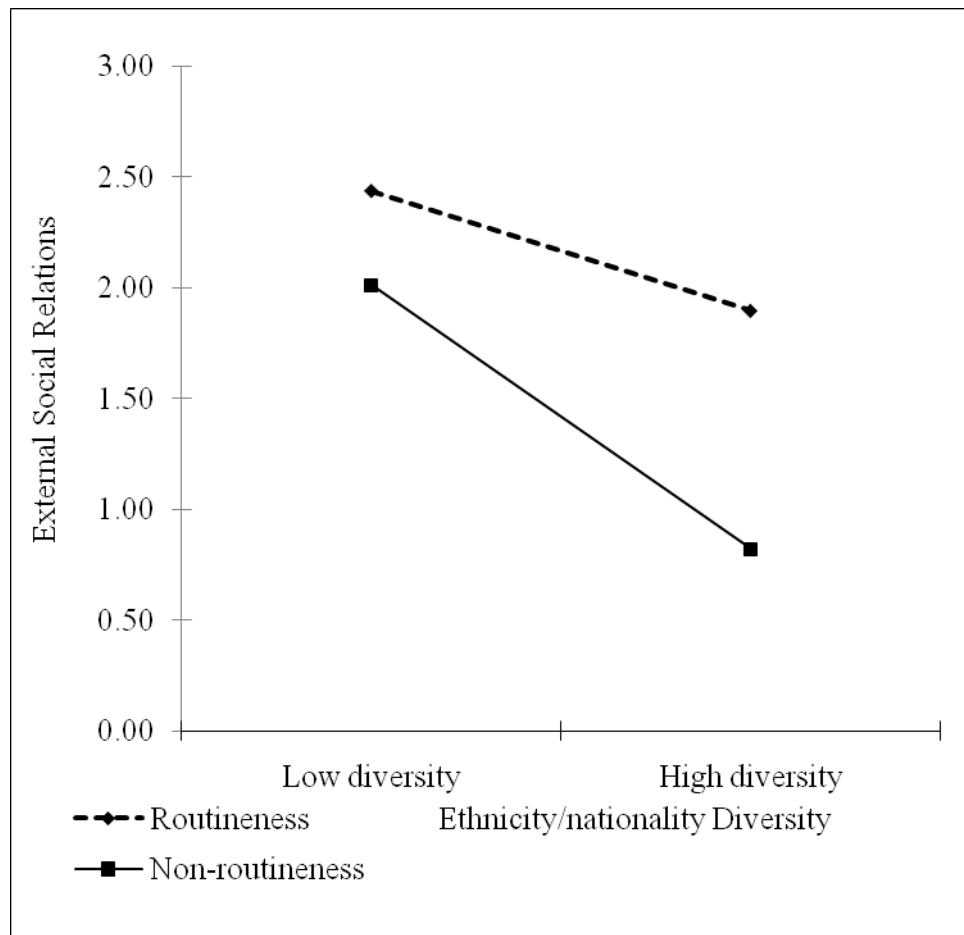
FIGURE 70. Task Routineness as a Moderator of the Relationship between Age
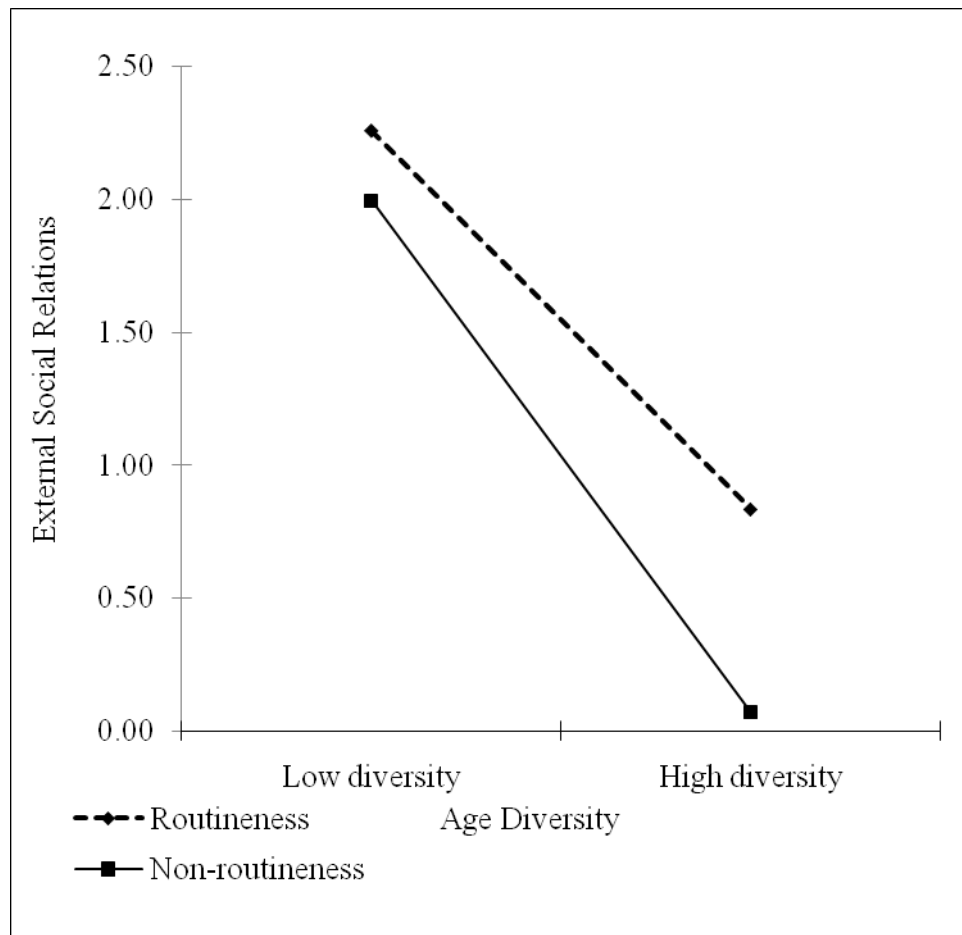Diversity and Cooperative Norm
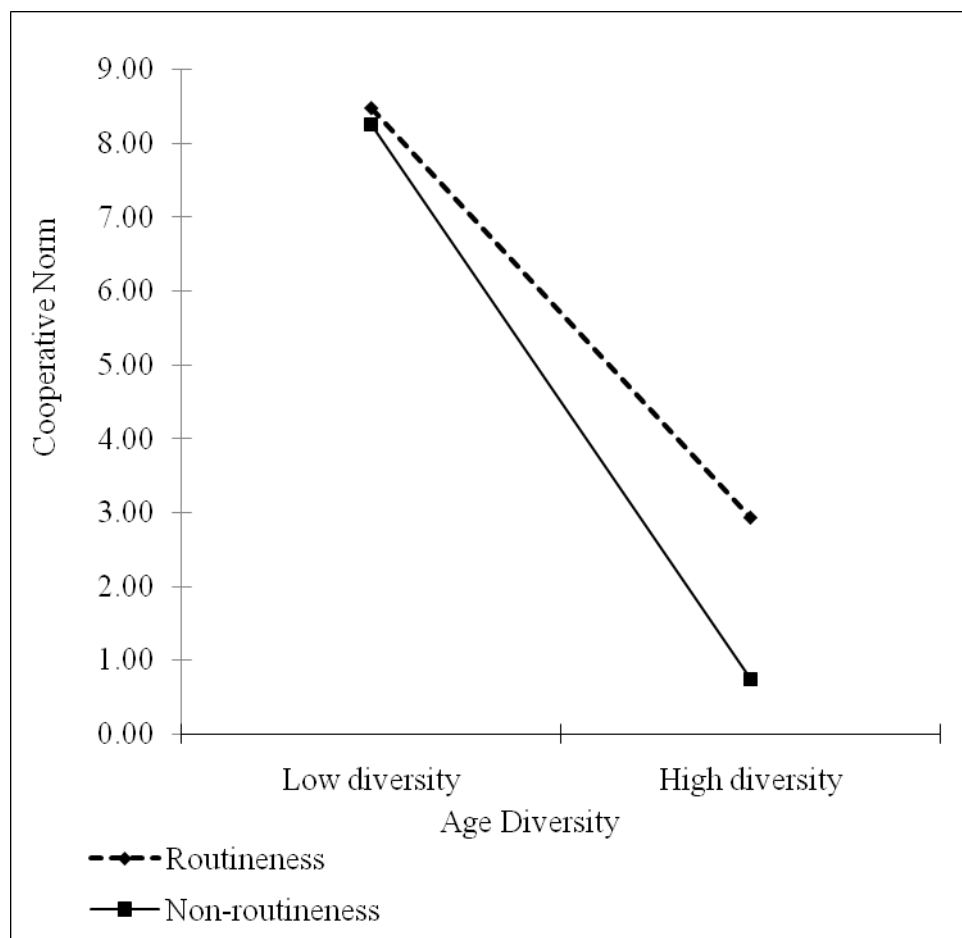
FIGURE 71. Task Routineness as a Moderator of the Relationship between Status Diversity and Cooperative Norm
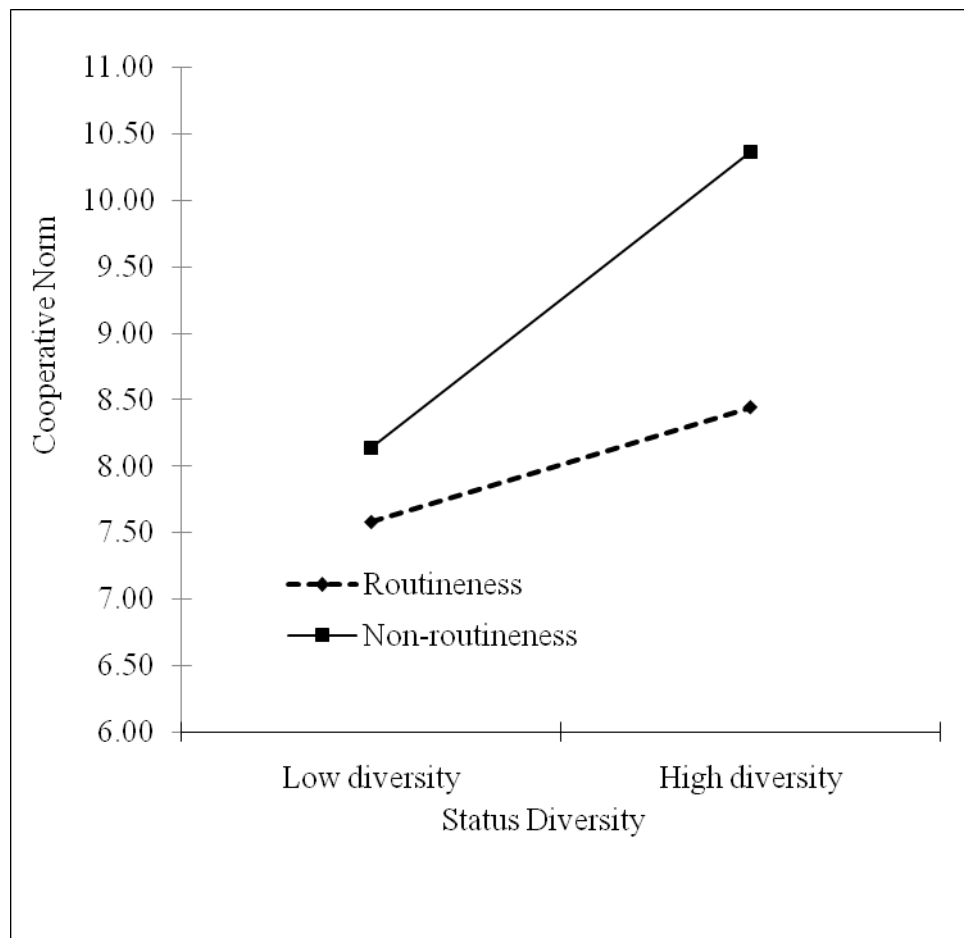
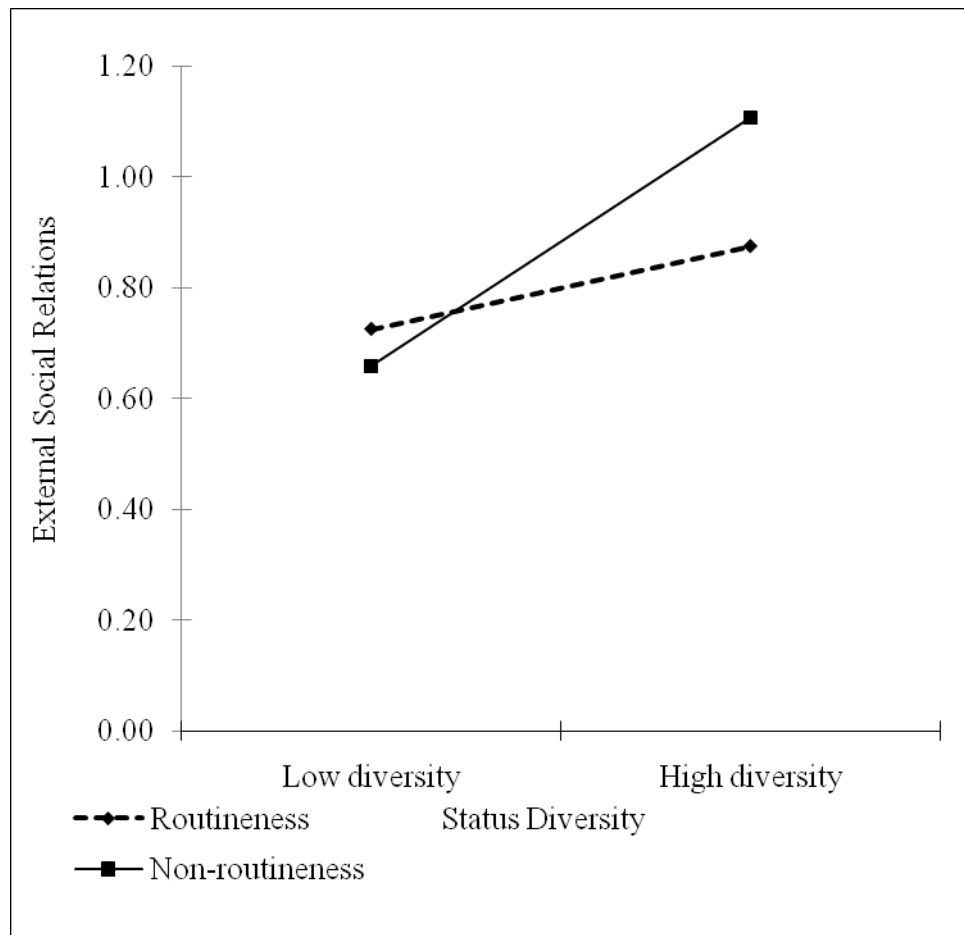FIGURE 72. Task Routineness as a Moderator of the Relationship between Tenure Diversity and Cooperative Norm
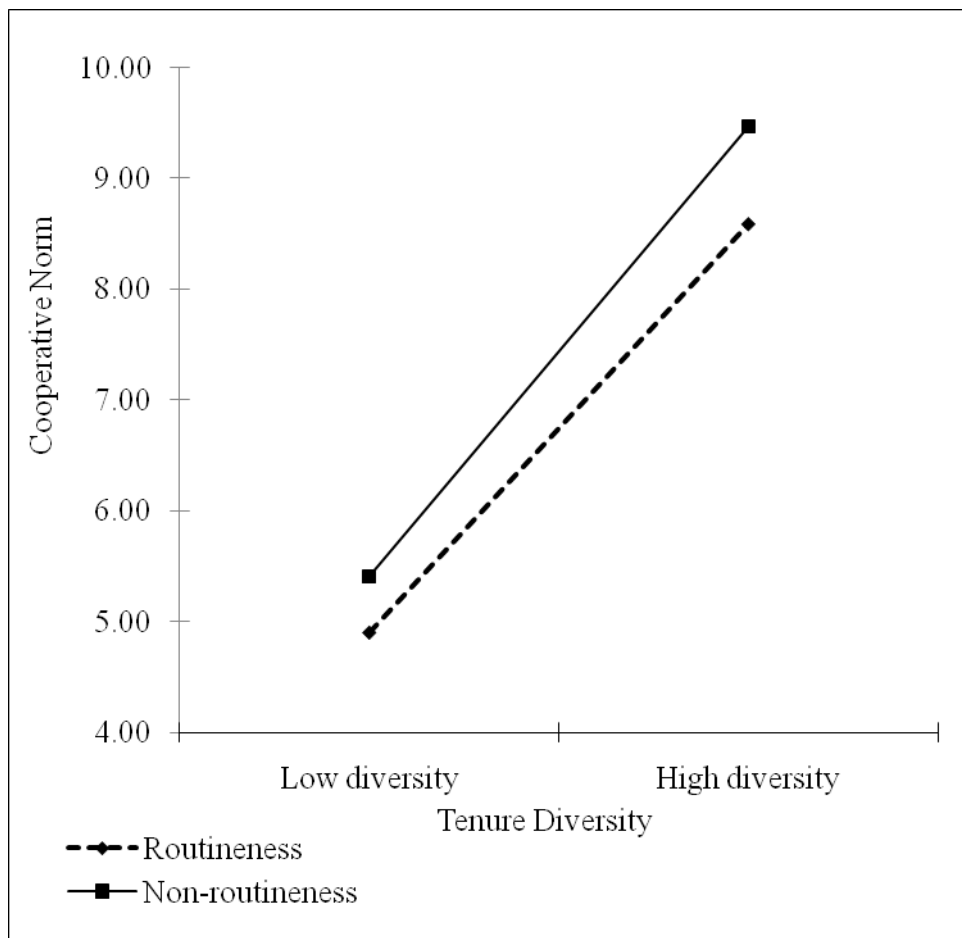
FIGURE 73. Task Routineness as a Moderator of the Relationship between Major Diversity and Cooperative Norm
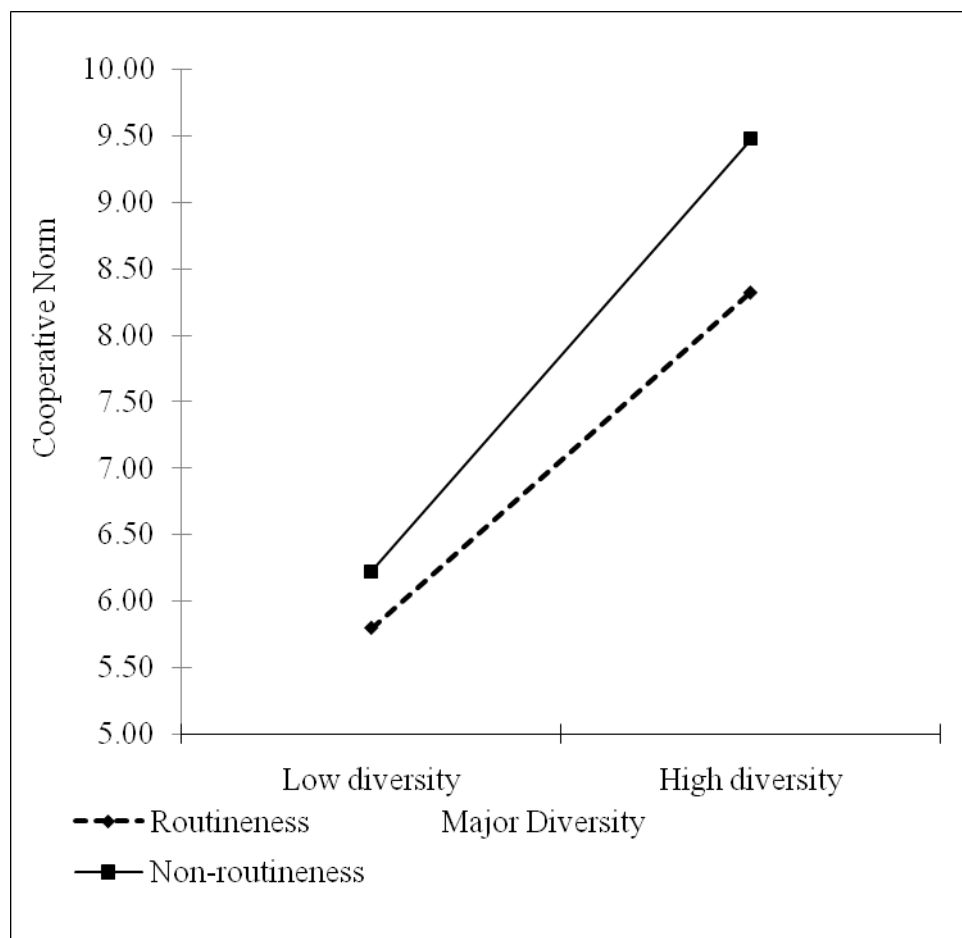
FIGURE 74. Task Routineness as a Moderator of the Relationship between
Ethnicity/Nationality Diversity and External Network Size

FIGURE 75. Task Routineness as a Moderator of the Relationship between Age
Diversity and External Network Size

FIGURE 76. Task Routineness as a Moderator of the Relationship between Status Diversity and External Network Size

FIGURE 77. Task Routineness as a Moderator of the Relationship between Tenure Diversity and External Network Size

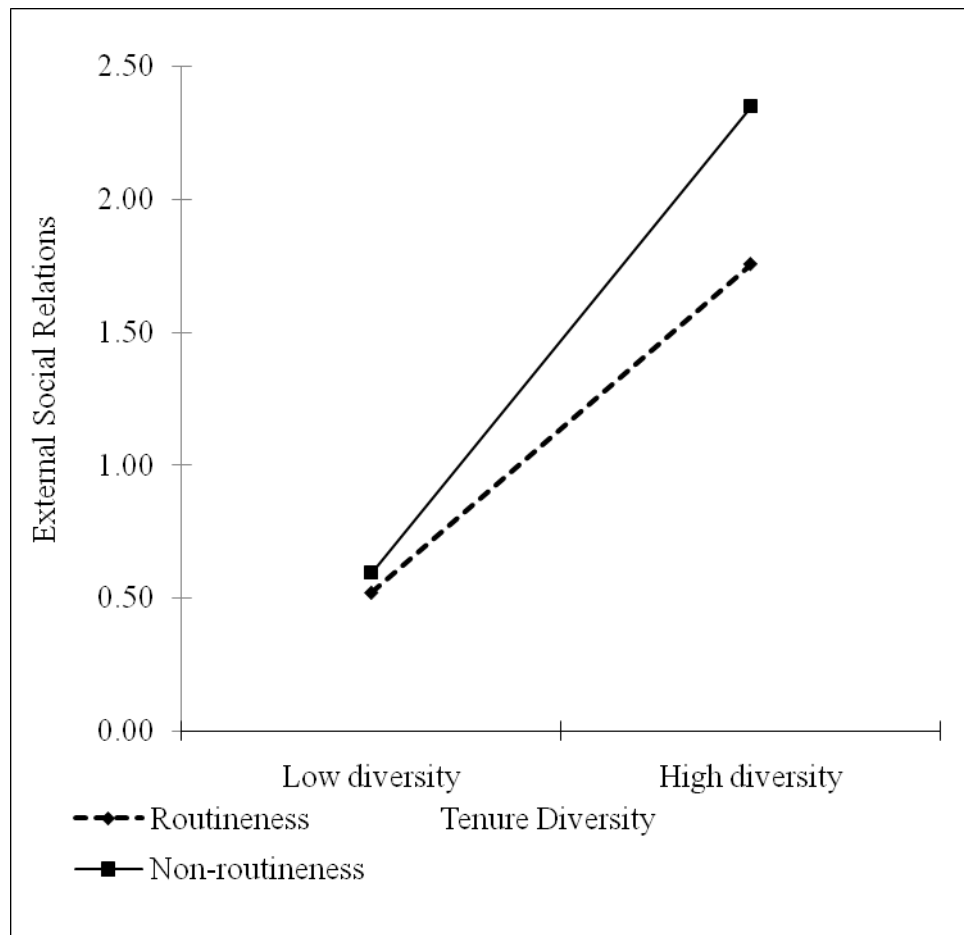FIGURE 78. Task Routineness as a Moderator of the Relationship between Sex Diversity and External Social Relations

FIGURE 79. Task Routineness as a Moderator of the Relationship between Ethnicity/Nationality Diversity and External Social Relations

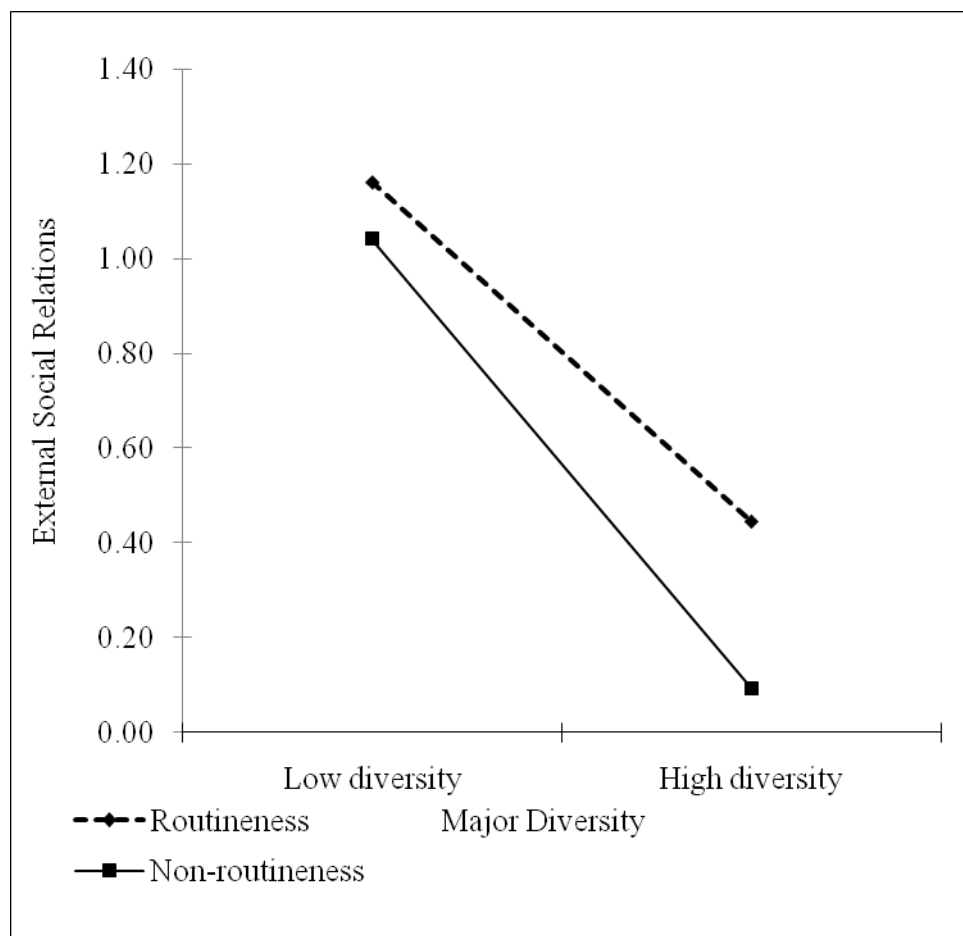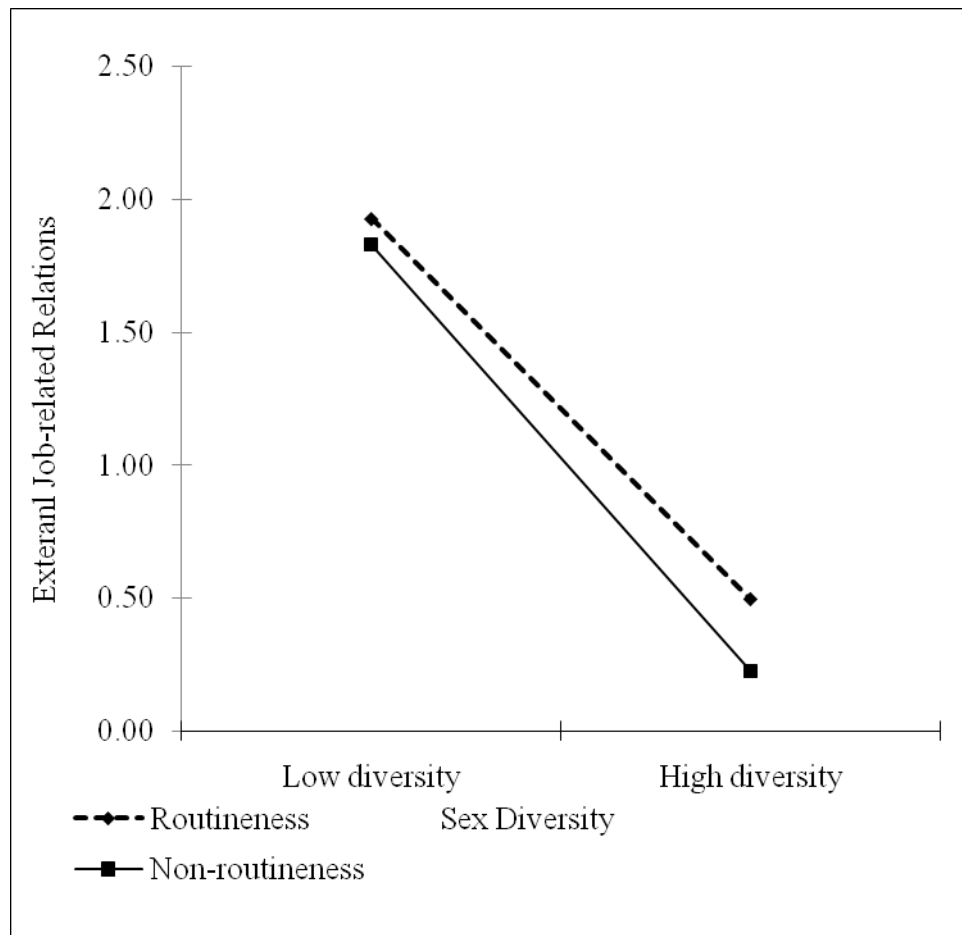FIGURE 80. Task Routineness as a Moderator of the Relationship between Age Diversity and External Social Relations

FIGURE 81. Task Routineness as a Moderator of the Relationship between Status Diversity and External Social Relations

FIGURE 82. Task Routineness as a Moderator of the Relationship between Tenure Diversity and External Social Relations

FIGURE 83. Task Routineness as a Moderator of the Relationship between Major
Diversity and External Social Relations

FIGURE 84. Task Routineness as a Moderator of the Relationship between Sex Diversity and External Job-related Relations

FIGURE 85. Task Routineness as a Moderator of the Relationship between Sex Diversity and Diversity of External Sex Networks
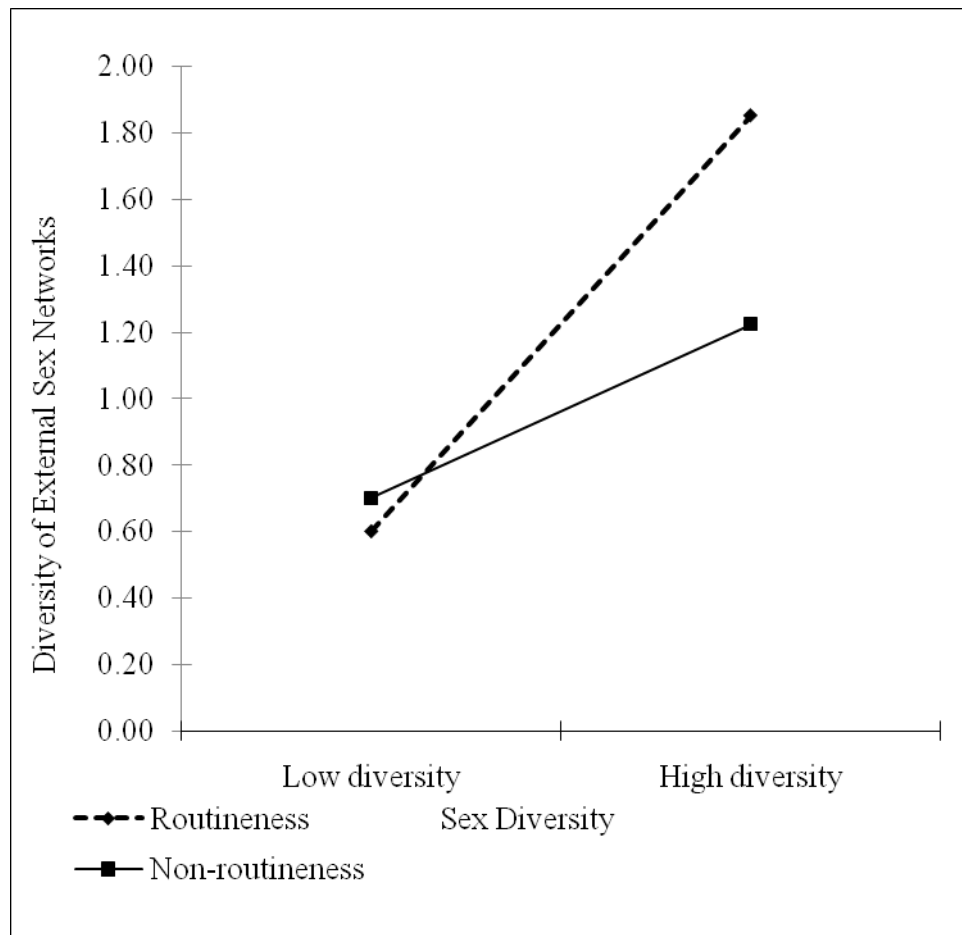
FIGURE 86. Task Routineness as a Moderator of the Relationship between Status Diversity and Diversity of External Level Networks
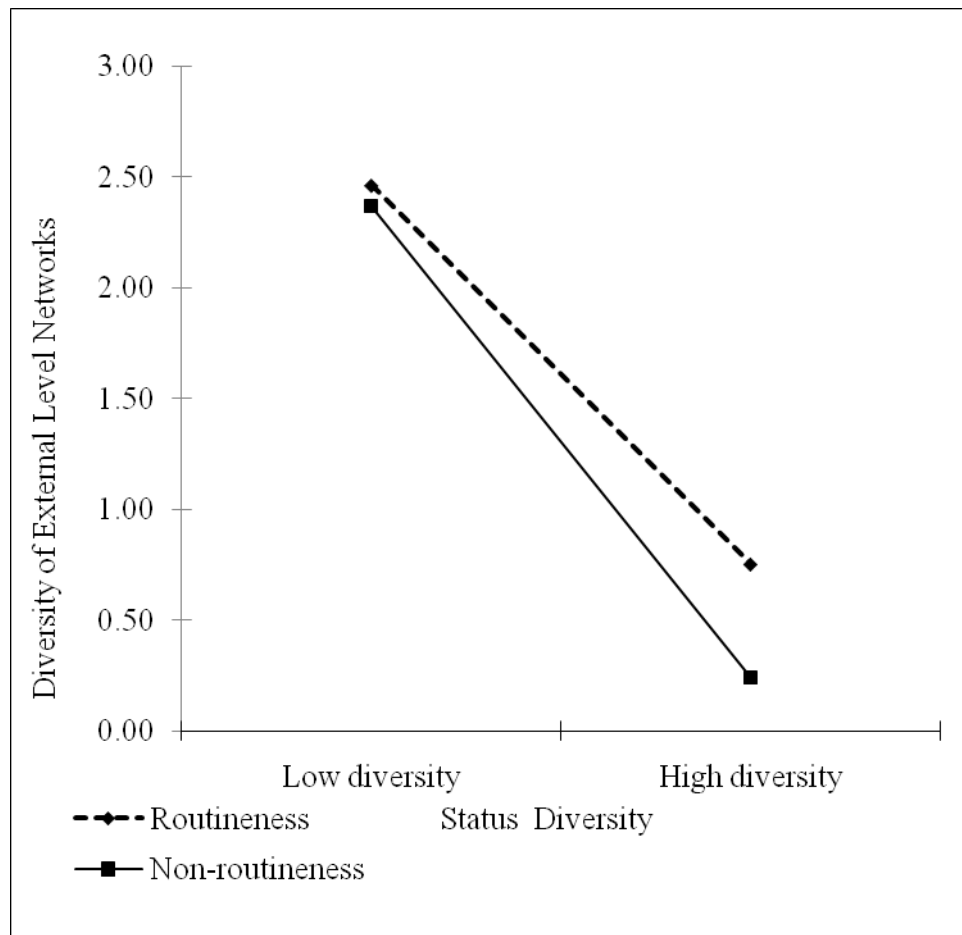
FIGURE 87. Task Routineness as a Moderator of the Relationship between Major Diversity and Diversity of External Major Networks
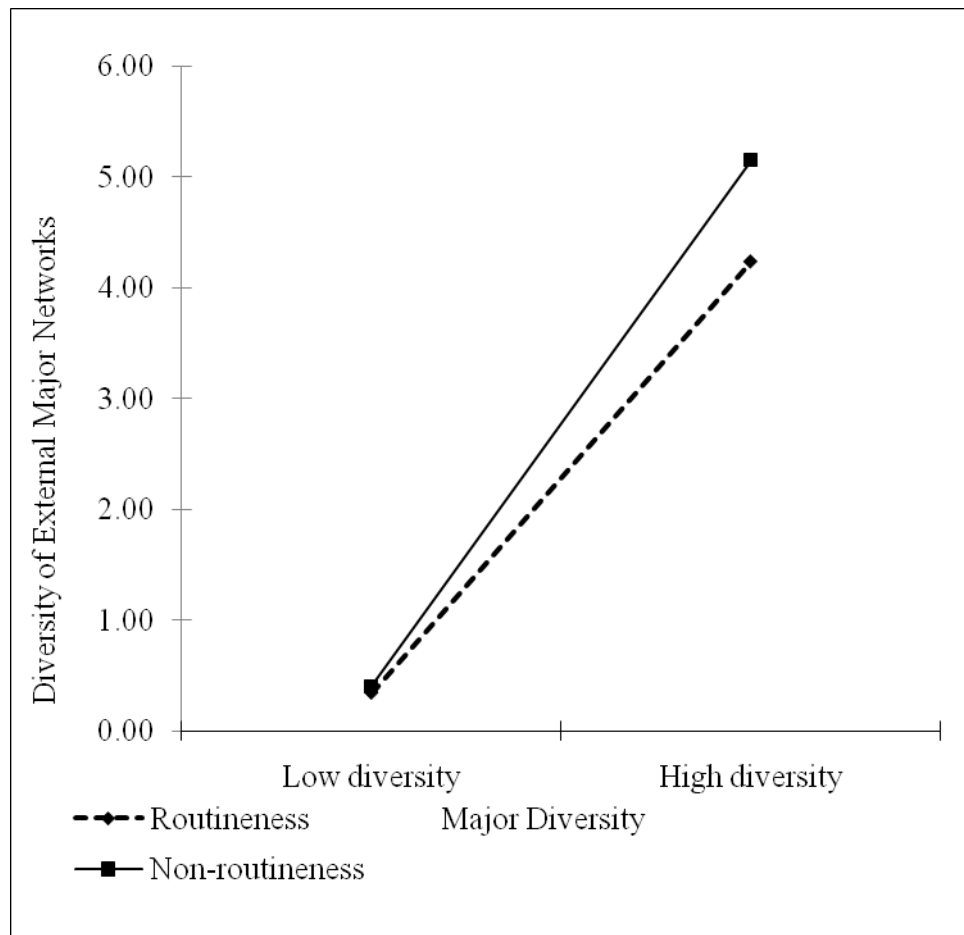
FIGURE 88. Task Routineness as a Moderator of the Relationship between Major Diversity and Diversity of External Department Networks
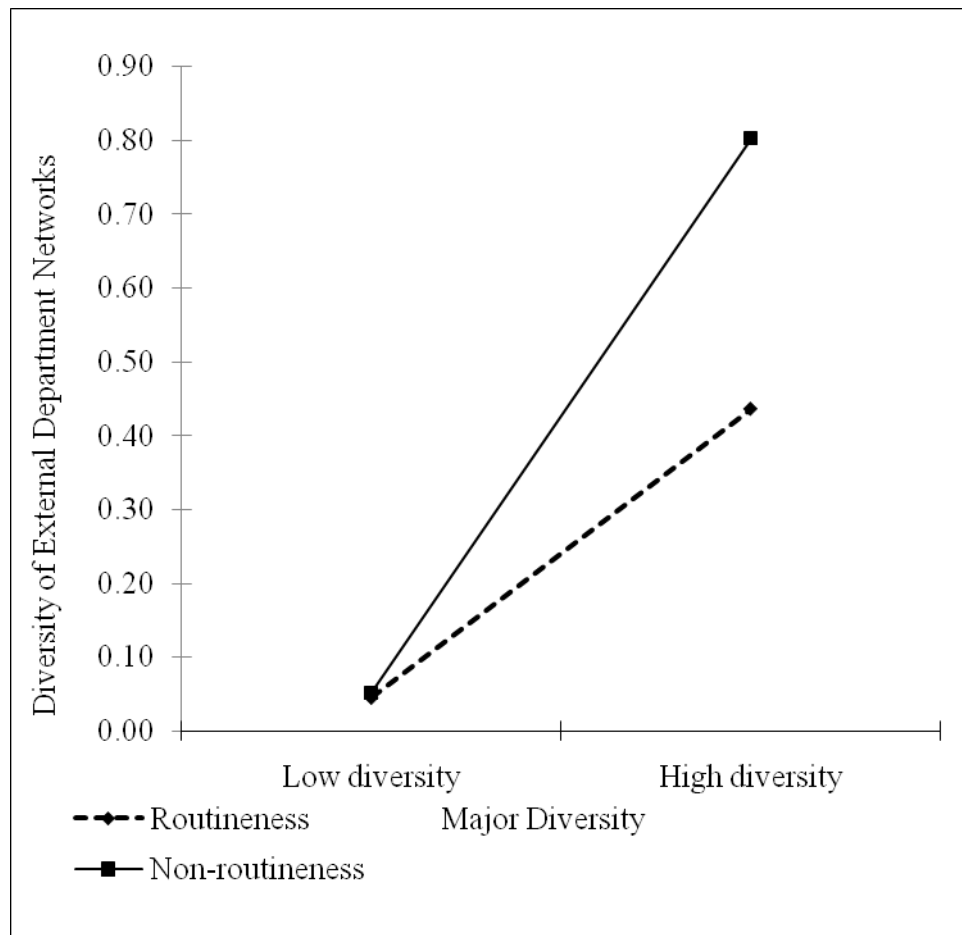
FIGURE 89. Task Routineness as a Moderator of the Relationship between Social Cohesion and Performance (Manager)
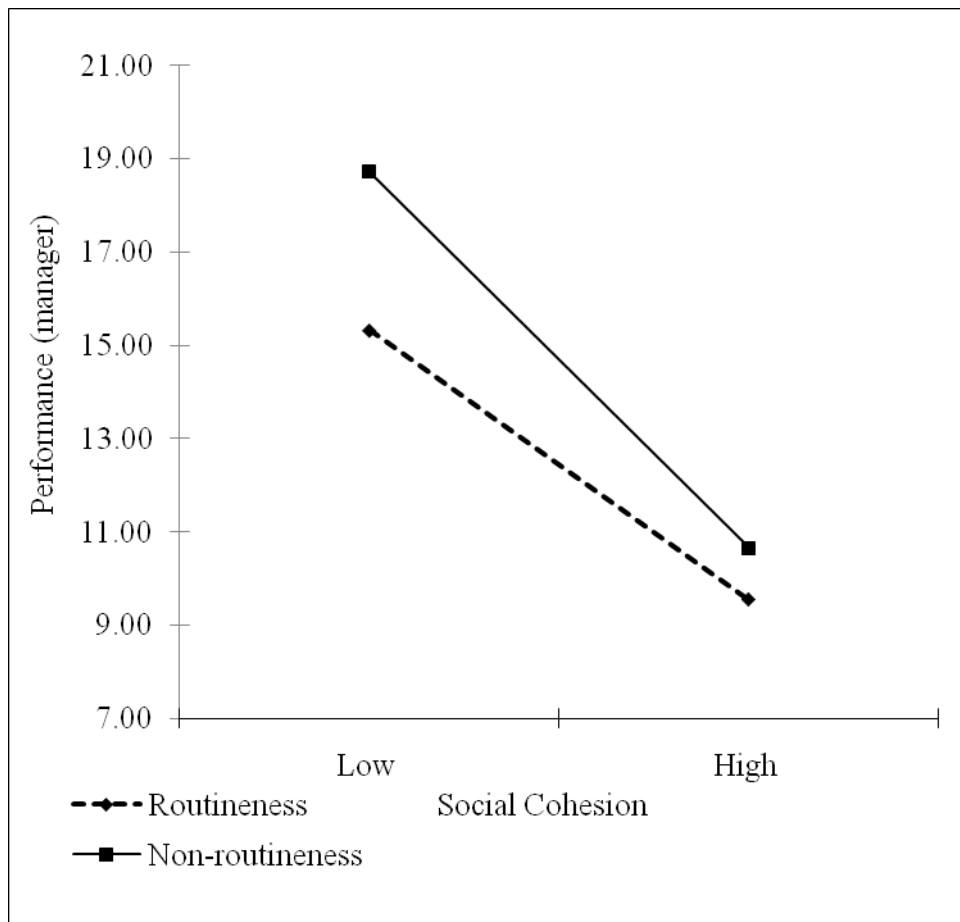
FIGURE 90. Task Routineness as a Moderator of the Relationship between Job-related Cohesion and Performance (Manager)
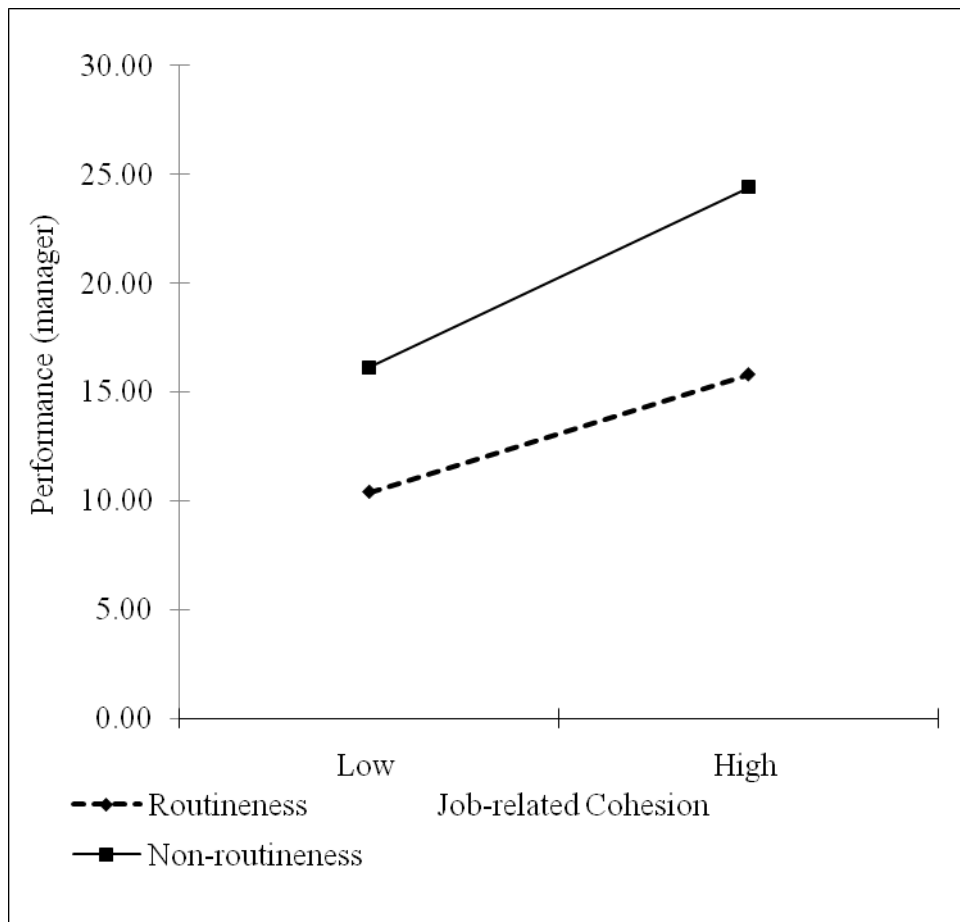
FIGURE 91. Task Routineness as a Moderator of the Relationship between Cooperative Norms and Performance (Manager)

FIGURE 92. Task Routineness as a Moderator of the Relationship between Social Cohesion and Performance (Manager)

FIGURE 93. Task Routineness as a Moderator of the Relationship between Job-related Cohesion and Performance (member)

FIGURE 94. Task Routineness as a Moderator of the Relationship between Trust and Performance (member)
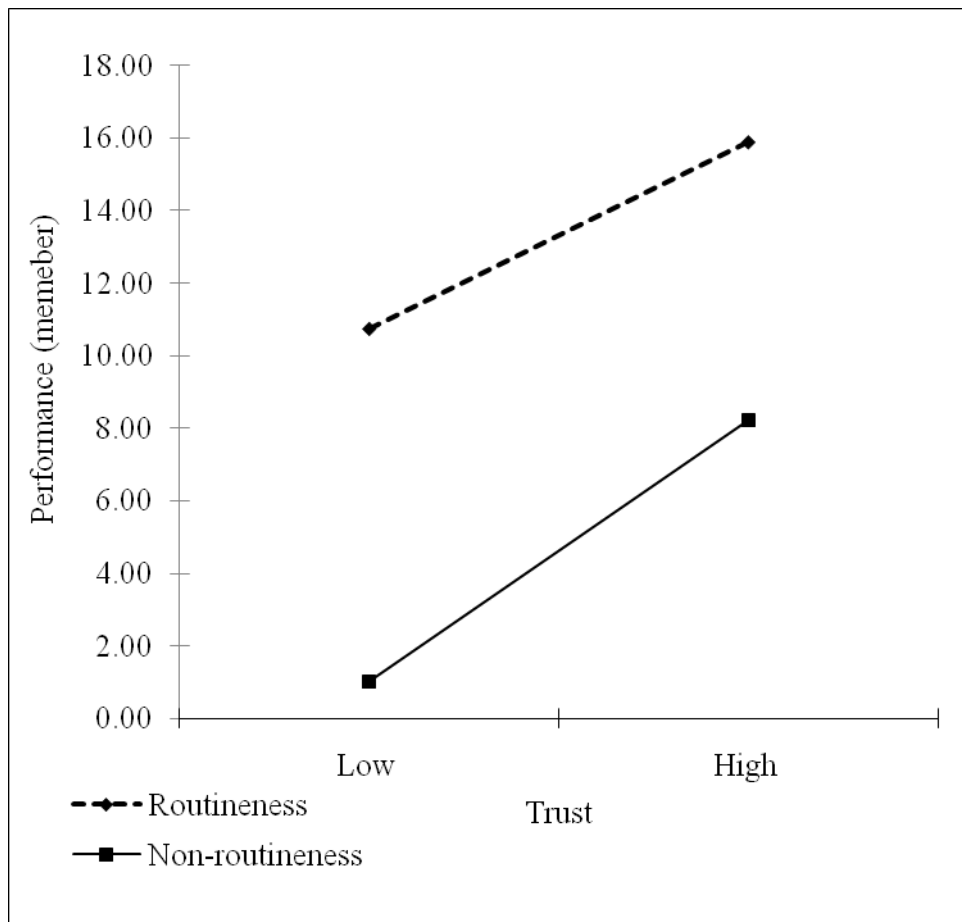
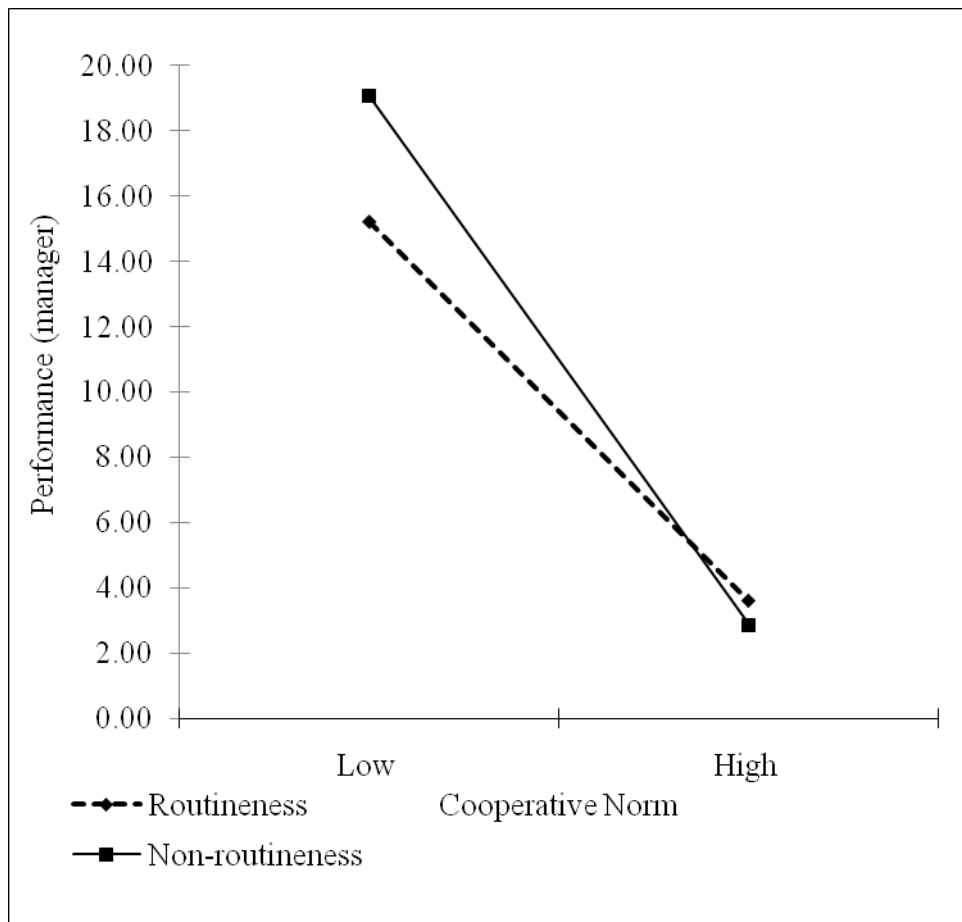FIGURE 95. Task Routineness as a Moderator of the Relationship between Cooperative Norm and Performance (Member)
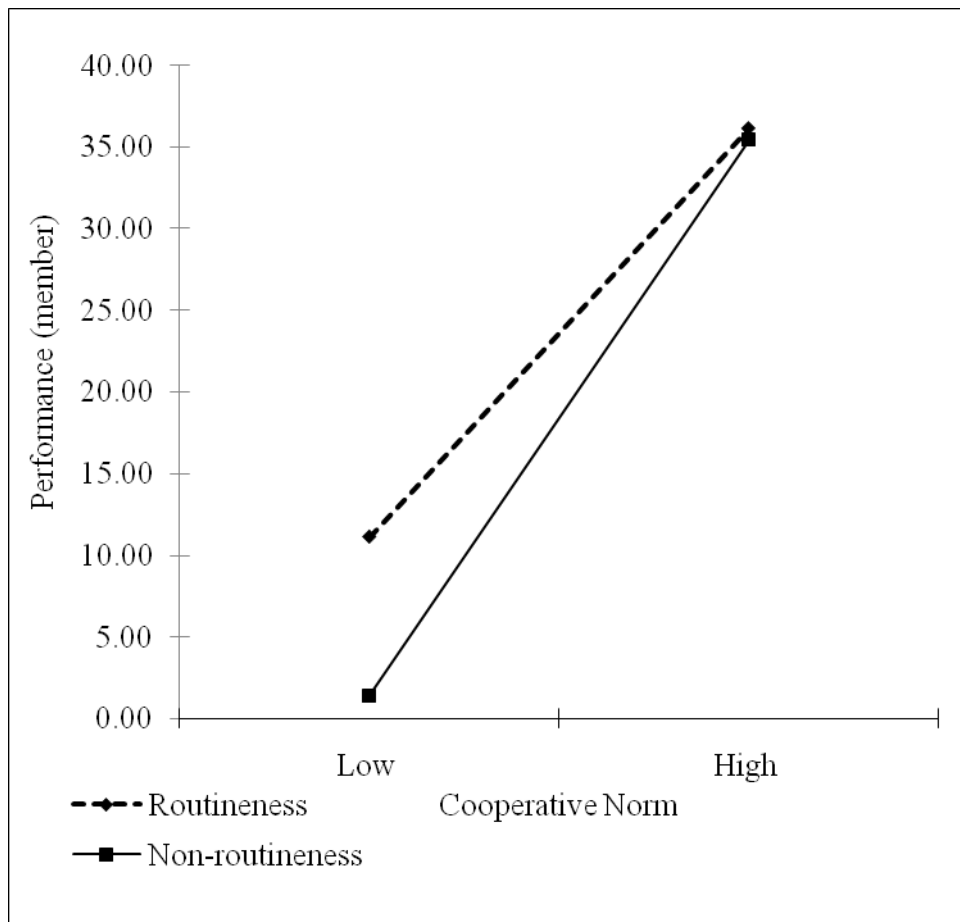
FIGURE 96. Task Routineness as a Moderator of the Relationship between Trust and Performance (Both)

FIGURE 97. Task Routineness as a Moderator of the Relationship between Social Cohesion and Knowledge Availability
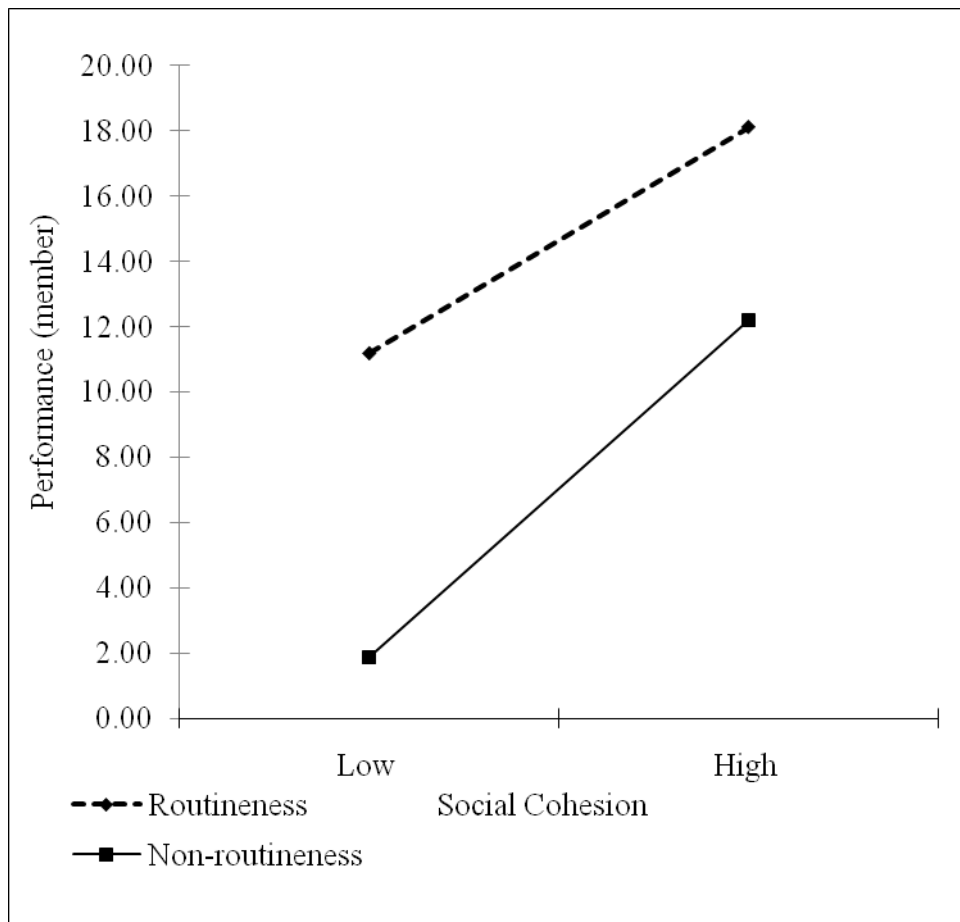
FIGURE 98. Task Routineness as a Moderator of the Relationship between Job-related Cohesion and Knowledge Availability

FIGURE 99. Task Routineness as a Moderator of the Relationship between External Job-related Relations and Performance (Manager)

FIGURE 100. Task Routineness as a Moderator of the Relationship between External Network Size and Performance (Member)

FIGURE 101. Task Routineness as a Moderator of the Relationship between External Social Relations and Performance (Member)

FIGURE 102. Task Routineness as a Moderator of the Relationship between External Job-related Relations and Performance (Member)
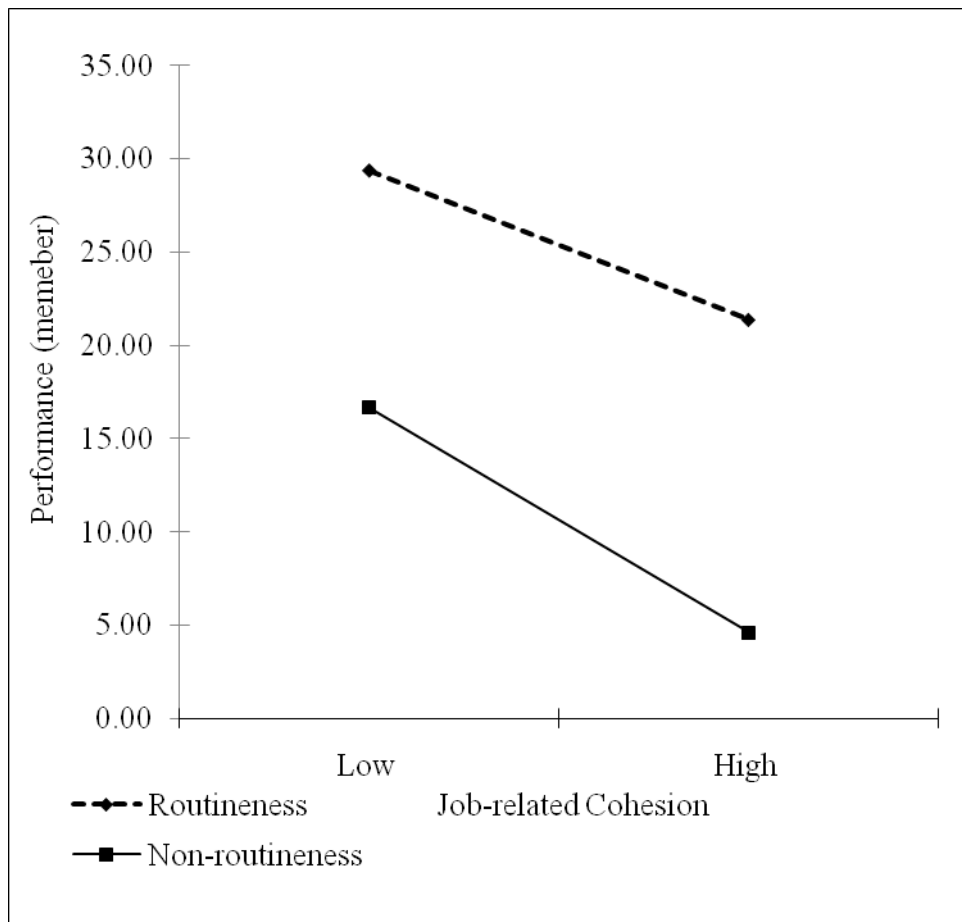
FIGURE 103. Task Routineness as a Moderator of the Relationship between External Social Relations and Performance (Both)

FIGURE 104. Task Routineness as a Moderator of the Relationship between External Job-related Relations and Performance (Both)
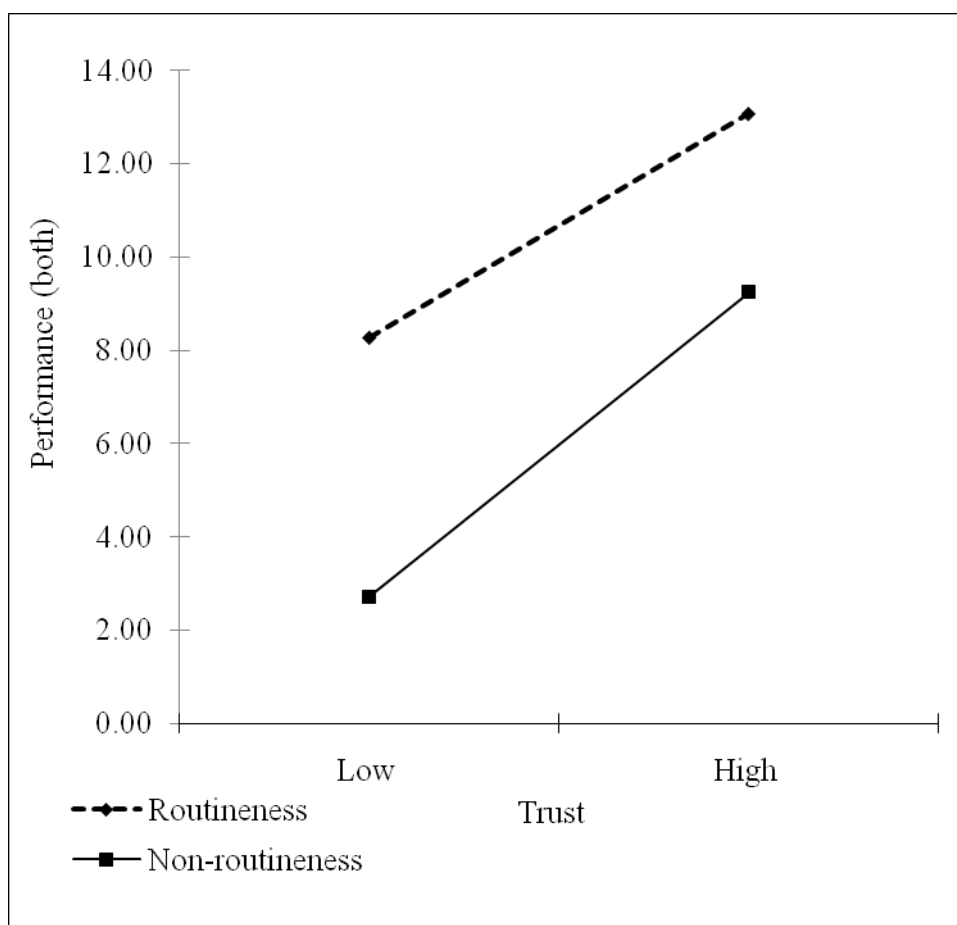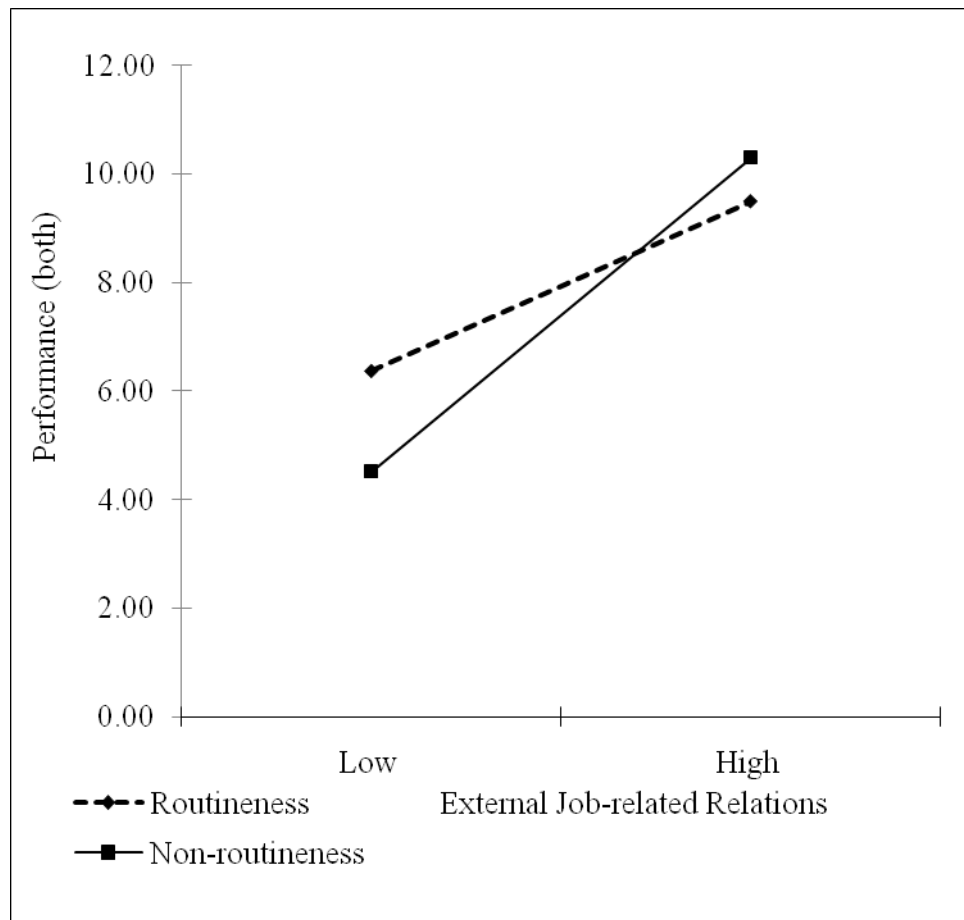
FIGURE 105. Task Routineness as a Moderator of the Relationship between External
Social Relations and Knowledge Availability
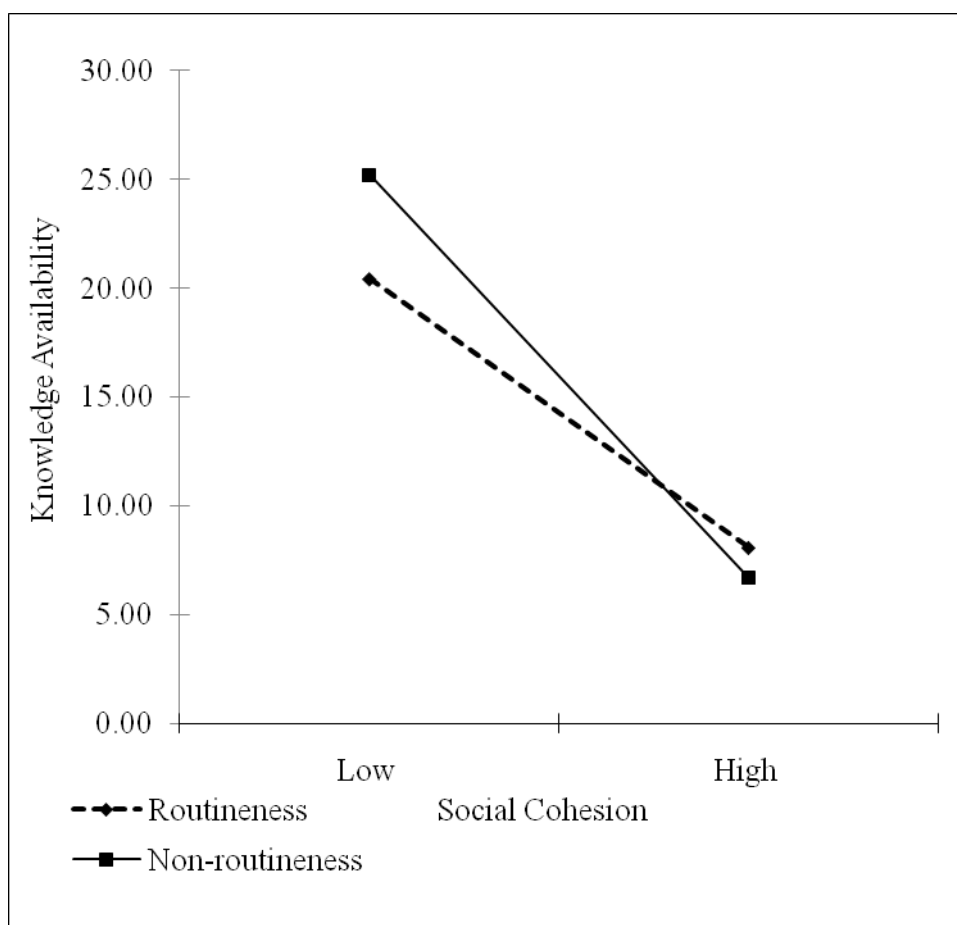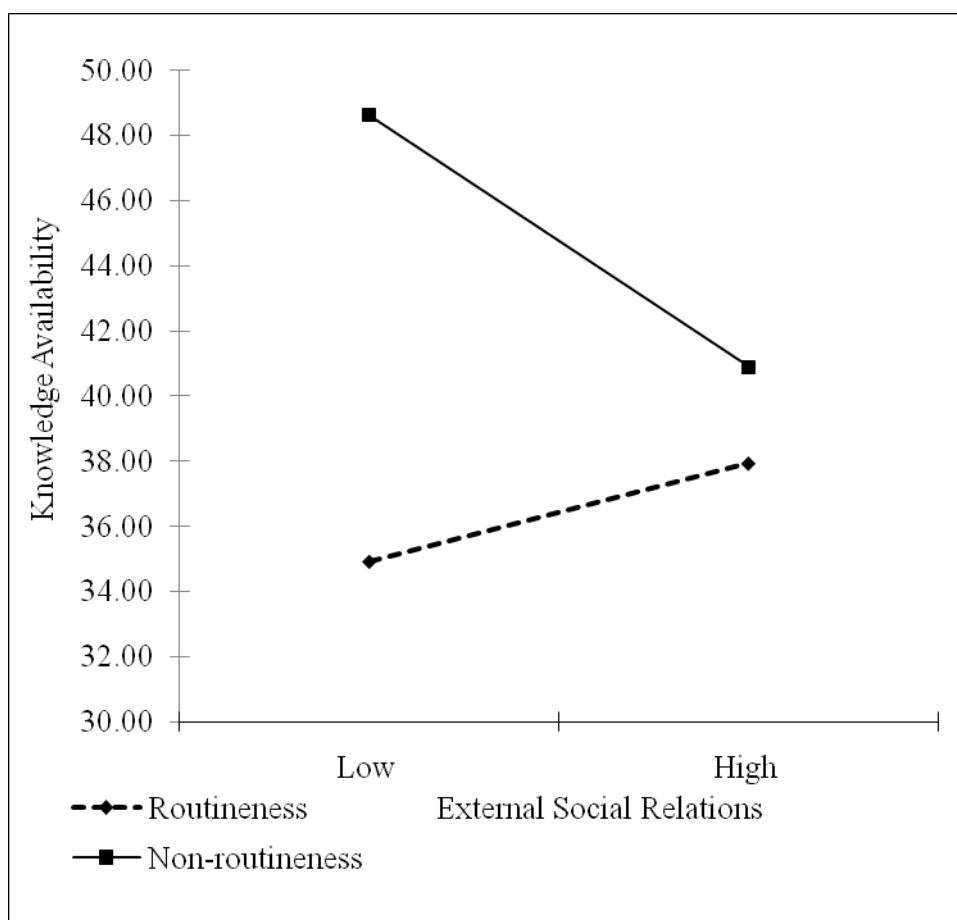
FIGURE 106. Task Routineness as a Moderator of the Relationship between External Job-related Relations and Knowledge Availability
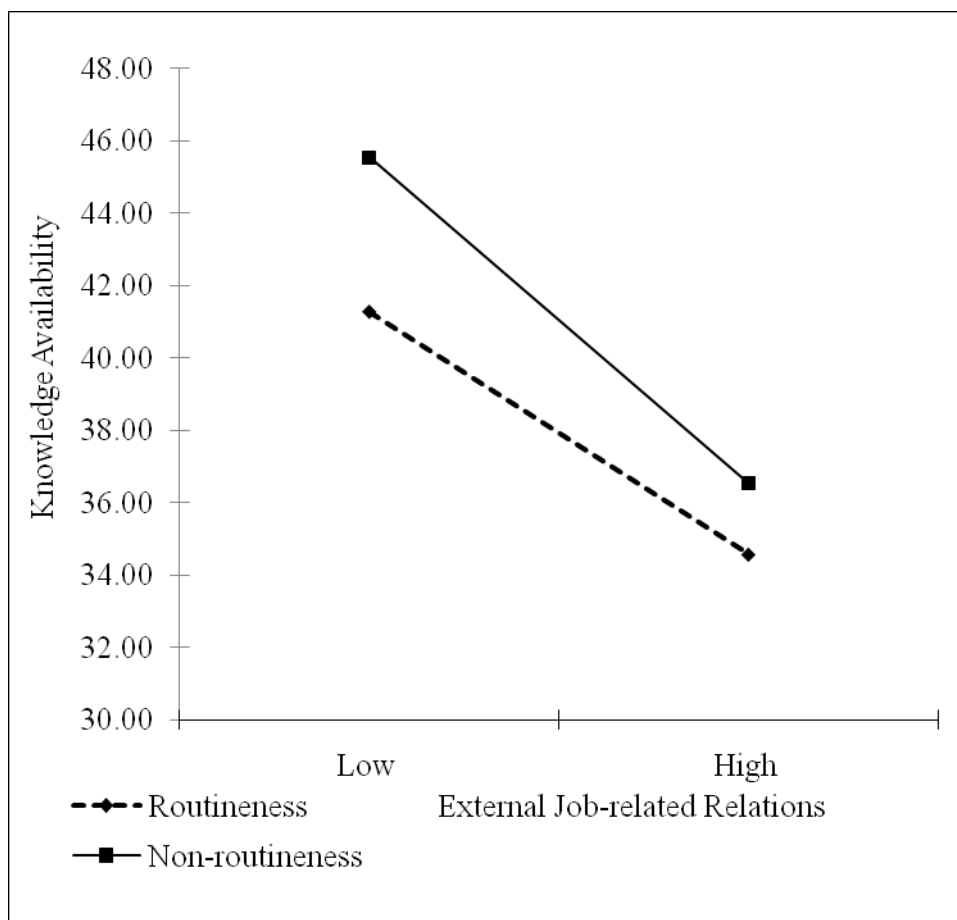
FIGURE 107. Task Routineness as a Moderator of the Relationship between External Network Size and Objective Team Performance
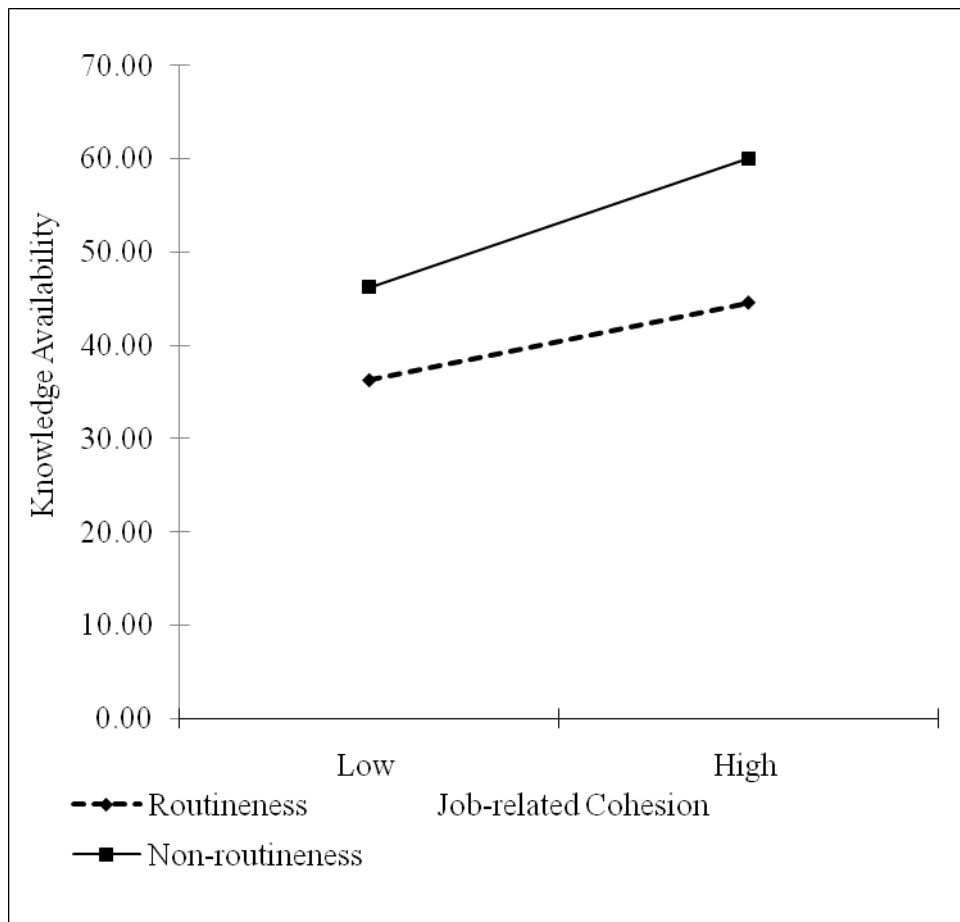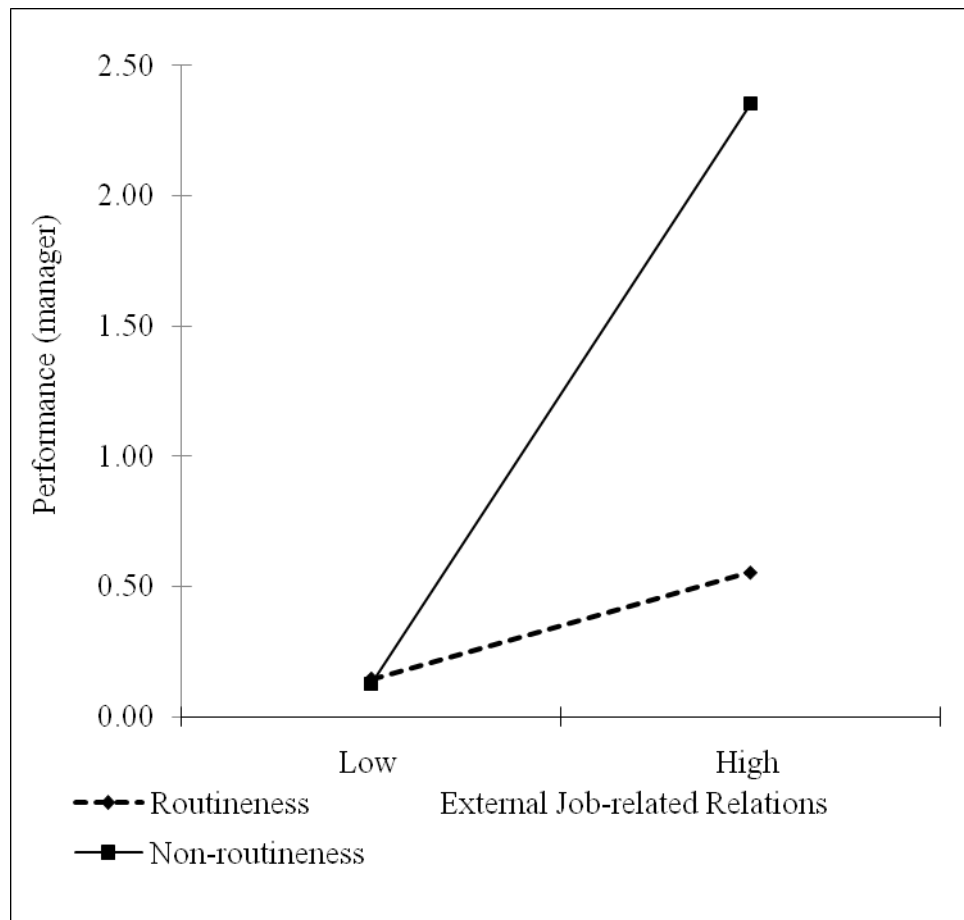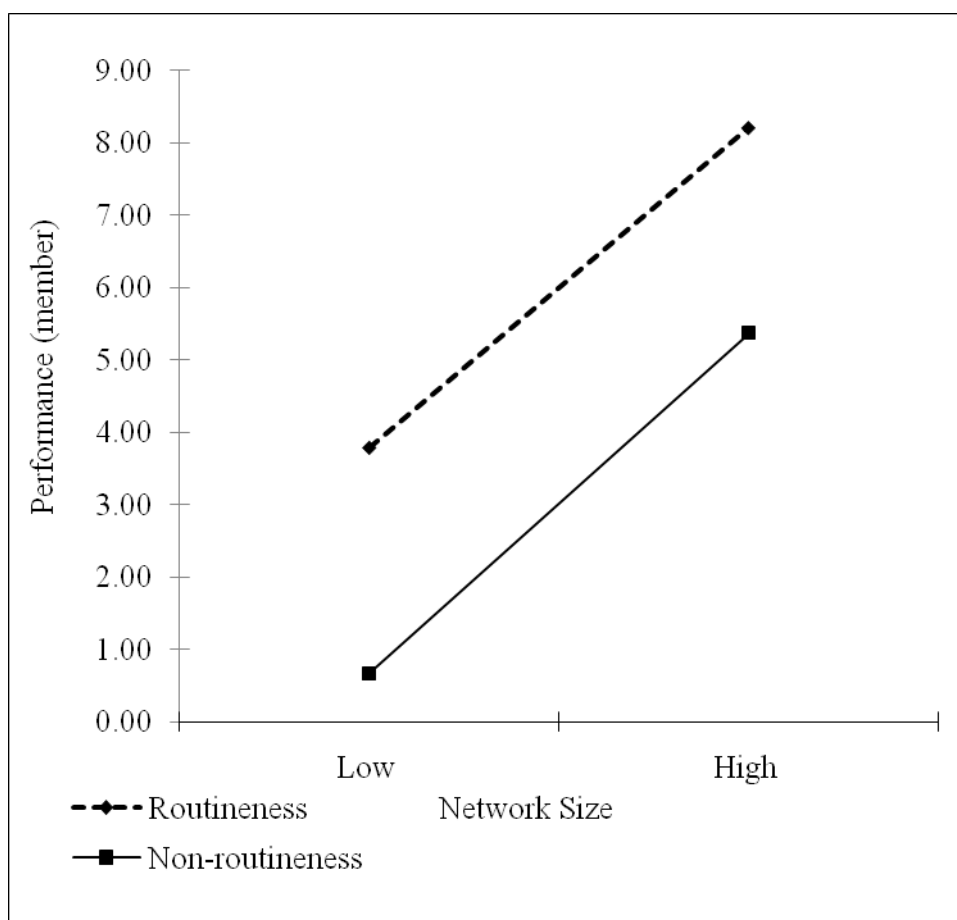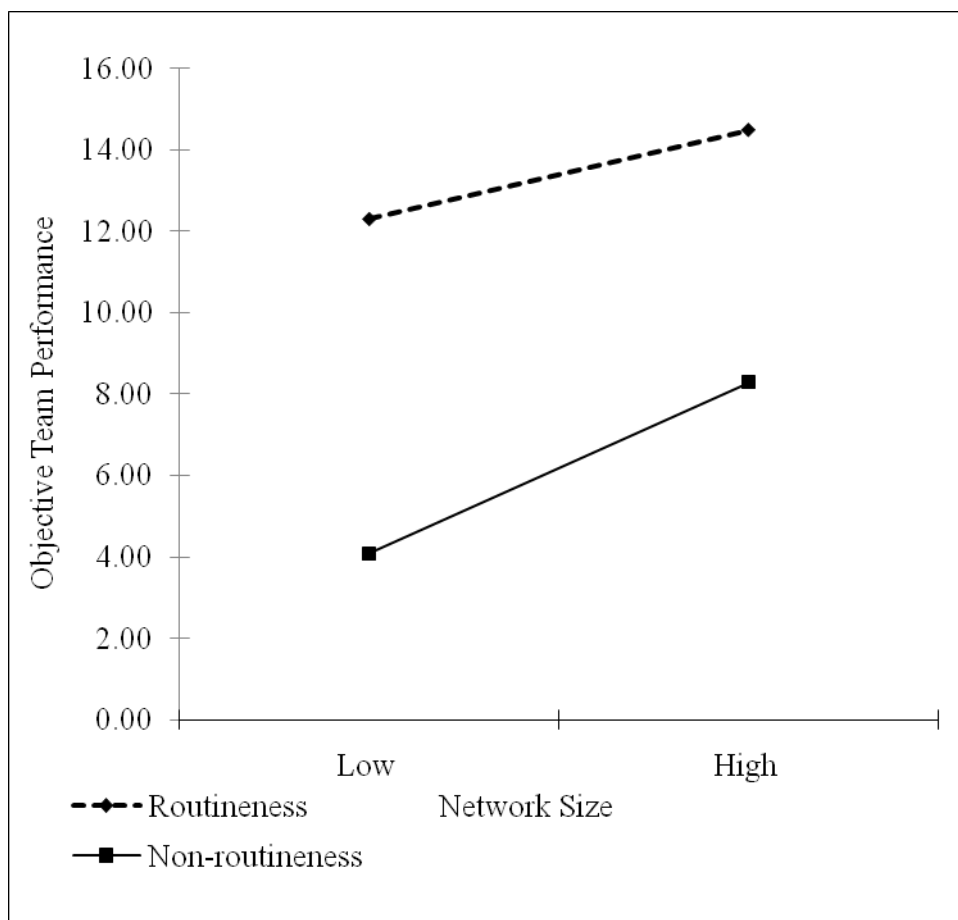
FIGURE 108. Task Routineness as a Moderator of the Relationship between External Social Relations and Objective Performance

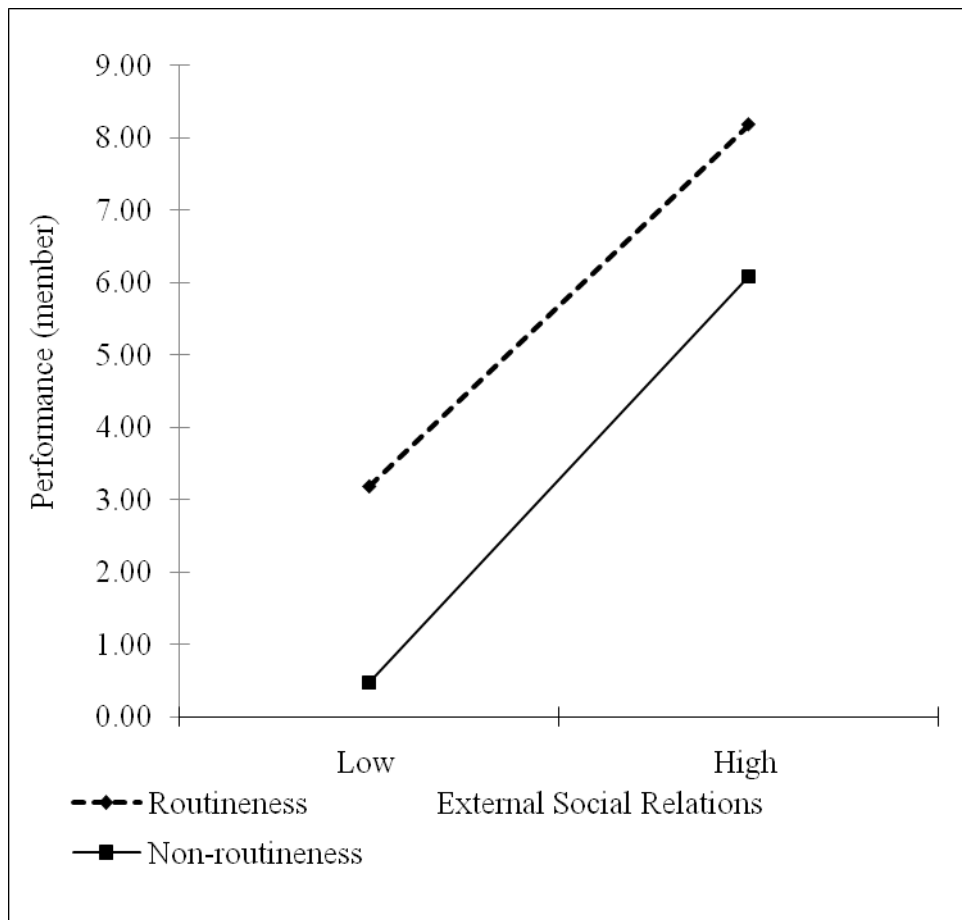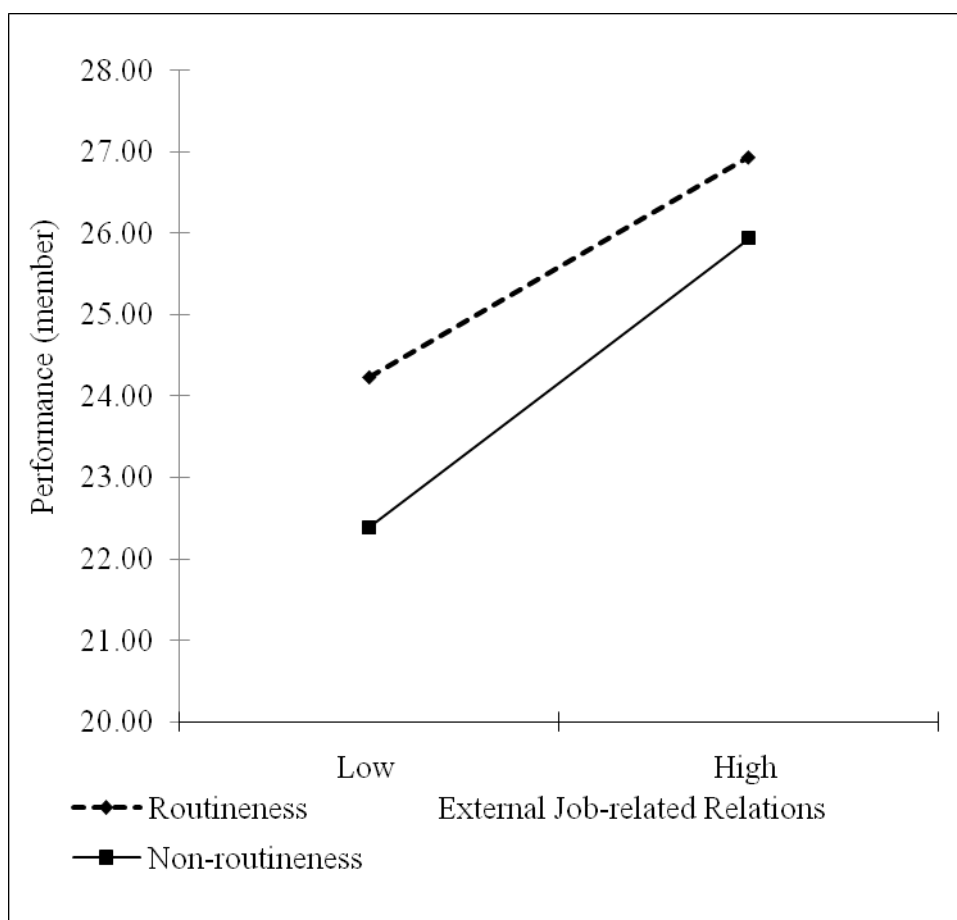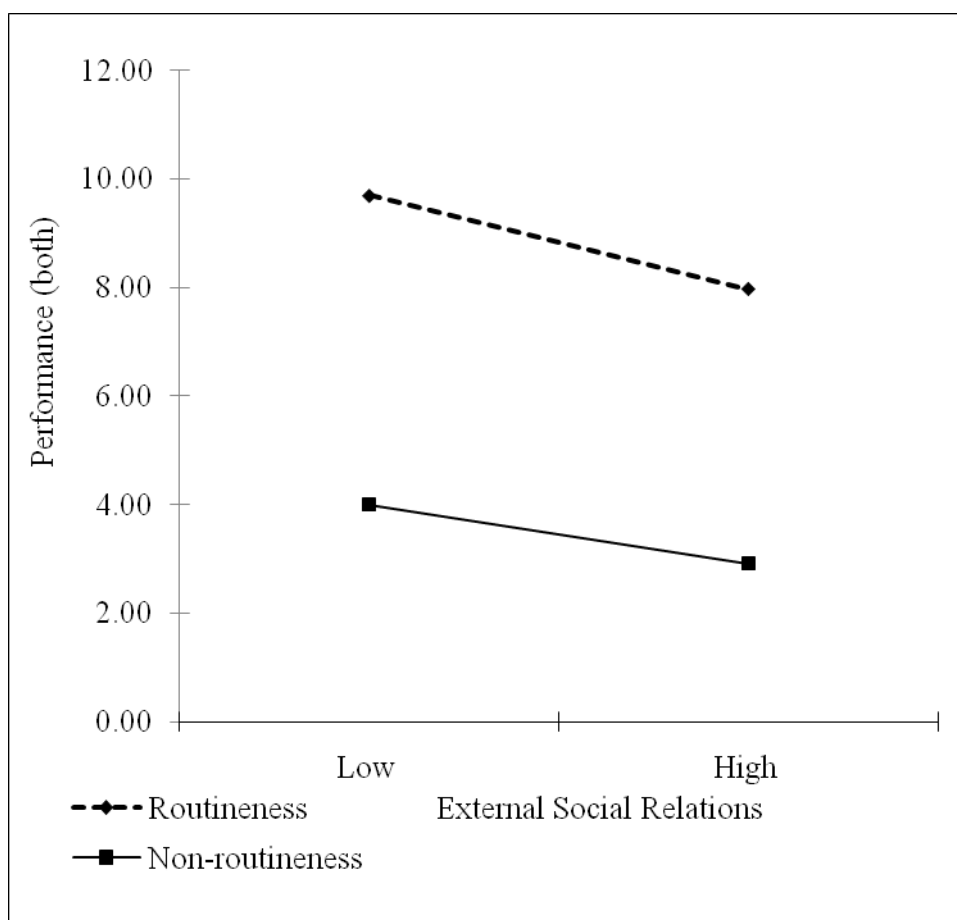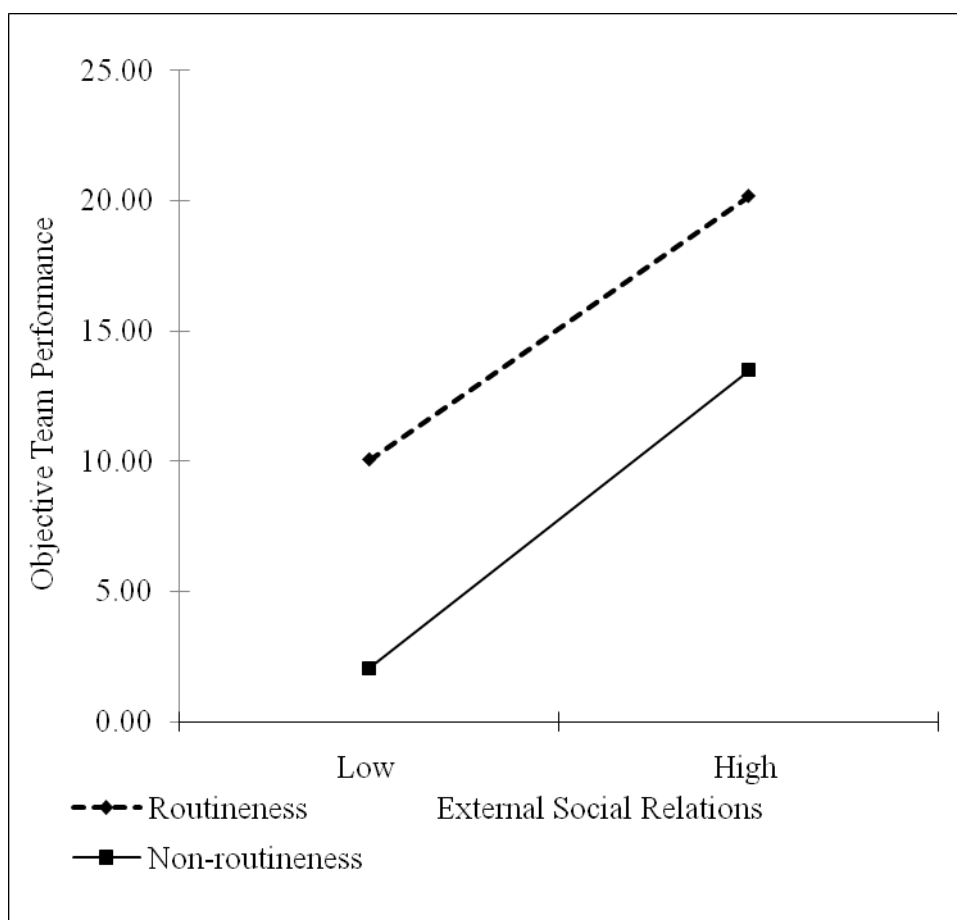FIGURE 109. Task Routineness as a Moderator of the Relationship between External Job-related Relations and Objective Team Performance
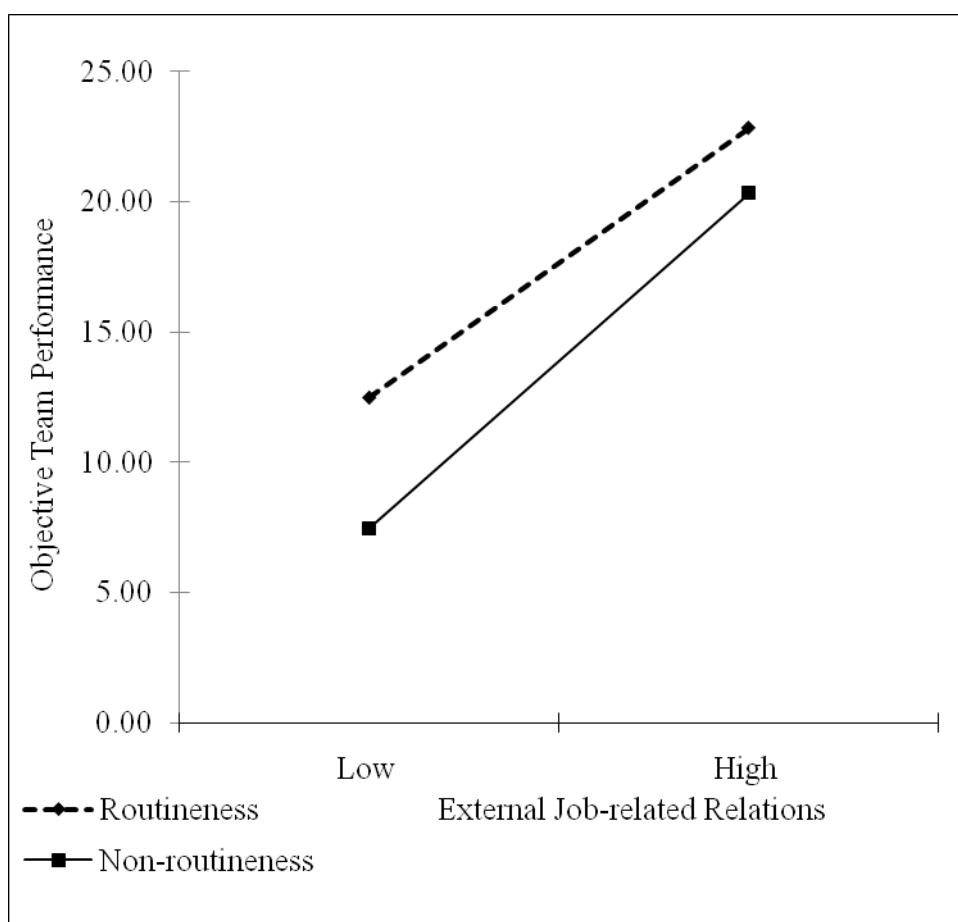
APPENDIX 1. MEASURES OF TEAM MEMBER SURVEY

Demographic Diversity

1. Gender: ❑ Male   ❑ Female

2. Age: _____ years

3. Ethnicity/nationality:

If you <u>are a U.S. citizen</u>, please select your ethnicity among the following ethnic groups.

   ❑ White/Caucasian
   ❑ Black/African American
   ❑ American Indian/Alaskan Native
   ❑ Hispanic------   ❑ Mexican
                        ❑ Puerto Rican
                        ❑ Other Hispanic or Latino,
                         please specify_____

   ❑ Asian   --------   ❑ Asian Indian
                        ❑ Chinese
                        ❑ Filipino
                        ❑ Japanese
                        ❑ Korean (South Korean)
                        ❑ Taiwanese
                        ❑ Vietnamese
                        ❑ Other Asian,
                        please specify_____
   ❑ Native Hawaiian and Pacific Islander
   ❑ Other race/ethnicity, please specify_____

If you <u>are NOT a U.S. citizen</u>, please select your nationality.

   ❑ African, please specify_____
   ❑ Asian   --------   ❑ Asian Indian
                        ❑ Chinese
                        ❑ Filipino
                        ❑ Japanese
                        ❑ Korean (South Korean)
                        ❑ Taiwanese
                        ❑ Vietnamese
                        ❑ Other Asian,
                        please specify_____
   ❑ Australian
   ❑ Canadian
   ❑ European, please specify_____
   ❑ Hispanic   ------ ❑ Mexican

❑ Puerto Rican
❑ Other Hispanic or Latino,
please specify_____

❑ Other nationality, please specify_____

Informational Diversity

4. What is the highest level of education you have completed?
❑ High school graduate or less
❑ College undergraduate, no degree
❑ Two-year college degree
❑ Four-year college degree
❑ Master's degree
❑ Doctoral degree

5. Your status
❑ Professor or Associate Professor
❑ Assistant Professor
❑ Research Professor
❑ Post-doc
❑ Technician
❑ Doctoral student
❑ Master's student
❑ Undergraduate student
❑ Other, please specify _____

6. How many years have you worked at your current laboratory? _____
years _____months

8. Your current major (e.g. chemistry, physics):
9. Your specialty of areas in your current major (Please be as specific as possible):

Team Performance

Perceived team performance (subjective measure)

Ancona & Caldwell (1992): Efficiency, quality, technical innovation, adherence to schedules, adherence to budgets, and work excellence

Campion, Papper and Medsker (1996).
7-point Likert scale: 1=very poor to 7=outstanding.

Alpha = .94
Original items:
1. quality of work done
2. customer service provided
3. productivity
4. completing work on time
5. completing work within budget
6. providing innovative products and services
7. responding quickly to problems or opportunities
8. job satisfaction of members
9. overall performance

Modified items:
1. quality of work done
2. productivity
3. providing innovative products and research
4. responding quickly to problems or opportunities
5. problem solving skills
6. overall performance

<u>Knowledge/information availability</u>

Spreitzer, G. M. 1996. Social structural characteristics of psychological empowerment. *Academy of Management Journal*, 39: 483-504.

Access to Resources: (Alpha =.83)
    1= Strongly disagree to 7= Strongly agree

Original Items:
1. I can obtain the resources necessary to support new ideas
2. When I need additional resources to do my job, I can usually get them
3. I have access to the resources I need to do my job well

Modified Items:
1. I can obtain the knowledge and information necessary to support new ideas.
2. When I need additional knowledge and information to do my job, I can usually get them.
3. I have access to the knowledge and information I need to do my job well.

Internal Social Capital

Group norm for cooperation: Chatman & Flynn (2001):
Alpha = .62 and .77

1= Strongly disagree
2= Disagree
3= Somewhat disagree
4= Neutral
5= Somewhat agree
6= Agree
7= Strongly agree

1. It is important for us to maintain harmony within the team.
2. There is little collaboration among team members, tasks are/were individually delineated" (reverse-coded).
3. There is a high level of cooperation between team members.
4. People are willing to sacrifice their self-interest for the benefit of the team
5. There is a high level of sharing between team members.

Social and job-related networks and trust networks

The following questions ask about relationships between you and all coworkers (including professors, post-docs, students and technicians) in your laboratory or team during the past year. Remember, your responses will remain confidential.

Please refer to the roster provided, where lists the names of all workers in your laboratory. First, please write initials of the workers in the first column. Make sure that each name should be matched to the serial number of each team member in the roster. Second, please answer each queation related to the person in other columes.

TEAM MEMBERS Please write here FIRST AND LAST NAME INITIALS	How close is your social relationship with each person? E= Especially close C= Close L= Less than close D= Distant	How close is your work-related relationship with each person? E= Especially close C= Close L= Less than close D= Distant	How much do you trust each person? 1= To a great extent 2= To a moderate extent 3= To a small extent 4= Not at all
(1) Lab Head	E C L D	E C L D	1 2 3 4
(2)	E C L D	E C L D	1 2 3 4
(3)	E C L D	E C L D	1 2 3 4
(4)	E C L D	E C L D	1 2 3 4
(5)	E C L D	E C L D	1 2 3 4

External Social Capital: Informational Networks

Please indicate the names of people in your organization who have been <u>valuable resources of work-related/job-related information</u> for you in your current job during the past year. Please list as many names as you can. And, answer each queation related to the person you listed.

	(1)	(2)	(3)
PEOPLE NAMED FIRST NAME AND LAST INITIAL			
Gender 　M=Male, F=Female	M F	M F	M F
Ethnicity Same=Same ethnicity with you Diff=Different ethnicity from you	SAME DIFF	SAME DIFF	SAME DIFF
Job Title 　Professor or Associate Professor 　Assistant Professor 　Research Professor 　Post-doc 　Doctoral/Master's students 　Technical/administrative workers	PROF APROF RPROF POST STUD TECH	PROF APROF RPROF POST STUD TECH	PROF APROF RPROF POST STUD TECH
Department 　Same=Same department with you 　Diff=Different department from you	SAME DIFF	SAME DIFF	SAME DIFF
How close is your social relationship with each person? E= Especially close C= Close L= Less than close D= Distant	E C L D	E C L D	E C L D
How close is your work-related relationship with each person? E= Especially close C= Close L= Less than close D= Distant	E C L D	E C L D	E C L D
Please check (∨) if the person is currently working on a project with you.			
Please check (∨) if the person worked on a project with you in past.			

Task Routineness

Task Routine/non-routineness
Original items:
Van der Vegt & Janssen (2003) and Jehn (1995)
 1= completely disagree
 7= completely agree
 alpha=.86

Original Items
1. The type of work done in my work unit is fairly consistent, so that people do the same job in the same way most of the time.[*]
2. I encounter a lot of variety in my normal working day.[*]
3. The methods I follow in my work are about the same for dealing with all types of work, regardless of the activity.
4. To what extent is there a specific "right way" to do things in your job?
5. To what extent are there specific standards which you must meet in doing your work?
6. How much variety is there in your job?[*]
7. How often is your job boring?
8. How often can you predict how long a task will take?
9. How much does your job include problem-solving?
10. How much routine is there in your job?
11. To what degree are there set patterns in your work day?
12. How often is your work simple?
13. To what extent is your job challenging?[*]
14. In general, how much actual "thinking" time do you usually spend trying to solve such specific problems?[*]
15. To what degree does your work include actually performing tasks (rather than planning)?
16. To what degree are there set patterns in your work week?
17. To what degree does your job include being creative?[*]
18. To what extent is your job tiresome?
19. How often does your work give you a sense of accomplishment?[*]
20. To what extent do you feel like you are doing the same thing over and over again?

Selected items
1. My job is very routine
2. I feel like I am doing the same thing over and over again.
3. I encounter a lot of variety in my normal working day (*)
4. The methods I follow in my work are about the same for dealing with all types of work, regardless of the activity.

* Reverse-scored.

Needs for Internal and External Networks

Need for networks with <u>coworkers in your lab</u>

To what extent do you think your <u>social-related relationship with your coworkers in your lab</u> is needed to perform your work effectively?

To what extent do you think your <u>work-related relationship with your coworkers in your lab</u> is needed to perform your work effectively?

Need for networks with <u>people outside of your lab at your organization</u>

To what extent do you think <u>your social-related relationship with people outside your lab is</u> needed to perform your work effectively?

To what extent do you think <u>your work-related relationship with people outside your lab is</u> needed to perform your work effectively?

Objective Team Performance (Publications)

About Your Academic Performance
Please answer the following questions. *Remember, your responses will remain confidential.*

Your Published Papers

	Year	Journal Title
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

* If there are more than 10 papers and conference presentations, use the back of this page.

APPENDIX 2. MEASURES OF TEAM LEADER SURVEY

Task Interdependence

Task interdependence

Ven de Ven & Ferry (1980)
Original items:

The next four questions are about the internal flow of work between your immediate subordinates. Listed and diagrammed below are four common ways that the work performed in your unit can flow between your immediate subordinates. (You, as the unit supervisor, should consider your self outside the boxes below).

Please indicate how much of the normal work in your unit flows between your immediate subordinates in a manner as described by each of the following cases:

1. *Independent Work Flow Case*, where work and activities are performed by your immediate subordinates separately and do not flow between them?
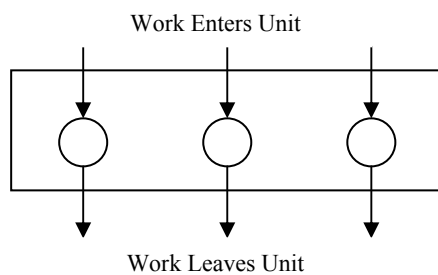
2. *S*equential *Work Flow Case*, where work and activities flow between your immediate subordinates, but mostly in only one direction?
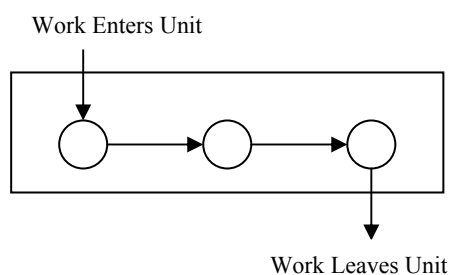
3. *Reciprocal Work Flow Case*, where work and activities flow between your immediate subordinates in a back-and-fourth manner *over a period of time*?

4. *Team Work Flow Case*, where work and activities come into your unit and your immediate subordinates diagnose, problem solve, and collaborate as a group at the same time in meetings to deal with the work.

Work Enters Unit

Work Leaves Unit
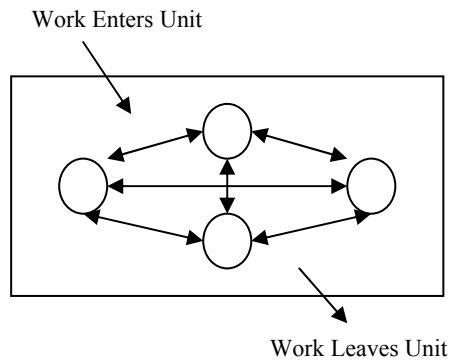
This measure was assessed using a Guttman scale: How much work normally flows between my immediate subordinates in this manner? 1=almost none of the work, 2=little, 3=about 50% of all the work, 4=a lot, 5=almost all of the work.

Answers were weighted by multiplying the supervisor's response to independent flow by zero, sequential flow by .33, reciprocal flow by .66, and team flow by one, then adding the products to obtain the overall work flow independence score (Ven de Ven & Ferry, 1980:166).

Modified items:

The next four questions are about the internal flow of work between your lab members. Listed and diagrammed below are four common ways that the work performed in your lab can flow among your lab members. (You, as the lab leader, should consider your self outside the boxes below).

Please indicate how much of the normal work in your lab task flows among your lab members in a manner as described by each of the following cases:
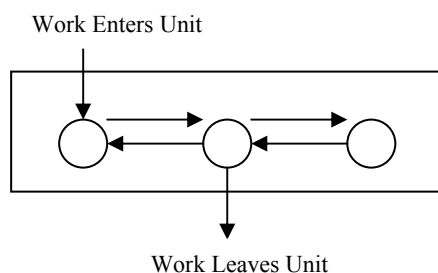
2. *Independent Work Flow Case*, where work and activities are performed by your lab members separately and do not flow between them?
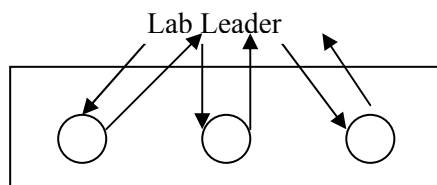
Lab Leader

2. Sequential *Work Flow Case*, where work and activities flow among team members, but mostly in only one direction?
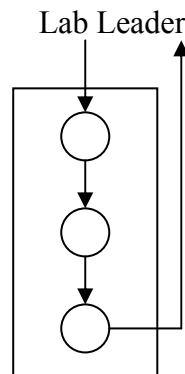
Lab Leader

3. *Reciprocal Work Flow Case*, where work and activities flow among lab leaders in a back-and-fourth manner *over a period of time*?

Lab Leader
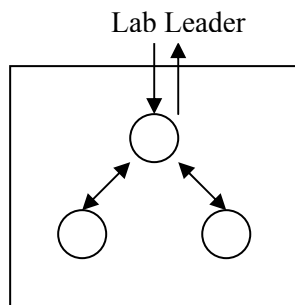
4. *Team Work Flow Case*, where work and activities come into your lab and your lab members diagnose, problem solve, and collaborate as a group at the same time in meetings to deal with the work.

Lab Leader
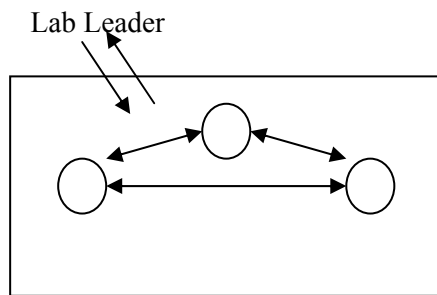
This measure was assessed using a Guttman scale: How much work normally flows among your lab members in this manner? 1=almost none of the work, 2=little, 3=about 50% of all the work, 4=a lot, 5=almost all of the work.

Answers were weighted by multiplying the lab leader's response to independent flow by zero, sequential flow by .33, reciprocal flow by .66, and team flow by one, then adding the products to obtain the overall work flow independence score (Ven de Ven & Ferry, 1980:166).

Team Performance

Perceived team performance (subjective measure)

Ancona & Caldwell (1992)

Campion et. al, (1996).
7-point Likert scale: 1=very poor to 7=outstanding.

Alpha = .94
Original items:
1. quality of work done
2. customer service provided
3. productivity
4. completing work on time
5. completing work within budget
6. providing innovative products and services
7. responding quickly to problems or opportunities
8. job satisfaction of members
9. overall performance

Modified items:
1. quality of work done
2. productivity
3. completing work on time
4. completing work within budget (efficiency or not wasting materials)
5. providing innovative products and research
6. responding quickly to problems or opportunities
7. problem solving skills
8. overall performance

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PUBLICATIONS

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