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EXAMINING THE CREATIVE PROCESS IN DESIGN TEAMS: THE INTERPLAY OF INDIVIDUAL CHARACTERISTICS, TEAM CONFLICT, AND TEAM CLIMATE FOR INNOVATION

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Abstract

Modern organizations often place great value in both teamwork and creative performance. However, the characteristics that drive individual creative performance may not lead to successful innovation at the team level. This study examined 55 teams of engineering students in order to ascertain what individual and team-level factors drive team creative performance. Results indicated that individual differences had little direct effect on team creative performance. Instead, complex relationships among individual characteristics, team conflict, and team climate emerged. In particular, an unexpected interaction between participative safety and team task conflict was found to impact creative performance. These results suggest that team creative performance must be understood as an intricate set of multilevel phenomena. Organizations desiring creative performance from teams of employees must be cognizant of these complexities.

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Introduction

Modern organizations face continual pressure to be innovative. Confronted with the demands of a highly technical, knowledge-driven society, many companies must be flexible and constantly innovate in order to stay competitive (DeFillippi, Grabher, and Jones, 2007). Florida (2002), for example, argues that creativity is essential for organizations to remain ahead of the competition. As such, many organizations place a premium on employees who are creative thinkers, as they form the core source of innovation within the organization. At the same time, many organizations are placing an increased emphasis on team-based work, with large projects rarely being carried out by lone individuals. Particularly in the design and engineering fields, creative problem solving and design is often a team-based, social process (Warr & O'Neill, 2005). In light of these circumstances, it is important to consider how team members work together to navigate the creative process in order to facilitate innovation. However, much remains unknown about the factors that drive team creative performance. The present study seeks to address this issue by combining team and creative process research to examine how individual creative performance and characteristics influence team creative performance throughout a design task.

Broadly, it is expected that initial team creative performance on a design task will be impacted by the individual characteristics of the teams' members. These early design experiences will in turn influence the development of a team climate for innovation, through the cultivation of team dynamics. Ultimately, it is the creation of such a climate that is thought to drive innovative outcomes for the team. A proposed model of these relationships is presented in Figure 1.

Insert Figure 1 about here

Interpreting such a model requires a closer examination of how early team experiences in the creative process influence performance and development at later stages. As such, the present research will be grounded in two relevant process models; the Input-Mediator-Output-Input (IMOI) model of team dynamics (Ilgen, Hollenbeck, Johnson, & Jundt, 2005), and the eight-stage model of the creative process (Baughman & Mumford, 1995; Mumford, Mobley, Uhlman, Reiter-Palmon, & Doares, 1991; Mumford et al. 1996, 1997).

The IMOI Model of Team Performance

Teams are entities that change and develop, based on their interactions with one another and the work that they do. In this way, team dynamics are frequently in flux, prone to change and evolve (Mcgrath, Arrow, & Berdahl, 2000). Thus, models of team performance that account for this complexity are more accurate, and therefore more useful than those that do not. In order to truly understand what drives team performance, it is necessary to study teams in terms of their ongoing interactions and experiences in context (Day, Gronn, & Salas, 2006).

However, in a review of process models of team performance, Ilgen et al. (2005) identified that most frameworks for examining team performance over time were sorely lacking. In particular, the researchers argue that, prior to the mid-1990s, empirical research on teams focused on clear-cut outcomes (such as team performance and viability), with little consideration of the complex processes that allow teams to reach these outcomes (Ilgen et al., 2005; Goodwin, Burke, Wildman, & Salas, 2008; Wiggins & Crowston, 2010). This is likely due to a narrow focus on what factors make some teams more effective than others. Such an approach classifies team performance as a simple equation, and asks what inputs (such as team composition variables and organization contextual factors) lead to the best performance outcomes (Wiggins & Crowston, 2010).

These more simplistic models of team performance ignore mediators that depict *how* inputs into team processes relate to later outcomes, and also assume a linear relationship between team inputs, processes, and outcomes (Algesheimer, Dholakia, & Gurau, 2011; Ilgen et al., 2005; Wiggins & Crowston, 2010). Such a focus limits how researchers may examine performance over time, as there is no way to determine how initial performance outcomes influence future performance (Algesheimer et al., 2011; Ilgen et al., 2005). Additionally, these more traditional models ignore interaction effects that occur within the team context, resulting in an overly simplistic model of team performance (Ilgen et al., 2005).

In contrast to these simplified approaches, Ilgen and colleagues (2005) propose a nonlinear, mediated model of team performance. Here, team inputs, such as contextual factors, team members' individual characteristics, and team member motivation, lead to early team performance through mediating factors within the team context (Ilgen et al., 2005; Richardson & West, 2010; Wiggins & Crowston, 2010). Ilgen and colleagues (2005) divide these mediating factors into *processes* and *emergent states*. Processes include interactions among team members, such as information exchange (Wiggins & Crowston, 2010), whereas emergent states include cognitive and affective elements, such as team conflict, cohesion, and viability (Ilgen et al., 2005; Wiggins & Crowston, 2010). An additional, crucial difference between the IMOI model and more traditional approaches to team performance is this model is recursive, with outcomes of team performance further acting as inputs for future performance (Goodwin et al., 2008; Ilgen et al., 2005; Richardson & West, 2010; Wiggins & Crowston, 2010).

The IMOI conceptualization of team processes provides a greatly improved perspective on how teams work together over time, and offers a backbone for empirical research into the factors that drive team performance. However, in the context of creative work, additional elements must also be considered. Specifically, we should consider the requirements for teams not to merely perform successfully, but also to be *creative.* To address this question in the context of team performance evolving over time, a process-based model of creative performance must be considered.

Rationale for a Creative Process Model

Early views of creativity saw the construct primarily as an outcome of performance, with driving processes thought to be unobservable (Ward, Smith, & Finke, 2009). As such, early attempts to examine creative performance over time took a “black box” approach to conceptualizing a creative process, with inputs leading to creative outcomes through developments that were not wholly understood, and thought to be outside the realm of what could be examined empirically.

Dewey (1910) proposed a stage-based model of problem solving, identified as a particularly early model of the creative process. This model consisted of perceiving a particular difficulty, defining a specific problem to address, identifying potential solutions to the problem, building on proposed solutions, and then testing them (Dewey, 1910, in Lubart, 2001). Though this model has been applied to examine creative problem solving, it does not really address *how* creative solutions develop.

Following Dewey's model, Wallas (1926) proposed a four-stage model of the creative process that focused on the development of creative solutions through "flashes of inspiration" proposed to be central to the creative process. In Wallas' initial *preparation* stage, an individual is purported to study the problem at hand and perform a preliminary analysis, using one's own knowledge, skills, and analytical abilities. Then, during *incubation*, the worker is not consciously thinking about the problem. Instead, Wallas suggests that one is subconsciously forming conceptual combinations and testing associations at this stage. Then, during *illumination*, a particularly salient combination of ideas breaks through into consciousness, resulting in an "aha" moment. Following this, during *verification*, this idea is refined and evaluated, undergoing further development, testing. (Wallas, 1926). Although more explicitly defined in terms of the development of creative solutions than Dewey's early model, Wallas emphasized that creativity arises when subconscious combinations of ideas break into consciousness, without elaborating on how this happens. Therefore, despite being a more detailed model than what preceded it, this four stage model again considers the actual development of creative ideas to occur within a "black box."

Central to the present study, more recent models have opened this "black box," allowing for examination of components and stages of the creative process. Such models present logical links between the results of one stage of creative problem solving, and subsequent stages, and examine how these elements of the process come together, and ultimately lead to creative outcomes.

These more fine-grained models typically describe the creative process in terms of a series of successive iterations, in which ideas are conceived, considered, and revised multiple times, as designers explore problems and try to develop an effective, creative solution (Finke, Ward, & Smith , 1992; Ward et al., 2009). Further, it is *how* these ideas are considered, combined, and revised that ultimately gives rise to creative performance. Specifically, early generative processes typically begin by developing an pool of preliminary ideas that may be useful in addressing an ill-defined problem. (Finke et al., 1992,). Such ideas are often considered "preinventive," forming the fuel for the creative process, as they are original and appropriate to the task at hand. However, they are not themselves the creative ideas that will be directly utilized to address a problem (Ward et al., 2009).

Instead, such preinventive ideas are combined with one another and explored, to see what might result from such combinations. It is this exploration and combination that forms the basis for creative thought, and it is the exploration, revision, and recombination of ideas that arises during this process that gives rise to the creative problem solving process (Ward et al., 2009).

Currently, one of the prevailing models of the creative process is an eight stage model developed by Mumford and Colleagues (Mumford, Mobley, Uhlman, Reiter-Palmon, & Doares, 1991; Baughman & Mumford, 1995; Mumford et al. 1996, 1997). This model breaks the development of creative solutions into discrete stages, during which each of which designers face specific tasks that must successfully be navigated in order to proceed to further stages of development.

In (1) *problem construction*, workers take an ambiguous problem and attempt to clearly define what they are trying to solve. This forms the "jumping off point" for the process, and so clearly defining the problem is essential to the success of the later stages (Hunter, Friedrich, Bedell, & Mumford, 2006). Next is (2) *information gathering*, in which workers gather information relevant to the present problem. This is followed by (3) *concept selection*, in which gathered information is sorted and organized, with the data most relevant to the problem at hand being clearly identified. Then, during (4) *conceptual combination*, these ideas and pieces of information are further organized and combined into useful and novel groupings. These combinations are then used in (5) *idea generation*, where they become the basis for potential approaches to addressing the problem. In (6) *idea evaluation*, these newly developed potential solutions are critically examined, replaced, or revised. In (7) *implementation planning,* the most viable ideas are considered for adoption and, ideally, enacted. In (8) *monitoring*, these ideas are evaluated for their success or failure, with opportunity to replace or revise them, based upon feedback.

It is important to note that, although the stages themselves are discrete, the order proscribed here is not necessarily absolute or linear. Instead, activity in one stage can feed back into previous stages, resulting in a recursive process. Ward and colleagues (2009) note that creativity in general is an iterative process, in which ideas are formed, combined, examined, and then revised or replaced as necessary. In this way, the process is continually returning to earlier stages, rather than progressing forward in a linear manner. Such a framework enables researchers to examine what designers are actually doing as they progress from identifying an initial, broad problem, to enacting an innovative solution, which is central to the research question of the present study.

Applied to a team setting, this process model has the potential to describe how teams come together to develop and implement creative solutions to problems. However, it is important to consider the initial inputs to team processes; when team members are first beginning to work together to navigate the creative process, their relationships are not yet established. At this stage, it is likely that the individual characteristics of the team's members drive both early creative performance and the development of the dynamics that will influence future team creative performance. As such, it is essential now to consider some of these individual characteristics, as they relate to creative performance.

The Role of Team Member Individual Characteristics on Creative Performance

When a team first begins working on its first task together, members probably do not have an established working relationship, and may not know much about one another. Therefore, they are unlikely to have impressions of one another's personalities, work styles, and abilities. Instead, such impressions are developed through observation of one another and continued interaction across the team's tasks.

Therefore, it is important to consider the framework within which these individuals interact, as this provides the context by which they will form impressions and make decisions about one another. Specifically, team members' initial impressions of one another tend to be based on more superficial characteristics, and it is only with continued interaction and experience over time that team members take into account "deeper level" information regarding their peers, and form more accurate impressions of their peers (Van Knippenberg & Schippers, 2007). In this way, it is through continued interaction that, for better or worse, team members form stronger, longer-lasting impressions of one another, which in turn influences the development of team conflict and team dynamics such as cohesion, viability, and team climate.

In the context of the present study, it will be shown that these dynamics will have a great influence on the creative performance of the team. Within the IMOI framework (Ilgen et al., 2005), this can viewed as individual differences which act as initial inputs influencing the development of mediators of creative performance, which will in turn influence future team creative performance (Richardson & West, 2008; Wiggins & Crowston, 2010). These mediators will be examined in greater detail in subsequent sections, in terms of team conflict and team climate.

In the context of Mumford's creative process model (e.g., Baughman & Mumford, 1995; Mumford et al. 1996, 1997), it is expected that team members' individual characteristics will exert an influence on team creativity by impacting performance during the early stages of the creative process. These early experiences will influence team creative processes by driving the development of team dynamics. In turn, these dynamics will partially mediate the relationship between early team experiences and creative performance outcomes. Once the team is established, and has a sense of one another, it is expected that the relationship between early experiences and creative outcomes will be mediated by the development of a team climate that supports innovation.

Numerous individual characteristics may influence how a team's members approach their tasks, how creative they may be in doing so, as well as how successful they will be on such tasks. Such characteristics may include member's previous experience on similar tasks, expertise in the content area, divergent thinking ability, and creative personality. Given that participants in the present study will be students, expertise and previous experience may show limited variability, and the focus will instead be on characteristics that are likely to be more highly differentiated between team members.

One such characteristic is team members' divergent thinking ability. Divergent thinking ability is, in essence, an individual's capacity to generate and develop novel ideas (Guilford, 1967). It is composed of several elements, each of which can be related to an individual's capacity for creativity; *fluency* relates to an individual's ability to quickly generate a large number of potential solutions or ideas. *Flexibility* is the ability to pursue multiple, distinct approaches to solving a problem at the same time. *Originality* is the degree to which the ideas an individual produces are qualitatively different from the ideas that would be produced by most other people (Guilford, 1967; McCrae, 1987).

These particular abilities enable individuals to develop the initial ideas that are essential to solving creative problems, which tend to be broad, ill-defined, and ambiguous (Lubart, 2001). In such situations, creative performance hinges on an individual's ability to work under such ambiguous circumstances, and being able to develop and examine numerous novel ideas early in the process will help to both further define the problem, as well as then fuel further development of creative solutions. Although team creative performance will ultimately be more influenced by the results of the teams' efforts, the initial impact of divergent thinking ability during the early stages of the creative process is expected to exert an influence on creative outcomes. It is expected, then, that:

Hypothesis 1a: Individuals' divergent thinking ability will have a modest, positive relationship with team creative performance.

It is important to note that, although individuals high in divergent thinking may be very good at supplying novel ideas on their own, during the design process individuals aren't working entirely "without a net." Computers and information technology pervade every aspect of our lives, and are an inescapable part of the design process (Agarwal & Karahanna, 2000; Agarwal & Prasad, 1998; Schneiderman, 2000; 2002). Technologies such as Computer-Aided Design (CAD) software, rapid prototyping equipment, web-based repositories of design elements, and even Internet search engines can be valuable aids in the design process, providing individuals with a vast array of potential ideas and various unexpected ways to combine them.

However, not all individuals are equally disposed to using technology in the creative process. People who are better at using technology, and enjoy using it more, are likely to be able to develop better solutions (Agarwal & Prasad, 1998). Furthermore, effective use of technology should allow individuals to discover information and new connections among constructs that would have otherwise been unavailable to them. Therefore, it is expected that individuals who have a positive orientation toward using computers and technology will make better use of the tools available to them during the creative process, and will thus develop solutions that are higher in bother novelty and usefulness. Although creative performance will ultimately be driven primarily by the team's efforts, individuals with an orientation toward technology will likely help their teams to develop more effective, inventive solutions; greater creative performance when members actively engage in using technology to its fullest.

Hypothesis 1b: Individuals' orientation toward computers and technology will have a modest, positive relationship with team creative performance.

Another set of individual characteristics with far-reaching implications for creative performance are specific personality traits thought to be related to individuals' potential for creative work. A meta-analysis by Feist (1998) attempted to identify what individual characteristics are associated with creativity. Using data from prior personality-based studies, this meta-analysis composed separate models of creative personality for both artists and scientists. Of interest to the present study is Feist's (1998) model of creative personality for scientists, which is divided into three domains: cognitive, motivational, and social. Within the cognitive domain, creative scientists are those high on openness and flexibility. In motivation, drive and ambition were identified as essential personality constructs. With regard to the social domain (perhaps of most interest in the present, team-based study), dominance, arrogance, hostility, self-confidence, autonomy, and introversion emerged as key traits (Feist, 1998).

In examination of these traits, creative scientists are those who are open to experiences, flexible in how they approach problems, and are highly self-confident and ambitious. However, these individuals are also often quite prone to anti-social behavior. Such tendencies may be in some cases be adaptive, as Feist (1998) posits that these characteristics may operate as defense mechanisms when creative individual's ideas come under attack from their more traditional peers. When examined solely at the individual level, is expected that several personality characteristics will be associated with greater creative performance.

A key personality trait that is expected to influence creative performance is conscientiousness. Although conscientiousness is traditionally conceptualized as a positive predictor of performance (e.g., Barrick & Mount, 1991; Barrick, Mount, & Strauss, 1993; Kichuk & Wiesner, 1998), it is typically associated with an emphasis on perfectionism, rule following, and impulse control (e.g., Feist, 1998; George & Zhou, 2001; Walker, Koestner, & Hum, 1995). These characteristics work in opposition to the unconventionality, tolerance for ambiguity, and generally unusual ideas associated with creative performance. In essence, individuals' conscientiousness tends to be associated with "doing it right" rather than being original (George & Zhou, 2001), and is therefore expected to be negatively related to creative performance.

Hypothesis 1c: Individuals' conscientiousness will have a modest, negative relationship with team creative performance.

In contrast to conscientiousness, individual-level openness to experience is expected to be positively related to creative performance. This personality dimension is associated with imagination, acceptance of unconventional ideas, and a willingness to explore novel concepts

(Costa & McCrae, 1992; George & Zhou, 2001; McCrae & Costa, 1997). When engaging in the creative process, individuals high in openness to experience are more likely to think of and accept unusual ideas, and then to incorporate them into potential solutions (George & Zhou, 2001). While it is ultimately the team that likely decides which ideas to pursue, and how to integrate them into a solution, having individuals who propose and are open to less conventional ideas is likely to have an impact on the team's creative performance.

Hypothesis 1d: Individuals openness to experience will have a modest, positive relationship with team creative performance.

In addition to personality, self-efficacy is another individual characteristic that is likely related to creative performance. Creative problem solving is an inherently ambiguous process (Amabile, 1996) and such problems can therefore be quite difficult to initially approach. The ambiguity of such situations can induce stress that can potentially impair performance, if individuals are not able to compensate successfully (Bandura, 1982). When individuals do not believe they can accomplish a task, they tend to shy away from it, or allow themselves to fail (Bandura, 1977). Conversely, individuals with a high sense of self-efficacy maintain a belief that they have the ability to succeed, and are therefore more likely to persist in the face of adversity, and are willing to expend greater effort and resources in order to do so (Bandura & Schunk, 1981; Bandura, 1982).

In the context of succeeding at creative problem solving, individuals need to believe that they can structure the problem in a meaningful way, and then successfully develop and implement a solution. Therefore, extent to which an individual believes he or she has the ability to see the task through to fruition should be related to persistence and expenditure of effort on the task, ultimately influencing creative performance.

Hypothesis 1e: Individuals' self-efficacy will have a positive relationship with team creative performance.

Despite the potential for individual-level characteristics to exert influences on team creative performance, it is important to remember that these individuals are *not* working alone; they must operate in tandem with one another in order to navigate the creative process and arrive at creative solutions. Therefore, it is essential to examine how these individual-level differences influence how the *team* approaches creative problem solving, and navigates the creative process.

As may be inferred from Feist (1998), this matter is further complicated, as aspects of some of these individual characteristics may be antisocial; the same processes that enable individual designers to be creative, and help them defend themselves from criticism may in fact cause team members to clash, inducing conflict in the team and inhibiting social processes and the development of positive team dynamics. Indeed, Patterson (2002) questions how ready organizations are to hire creative individuals, who are likely to "challenge the status quo, question authority and are less conforming" (Burch, Pavelis, & Port, 2008, pp. 178).

In order to understand how creative individuals can successfully work together, we must examine how these individual differences operate within the context of team processes. It is expected that, as team members work together, their continued interactions will shape the development of team dynamics, particularly conflict within the team. As will be discussed, such conflict is expected to impact team creative performance by influencing the development of a team climate for innovation. In order to understand how team conflict may exert such influences, it is necessary now to examine the constructs of team conflict in more detail.

Development of Team Conflict

There is a significant body of research suggesting that social processes within a team influence how well the team works together and shares information during the creative process (Beal et al., 2003; Hunter et al., 2011; Taggar, 2001, 2002; West, 2002). As discussed previously, as team members share ideas during the early stages of the creative processes, their initial interactions will be influenced by the characteristics of the individual members. Therefore, it is at this point when the team is most vulnerable to the potential influences of individuals' "antisocial" personality traits on team dynamics. If this occurs, poor interpersonal relationships can develop, creating maladaptive conflict among team members, which will in turn hinder team creative performance. Given the potential effects of team conflict on creative performance, it is necessary to further examine how the characteristics of a teams' members may influence the development of conflict within the team.

Jehn (1995) divides team conflict into two distinct constructs; task conflict and relationship conflict. Task conflict is defined as disagreement about how the team should approach their tasks. This may involve differences of opinion, disagreement about ideas, and discrepancies among team members viewpoints. Relationship conflict is discussed in terms of interpersonal disagreement among members of a team, which may involve interpersonal tension, discontent, and dislike among members of a team (Jehn, 1995). It is important to note that these are two distinct constructs, which can have separate causes and discrete sets of effects on team performance (Jehn & Mannix, 2001).

Regarding specific, individual-level influences on team conflict, it is expected that individual differences that give rise to varied ideas and viewpoints will lead to increased task conflict within the team; by increasing the total number of ideas and introducing unusual or unexpected connections among ideas, it is more likely that team members will experience disagreements about what ideas to pursue, and how to combine them into a coherent product. Furthermore, social judgment theory suggests that, if the large number of unexpected or unusual ideas provided by individuals high in divergent thinking cannot be integrated, individuals may begin to judge one another, driving up interpersonal, relationship-based conflict within the team (Brehmer, 1976). As such, it is expected that divergent thinking ability will be positively related to both task and relationship conflict.

Hypothesis 2a: Individuals' divergent thinking ability will be positively related to task conflict and relationship conflict

Similar effects are expected for individual-level openness to experience. While individuals high in this dimension are more likely to be accepting of new ideas and willing to listen to or explore novel approaches (Costa & McCrae, 1992), these individuals are also more likely to suggest ideas that are unconventional, unexpected, or even strange (Costa & McCrae, 1992; McCrae & Costa, 1997). Other team members may not be accepting of these unusual ideas, giving rise to task-related disagreements. Furthermore, individuals high in openness to experience are prone to challenging the status quo and expressing feelings and ideas that may make less open individuals feel uncomfortable. Such discomfort could potentially give rise to interpersonal, relationship-oriented conflict within the team.

Hypothesis 2b: Individuals' openness to experience will be positively related to task conflict and relationship conflict

Similarly, individual-level conscientiousness is also expected to be positively related to task and relationship conflict within the team. Given that conscientiousness is associated with rule following, perfection-seeking, and a desire for order (Costa & McCrae, 1992; McCrae & Costa, 1997), it is expected that conscientiousness will be related to an increase in task-related conflict, as conscientious individuals are likely to speak up or actively disagree with other team members when the team is not proceeding in the "correct" direction (i.e., toward the most logical, commonly-accepted solution). Furthermore, the rigidity and perfectionism associated with high levels of conscientiousness is likely to induce relationship conflict in the team, as highly conscientious individuals will become irritated with team members who are not following their idea of the correct solution, and other team members may experience animosity towards an individual who they see as being too inflexible.

Hypothesis 2c: Individuals' conscientiousness will be positively related to task conflict and relationship conflict.

Extroversion is another personality characteristic that is likely to induce conflict within the team. While extroverted individuals are often thought of as sociable (e.g., Hogan, 1991; Kichuk & Wiesner, 1998), extroversion is also associated with expression of one's own viewpoints and exhibiting dominance (Kichuk & Wiesner, 1998). Considering the relationship between extroversion and expressiveness of one's own ideas, it is expected that extroversion will be positively related with team task conflict; extroverted team members are likely to bring up their own interpretations, opinions, and ideas, even if they are in conflict with those expressed by other team members. Such disagreement as extroverted individuals try to "take charge" is likely to increase task-related conflict. This behavior is also likely to annoy members of the team who may feel that their ideas are being trampled over, and may also lead to individuals becoming frustrated with one another as more outspoken team members "butt heads."

Hypothesis 2d: Individuals' extroversion will be positively related to task conflict and relationship conflict.

In contrast, individual-level agreeableness is expected to be negatively related to both task and relationship conflict. Agreeable individuals tend to be more flexible, and more willing to adapt to ideas provided by others (Lee & Ashton, 2006). Such flexibility is likely to suppress task conflict when it would otherwise arise, as these individuals will tend to accept new ideas, or go along with the prevailing viewpoint within the group. Agreeableness is also associated with patience (Lee & Ashton, 2006), and therefore is expected to limit relationship conflict within the team; agreeable individuals are willing to put up with more from their team mates without becoming annoyed or taking disagreements things personally.

Hypothesis 2e: Individuals' agreeableness will be negatively related to task conflict and relationship conflict.

Additionally, self-efficacy is expected to be negatively related to both task and relationship conflict. Given that individuals high in self-efficacy have a belief that they can overcome difficult situations and persist to reach their goals (Bandura, 1982), it is expected that individuals high in self-efficacy will believe that they can overcome conflict within the team, and will therefore work to rectify or prevent disagreements among team members that could potentially impair performance.

Hypothesis 2f: Individuals' self-efficacy will be negatively related to task conflict and relationship conflict.

Finally, the technology that is often an inherent part of the design process may also exert an influence over the development of conflict within the team, depending on how it is utilized by the members of the team. As has been discussed, numerous technologies exist that can help individuals develop, integrate, and enact their ideas. It is expected that individuals who enjoy and become absorbed in using technology (such as CAD software, rapid prototyping equipment, and Internet searches) will be able to use these technologies to propose and elaborate on novel, surprising ideas (Agarwal & Prasad, 1998; Agarwal & Karahanna, 2000), which may be at odds with more traditional, conservative ideas of other team members. Furthermore, the heavy reliance on technology that can be associated with such cognitive absorption (Agarwal & Karahanna, 2000) may lead to task-related disagreements among team members, especially when other members may not feel inclined to utilize technology in similar ways. Such differing perspectives are likely to induce task-related conflict within the team.

However, in spite of the potential positive relationship between individuals' computer orientation and task conflict, such an orientation is expected to reduce relationship conflict within the team. When used to support the design process, information technologies can enable users to collaborate and share ideas in new, efficient ways (Schneiderman, 2000; 2002). For instance, CAD software can allow individuals to explore how different users' design ideas may fit together, and email correspondence and wikis can enable individuals to communicate ideas and quickly and succinctly. When individuals actively engage in using these technologies, and enjoy exploring how to use them effectively, they can provide the team with a common system by which to generate and combine their ideas (Schneiderman, 2002). This may help to keep members "on the same page," allowing them to contribute to the team's creative performance by sharing their own ideas in within a common framework. This in turn may provide a buffer against the development of relationship conflict, even when team members have differing ideas about the task at hand.

> *Hypothesis 2g: Individuals' computer orientation will be positively related to task conflict and negatively related to relationship conflict.*

Such task and relationship conflict can exert a great influence on the climate within a team, which will in turn have a major impact on team creative performance. Initially, such judgments about the efficacy of the team are expected to be based on team members' early experiences working with one another. If, early in the creative process, team members see one another as being able to work together toward a creative solution, this may lead to the development of a positive climate for innovation. In essence, early experiences in the creative process will impact the development of a team climate for innovation via team task and relationship conflict. Such a climate will, in turn, drive team creative performance.

The Mediating Role of Team Climate for Innovation

It is potentially difficult to make predictions about the relationship between team conflict and team creative performance, given the conflicting literature on the effects of team conflict on team performance. While there is generally agreement that relationship conflict is negatively related to team performance (e.g., De Drue & Weingart, 2003; Jehn, 1995; Jehn & Mannix, 2001), findings regarding the effects of task conflict are less straightforward. For instance, while Jehn (1995) and Chen (2006) found positive relationships between team task conflict and creative performance, a meta-analysis by De Drue and Weingart (2003) identified a negative relationship between task conflict and team creative performance. Adding further complexity, more recent work by De Drue (2006) suggests a curvilinear relationship between task conflict and creative performance.

The present study will attempt to resolve these discrepancies by examining at mediators of the conflict-performance relationship. In particular, it is expected that conflict will influence team creative performance via its impact on the development of a team climate for innovation. Such a climate is composed of several key elements, which involve team members getting along and being able and willing to work together; this further includes a sense that the team values innovation, has similar goals, and that members feel comfortable sharing information among one another.

Team cohesion is one such important process to consider when exploring contexts that support innovation. Cohesion is conceptualized as including elements of group pride, group commitment to tasks, and interpersonal attraction between group members (Mullen & Copper, 1994). A meta-analysis by Mullen & Copper (1994) found that one element of cohesion, group commitment to tasks, was significantly related to team performance, but that the remaining two elements, group pride and interpersonal attraction, were not related to performance. However, a more recent meta-analysis by Beal, Cohen, Burke, and McClendon (2003) refutes this, asserting that Mullen and Copper (1994) did not have an adequate conceptualization of team performance, and that this led to their non-significant findings. Whereas Mullen and Copper (1994) considered team performance as a singular outcome, Beal et al. (2003) defined performance as a *process* in which team members engage. Given such a definition of the criterion, all three elements of cohesion were found to have significant effects on team performance.

The implications of this finding for the present study are twofold. First, it suggests that an examination of cohesion is an important consideration when researching team performance. Second, as the present study is examining not just factors that influence creative output, but performance at all stages of the creative process, the definition of performance as a process and not a singular outcome will be a beneficial one. In line with the findings of Beal et al., (2003), the present study will examine the effects of cohesion across the creative process, and not just on the final product produced. Having laid the groundwork for considering team cohesion as a worthwhile element to examine, it will be necessary to examine some of the ways in which cohesion may influence the creative process.

Anderson and West (1998) found that team cohesion helped build comfort between team members, and facilitated the free exchange of ideas within the team. This exchange is an essential element of the creative process, beginning early with the idea generation stage, and progressing throughout the process, as team members must provide feedback and constructive criticism on ideas to facilitate problem solving and solution development. Additionally, research indicates that cohesion is an essential component of team performance, enhancing both commitment to the team and engagement in team-based tasks (such as team creative problem solving) (Hunter, Thoroughgood, Meyer, & Ligon, 2011; West, 2002). Furthermore, Brown, Tumeo, Larey, & Paulus (1998) suggest that poor intragroup processes, such as low team cohesion, may account for why the sum of a team's creative performance may be less the creative performance of its members working independently.

Similarly, as discussed previously, Taggar found that individual team members' creativity was only positively related to team creative performance when team creativity relevant processes were strong within a team (Taggar, 2001, 2002). These findings suggest that a team must reach at least some level of cohesion in order to succeed in the creative process. It is thought that cohesion helps give rise to team psychological safety, a condition under which team members feel comfortable with one another, and are willing to both share and critique ideas within the team (Edmonson, 1999).

In fact, in psychologically safe team environments, criticism of a team member's ideas is more likely to be perceived as constructive and beneficial to the team, whereas the same criticism is likely to be seen as negative and damaging to relationships in the absence of such psychological safety (Edmonson, 1999). Indeed, cohesion is associated with increased participative safety (Anderson & West, 1998), which helps team members feel more comfortable taking risks within the team and sharing their ideas with one another. This in turn, leads to a larger body of original ideas to draw from, adding more fuel to the creative problem solving process (Hunter et al., 2011). Since such a free flow of information among team members is essential to the success creative process, psychological safety is likely to mediate the relationship between cohesion and team creative performance.

However, while cohesion can help to give rise to psychological safety, excessive cohesion among team members may in fact impair team creative performance. As described above, many of the benefits of a cohesive team stem from the mitigating effect that cohesion has on conflict; by enabling members to work together better, performance is theoretically improved. However, there is evidence that some degree of task-related conflict is actually beneficial to team performance (Gully, Incalcaterra, Joshi, & Beaubien, 2002; Zellmer-Bruhn & Gibson, 2006).

In fact, some research suggests that some degree of cognitive, problem-focused debate is a necessary condition for the creative process to be successful (Isaksen, Lauer, & Ekvall, 1999). In light of this, it is telling that Edmonson (1999) notes that while cohesion is related to psychological safety, they are not the same construct, and that simply accepting others' ideas in the name of not "rocking the boat" does not benefit the team's performance. Similarly, Hunter and colleagues (2011) note that, in highly cohesive teams, members may be less likely to suggest novel ideas or to provide criticism of their teammates ideas, for fear of disrupting the status quo and introducing relationship conflict among members. Such an attitude interferes with multiple aspects of the creative process, by hindering idea generation, concept selection, conceptual combination, and idea evaluation.

However, additional team processes can influence the relationship between cohesion and team performance, by facilitating a *climate for innovation* within the team. As such, when considered in concert with other team climate variables, it is expected that team cohesion will be positively related to team creative performance.

> *Hypothesis 3a: When examined in conjunction with other team climate variables, team cohesion will be positively related to team creative performance.*

With regard to these additional elements of team climate, West (1990) identified four key factors specific to such a team climate for innovation. It was theorized that all of these elements must be present in order for team members to work together to solve problems creatively, and to innovate. The essential elements of this theory are described below.

Vision is the degree to which team members share a particular long-term, high-level goal, which they work toward together. Such a goal is a motivating factor for the team, keeping them focused on their tasks, leading to more appropriate approaches to solutions. Such vision is composed of several elements: clarity, which represents how well understood the long-term goals are by team members; visionary nature, the value that the team's vision represents to its members, focusing them on related team goals; sharedness, which is the degree to which all team members embrace the vision and its related goals; and *attainability*, which is a measure of how well-defined and tangible the team's long-term goals are. If the team's vision is too vague or abstract, it may not appear attainable, and can actually hurt motivation to pursue team tasks. (Anderson & West, 1998)

Task Orientation is a measure of team members' combined motivation toward performing well on team assignments. In order to be successful, teams must not only share a common vision, but be focused on the quality of their performance as they pursue such goals. (Anderson & West, 1998) In the context of teams faced with creative design problems, this facet is crucial both in defining how team members develop ideas and concepts to share with their peers, and also in how they provide feedback, constructive criticism, and impose constraints on others' ideas and designs.

Participative Safety is highly similar to psychological safety (Edmonson, 1999) as described previously. As discussed previously, it is a measure of how comfortable team members feel in presenting their ideas, and in giving and receiving constructive feedback to their team mates (Anderson & West, 1998). This is crucial in the context of the creative design process, as if team members do not feel comfortable sharing their ideas, members will have a smaller pool of resources from which to combine concepts, which will result in fewer options for designs and, conceivably, less innovative outcomes. Furthermore, if team members do not feel comfortable criticizing or providing constructive feedback on concepts that are selected by their peers, it is likely that less original or less viable potential solutions may be selected, leading to poorer outcomes.

Finally, *Support for Innovation* is the degree to which the team approves of novel approaches or ideas proposed within the team. It is essential that the team follow through on its stated support for innovation, so a distinction is drawn between support that is "articulated" (such as verbally, or in documentation), versus support that is "enacted" (what team members actually do) (Anderson & West, 1998). Actively encouraging innovation within the team should not only lead to more creative ideas being proposed, but also increase the likelihood that these ideas will be developed to fruition.

When such a team develops such a climate, it is expected that it will help to compensate for the potentially antisocial characteristics associated with members' creative personality traits, which of course, will themselves remain stable across the creative process. By developing a common sense of purpose and increased participative safety, members will be more likely to work positively with one another, such that the creativity-supporting aspects of these individual traits will show through, instead of the more antisocial ones, thus facilitating creative problem solving within the team.

Furthermore, as has been established, creative performance within a team is an ongoing process. As such, the outcome of any one stage is not itself going to lead to creative outcomes for the team; in order for the creative process to be successful, the team must persist in working with one another across the tasks associated with each stage. In this sense, if teams are to ultimately reach positive outcomes from the creative process, they have to continue wanting to work together *throughout* the process. This is a core concept of another essential aspect of team dynamics: team viability.

Team viability is the degree to which team members want to continue working with one another. Distinct from team cohesion, team viability is an index of the degree to which team members desire to continue working with one another on subsequent tasks (Lewis, 2004). It is important to note that team viability as a construct is specifically future-oriented, relating not to how teams are working with one another on a current task, but instead how they would or would not like to work together on later tasks. Specifically, Halfhill and Nielsen (2007) define team viability as a multifaceted construct that is broader than cohesion, and consists of several elements: continuity, or the stability of the team's membership; commitment, or the members' ongoing desire to pursue the team's goals; cohesion, as previously defined; and capability, the ability of the team to realize its goals.

Lewis (2004) identifies viability as an essential element of team performance. As team members work together on multiple tasks, their desire to continue working together has a crucial effect on future performance. As such, viability is a central element in the long-term success of a team (Hackman & Morris, 1975, in Lewis, 2004). Within the creative process, each stage requires commitment from the team in order to be successful, so developing and maintaining a high degree of team viability is essential to the team's ultimate creative performance. It is expected that team members' early experiences working with one another, in the form of their performance in the early stages of the creative process, will greatly impact the success or failure of future stages, influencing the eventual outcomes of the creative process.

> *Hypothesis 3b: The four dimensions of Team Climate for Innovation, as well as team viability, will be positively related to team creative performance.*

It is expected that these six team dynamics will act as mediators between team task and relationship conflict and team creative performance. That is, it is thought that the development of both task and relationship conflict in the early stages of the team creative process will impair the development of team dynamics and thus result in lower levels of team creative performance.

Specifically, task conflict involves disagreement about ideas and procedures associated with the team's tasks. It is expected that such task conflict will reduce the degree to which team members are in agreement about what steps the group should be following (Jehn, 1995; Jehn & Mannix, 2001) and therefore is likely to impair task cohesion by introducing differences of opinion into the group. Similarly, task conflict is expected to reduce a sense of shared vision within the team, as dissenting views about the team's tasks are likely to make it difficult to articulate a single high-level, long-term goal for innovation. Also along these lines, task conflict will make it hard for team members to agree about the direction they should be taking to achieve their goals, making it difficult for members to similarly direct their individual motivation, thereby negatively impacting task orientation. Additionally, the differences of opinion associated with task conflict can potentially impair participative safety within the team; if team members are already particularly vocal in disagreeing with one another, as occur when there is a high level of task conflict (Jehn & Mannix, 2001), the sense that it is safe to introduce new ideas and opinions can be undermined. Task conflict can also impair support for innovation; if there is a large degree of disagreement about how the team should proceed with their tasks, it is likely that the lack of a clear direction will mean that members of the team will not perceive a consistent pattern of approval and support for novel ideas.

> *Hypothesis 4a: Team climate for innovation will mediate the relationship between task conflict and team creative performance, such that task conflict will be negatively related to team climate for innovation variables, as well as team task cohesion.*

Overall, a similar pattern is expected between relationship conflict and these team climate variables. The intra-team animosity, resentment, and tension associated with relationship conflict (Jehn, 1995) likely directly reduces a sense of cohesion within the team, by undermining group commitment and willingness to work with one another (Beal et al., 2003; Mullen & Copper, 1994). Similarly, a team composed of members who do not get along interpersonally are unlikely to desire to continue working with one another (Jehn, 1995), resulting in low team viability. Additionally, if team members do not get along interpersonally, their anger and frustration is likely to impair team processes, such as a shared vision for the project or a shared sense of direction for the team's tasks. This is in line with findings that relationship conflict is negatively related to team performance (Jehn, 1995; Jehn & Mannix, 2001). Additionally, a team composed of members who do not get along is unlikely to perceive that their peers will follow through on supporting their novel ideas, resulting in a reduced sense of team support for innovation. Finally, and perhaps most importantly, team members who do not like one another and do not get along interpersonally are unlikely to feel comfortable sharing unconventional ideas, or proposing plans that may not succeed (West, 1990). This discomfort is expected to result in reduced perceptions of participative safety.

Hypothesis 4b: Team climate for innovation will mediate the relationship between relationship Conflict and team creative performance, such that relationship conflict will be negatively related to Team Climate for Innovation variables, as well as Team Task Cohesion and Team Viability.

In sum, it is expected that when team members come together to work on a creative task, their early performance will be driven primarily by their individual characteristics, which will be observable in terms of modest positive relationships between individual characteristics and team creative performance outcomes. Additionally, early team experiences will influence the development of the team dynamics that will drive team performance throughout the rest of the creative process, particularly team task and relationship conflict. Such conflict will influence the development of a team climate for innovation, which will in turn drive team creative performance. The present study will examine specifically how individual characteristics and early experiences combine to influence team dynamics, and how this influences creative performance outcomes.

Methods

Participants

The sample consisted of 161 students enrolled in design courses in the College of Engineering, divided into 55 teams of 3-5 individuals. 80.7% of the participants were male ($n = 130$), and the average age of the sample was approximately 20 years, with a standard deviation of 1.78 years. As part of their coursework, these teams participated in a semester-long creative design task, in which they were required to develop a novel engineering solution to a problem laid out by the instructor. These problems were broad in scope, and left teams with ample room to explore, and come up with different approaches to a solution.

Procedure

Participants in each engineering course were presented with a design problem that they were required to address as a team. These problems were designed to be broad, allowing team members to utilize a variety of strategies, materials, and techniques in order to arrive at a solution. Over the course of a semester, teams met approximately once per week in class to work on an engineering design to address their assigned problem. Additional group work outside of class time could not be directly assessed.

Depending on the section and course they were enrolled in, team's specific design projects did vary. However, all teams consistently worked with the same members on a project that was broad in scope and specifically required creative problem solving. Given the variation among teams' projects, a coding system for creative performance was devised in which projects would be compared to others within the same class, but utilizing the same metrics across classes. This was done in order to ensure that creative performance scores would be comparable across all teams, regardless of course or section.

Within the first two weeks of the semester (prior to beginning work on their group projects), team members completed the first assessment of their individual characteristics. These initial measures captured participants' age, gender, divergent thinking ability, computer orientation, personality, and self-efficacy.

Team members were surveyed again approximately halfway through the semester. At this point they were asked to complete a questionnaire relating to their experiences in the team thus far. This measure emphasized team dynamics and team conflict. Teams were surveyed a third time in the final two weeks of the semester, as they were completing and submitting their final projects. This final assessment focused on assessing the climate for innovation within the team.

At the conclusion of the semester, teams' final products were submitted to the researchers, and were coded for facets of creative performance (quality and originality) by a team of trained coders. Each dimension was assessed on a five-point scale. Initially, coders were instructed to individually assess each team's creative performance by comparing teams within each course to one another. This was done in order to ensure consistency of meaning across ratings, as different courses were assigned design projects that were qualitatively different.

After all coders completed their ratings, inter rater agreement was assessed, and agreement among coders was found to be poor. In light of this lack of agreement, projects were re-evaluated using an adaptation of Amabile's (1986) consensual assessment technique for the assessment of creative performance. In this process, raters met as a group to discuss each project and develop scores based on consensus. Raters were directed to use their prior coding expertise, and to refer to their original ratings as well, so that the raters could compare their interpretation of each project to those of their peers.

Measures

After being divided into teams, individual team members completed a self-assessment survey designed to assess their own individual characteristics. At the start of this survey, participants were asked to identify themselves by name, and also to list each of their team mates. This information was used to develop a coding scheme to link the responses of team members' to one another, so that perceptions of team dynamics may be assessed.

This self-assessment measure included several demographic characteristics, including students' age, gender, and year in their program. These elements, as well participants' prior experience working with their present team members, were recorded and held as control variables during analyses.

Additionally, the survey contained a measure of creative personality, adapted from subscales of the HEXACO personality inventory (Lee & Ashton, 2006). Subscales included are each ten-item measures, on a five-point Likert scale, with anchors ranging from "Strongly Disagree" to "Strongly Agree." The scales include measures of expressiveness (α = *.84*), sociability (α = *.85*), flexibility (α = *.73*), patience (α = *.88*), diligence (α = *.81*), perfectionism (α = *.80*), prudence (α = *.80*), inquisitiveness (α = *.78*), creativity (α = *.85*), and unconventionality (α = *.84*).

Self-efficacy was assessed using a ten-item subscale from the NEO (α =.78), which was measured on a five-point Likert scale, with anchors ranging from "Strongly Disagree" to "Strongly Agree." Sample items include "I complete tasks successfully," "I come up with good solutions," and "I have little to contribute (R)."

Divergent thinking ability was assessed using pair of exercises adapted from the Torrance Tests of Creative Thinking (TTCT) (Torrance, 1972). A brief, two-minute "unusual uses" task (i.e., Guilford's battery; Guilford, 1967), in which participants are asked to come up with as many uses as possible for tin cans was presented first, followed by a three-minute "consequences" task, in which participants were asked to list as many consequences as possible if people could no longer use their hands or arms. These tasks have been used extensively in the study of creativity, and are well-validated.

Team members' orientation toward computers and technology was assessed using the *Personal Innovativeness in the Domain of Information Technology (PIIT)* Scale (α =.84). This scale is a four-item measure on a five-point Likert scale, with anchors ranging from "Strongly

Disagree" to "Strongly Agree" (Agarwal & Prasad, 1998). To further assess computer orientation, Agarwal and Karahanna (2000)'s measure of cognitive absorption ($\alpha = .90$) when using computers was adapted to the present study. Originally developed to measure orientation toward the World Wide Web, this scale was adjusted to include any new technology as the referent. It is a nineteen item measure, on a five-point Likert scale, with sample items including "Time appears to go by very quickly when I am using a new technology," While working with technology I am able to block out most other distractions," and "Using new technologies provides me with a lot of enjoyment." Finally, a seven-item version of Webster and Martoccio's (1993) computer playfulness scale ($\alpha = .72$) was included. This instrument was also measured on a five-point likert scale, with anchors ranging from "Strongly Disagree" to "Strongly Agree." Sample items include "When using computers, I am imaginative" and "when using computers, I am playful."

Team conflict was assessed using measures of task conflict ($\alpha =.87$) and relationship conflict ($\alpha =.92$) adapted from Jehn (1995). Both scales were measured on a five-point likert scale, with anchors anchors ranging from "Strongly Disagree" to "Strongly Agree." Sample items for task conflict include "Members of my team often disagree about opinions regarding the work being done" and "There frequently are conflicts about ideas in my team." Sample items for relationship conflict include "There is tension among members in my team" and "There are personality conflicts among members in my team."

Team climate for innovation was assessed using a short form of the *Team Climate Inventory* (Anderson & West, 1998). This thirty-eight item scale was measured on a five-point Likert scale, with anchors ranging from "Strongly Disagree" to "Strongly Agree." Subscales for this measure include vision (α = .94), participative safety (α = .89), support for innovation (α = .92), task orientation (α = .92), and interaction frequency (α = .84).

Team cohesion was assessed using the "Task Cohesion" subscale (α = .74) of the *Group Environment Questionnaire* (Carless & DePaola, 2000). This is a four-item measure, on a five-point Likert scale, with anchors ranging from "Strongly Disagree" to "Strongly Agree." Team viability was measured using the viability scale of the *Team Effectiveness Form*. This scale is a fourteen item measure, on a five-point Likert scale, with anchors ranging from "Strongly Disagree" to "Strongly Agree."

Analyses

Prior to conducting analyses, response rates for the three surveys were examined, and teams for which there was never greater than one member responding were removed from the dataset. Following this step, analyses of the effects of individual differences on team creative performance and individual-level perceptions of team dynamics were conducted using linear regression procedures. In order to examine the actual effects of individual differences on team task and relationship conflict, multilevel analyses were conducted using multilevel modeling (HLM, Bryk & Raudenbush, 2002). More specifically, because individuals operate within broader teams, it will be necessary to account for this potential lack of independence among study participants and limit the potential for increased type 1 error.

Prior to conducting team-level analyses, agreement among team members on team conflict and team climate variables was assessed via ICC(2). All ICC values were greater than 0.70, providing justification for aggregation. Furthermore, results from multilevel analyses also support for aggregation, as a substantial portion of variance in task and relationship conflict was found to be due to differences between teams (31% and 21%, respectably). As such individual team members' ratings of team dynamics and team climate were averaged to create team-level aggregates.

In order to test for the proposed mediated relationships among individual differences, team conflict, and team climate, path models were tested using structural equations modeling in AMOS (IBM SPSS AMOS 19).

Results

Correlations and descriptive statistics for Means, standard deviations, and item correlations for all items at the individual level and team level are presented in Tables 1 and 2, respectably. Additionally, Table 2 contains ICC2 values for all aggregated constructs. As expected, sub-facets of the various individual-level personality constructs correlated relatively highly with one another. At the individual-level, self-efficacy was negatively correlated with perceived team task conflict ($r = -.258, p <.001$); the *prudence* sub-facet of was negatively related to perceived relationship conflict conscientiousness ($r = .18, p <.05$), and *computer playfulness* was positively related to perceived relationship conflict ($r = .19, p <.05$). With regard to performance outcomes, the creative performance dimensions of *quality* and *originality* were found to have a moderate, positive relationship with one another ($r = .46, p<.001$). No individual-level predictors were significantly correlated with project quality, while *self-efficacy* ($r = -.19, p<.05$) and perceived *task conflict* ($r = .19, p<.05$) were both negatively correlated with project originality.

At the team level, *relationship conflict* and *task conflict* were relatively highly correlated ($r = .62, p<.001$). *Relationship conflict* was negatively correlated with several team climate variables, including *participative safety* (r = *-.59, p<.001*), *shared vision* (r = *-.32, p <.05*) and *team viability* (r = *-.53, p <.001*). *Task conflict* was similarly negatively related to *participative safety* (r = *-.59, p <.001*), *shared vision* (r = *-.37, p <.01*), and *team viability* (r = *-.60, p <.001*). *Task conflict* was also positively related to the creative performance outcome of *originality* (r = *.28, p <.05*), while *relationship conflict* was not significantly correlated with either facet of creative performance.

Insert Table 1 about here

Insert Table 2 about here

Recall that hypothesis 1 predicted that individual-level differences will be related to team creative performance. To examine these proposed effects, linear regression analyses were conducted in which the sub-facets of creative performance (project quality and project originality) were each regressed on all individual-level predictors.

The combined individual differences predicted a substation proportion of variance in project quality ($R^2 = .47$; $R^2_{adj} = .25$). As anticipated, *divergent thinking: flexibility* ($\beta = 1.17$, $p<.001$) was positively related to project quality. *Divergent thinking: originality* had a marginally significant relationship with project originality ($\beta = .41$, $p<.10$). However, *divergent thinking: fluency* was negatively related to project quality ($\beta = -.997$, $p<.01$). Also surprisingly, *self-efficacy* ($\beta = -.43$, $p<.05$) was negatively related to the creative performance dimension of project quality. Also surprising, *openness to experience: creativity* demonstrated an unexpected, marginally significant negative relationship with quality. (*β = -.33, $p<.10$). Agreeableness: flexibility* was marginally related to originality *(β = -.30, $p<.10$).* No other individual differences were significantly related to project quality. *Team size* was also included as a covariate, and was not fond to influence the above results. A summary of the standardized regression coefficients for all individual-level predictors of project quality is presented in Table 3.

Insert Table 3 about here

Next, a linear regression analysis was conducted in which the creative performance dimension of originality was regressed on all individual-level predictors. For this dimension, the set of predictors explained a much smaller proportion of variance in the construct ($R^2 = .34; R^2_{adj} = .07$). The only individual-level predictor of originality to reach conventional levels of significance was *self-efficacy* ($\beta = .38, p<.01$). *Extroversion: expressiveness* ($\beta = .41, p<.10$), and *divergent thinking: fluency* ($\beta = .66, p<.10$) both had marginally significant relationships with originality. A summary of the standardized regression coefficients for all individual-level predictors of project originality is presented in Table 4.

Insert Table 4 about here

In sum, Hypotheses set 1 received only minimal support. Hypothesis 1a was partially supported, in that divergent thinking ability were positively related to project quality (flexibility, originality) and project originality (fluency), but fluency exhibited a surprising negative relationship with project quality. Hypothesis 1b was unsupported, and Hypothesis 1c received minimal support; although conscientiousness: prudence exhibited the expected relationship with project quality, no other dimensions were significantly related to either project quality or originality. Hypothesis 1d was also unsupported; no element of openness to experience was related to originality, and the openness sub-dimension of creativity was in fact negatively related to project quality. Hypothesis 1e received mixed support; although self-efficacy was positively related to project originality, it was surprisingly negatively related to project quality. Additionally, there were also unexpected positive relationships between sub-facets extroversion both originality and quality. The remaining variables tested as part of hypothesis set 1 exhibited no significant relationship with either quality or originality.

Hypothesis 2 predicted that individual differences will drive task and relationship conflict within the team. To test this hypothesis, multilevel analyses were conducted to examine the relationships between team member individual characteristics and team task and relationship conflict. First, in order to individual characteristics that may impact team conflict (and were therefore worth including in a multilevel model), hierarchical stepwise regression analyses were conducted, in which individual-level *perceptions* of task and relationship conflict were regressed on the complete set of individual differences.

The set of predictors accounted for a large proportion of variance in perceived task conflict ($R^2 = .42$; $R^2_{adj} = .35$). Significant predictors of such perceived conflict were *divergent thinking: originality* ($\beta = .29$, $p<.05$), *self-efficacy* ($\beta = -.48$, $p<.001$), *conscientiousness: perfectionism* ($\beta = .45$, $p<.01$), and *openness to experience*: *unconventionality* ($\beta = .28$, $p<.05$). Team size was included as a covariate, and was not found to influence perceptions of task conflict. The complete results of this regression analysis are presented in Table 5.

Insert Table 5 about here

The same set of predictors was entered into a hierarchical stepwise regression to predict perceived relationship conflict. Again, the set of predictors accounted for a large proportion of variance in the dependent variable ($R^2 = .63$; $R^2_{adj} = .55$). Significant predictors of perceived relationship conflict were *divergent thinking: fluency* ($\beta = .87$, $p<.001$), *self-efficacy* ($\beta = -.53$, $p<.001$), *computer playfulness* ($\beta = .29$, $p<.01$), *conscientiousness: perfectionism* ($\beta = .34$, $p<.05$), *openness: unconventionality* ($\beta = .20$, $p<.05$), *agreeableness: flexibility* ($\beta = -.32$, $p<.05$), and *agreeableness: patience* ($\beta = .29$ $p<.05$). *Divergent thinking: flexibility* ($\beta = -.39$, $p<.10$) and *divergent thinking: originality* ($\beta = -.30$, $p<.10$) were both marginally significant. When included as a control variable, team size was not found to influence perceived relationship conflict. The complete results of these regression analyses are presented in Table 6.

Insert Table 6 about here

Based on these hierarchical regression analyses, individual differences were selected that appear to influence individuals' perceptions of task and relationship conflict. It was expected that similar factors would influence actual, team-level conflict, and as such, variables from this identified pool were selected as inputs for multilevel models of team task and relationship conflict.

Multilevel modeling was conducted using Hierarchical Linear Modeling (HLM) (Bryk & Raudenbush, 2002). For team-level task conflict, *self-efficacy*, *conscientiousness: perfectionism*, *personal innovativeness in information technology*, and *openness to experience: originality* were entered as the individual-level predictors. Overall, 79% of the variance in task conflict was found to be due to individual-level differences. Of those tested, *self-efficacy* (γ = *-.82, p<.001), -conscientiousness: perfectionism* (γ = *.30, p<.01), and personal innovativeness in information technology* (γ = *.16, p<.05)* were found to be significant predictors of team-level task conflict.

For team-level relationship conflict, *computer playfulness*, *self-efficacy*, and *divergent thinking: fluency* were entered as individual-level predictors. Together, individual-level differences accounted for 69% of the variance in the team-level construct. Of the variables included in the model, *computer playfulness (*γ *= .28, p<.01)* and *self-efficacy* (γ = *-.55, p<.05)* emerged as significant predictors of team-level relationship conflict.

A summary of the multilevel modeling results for both team task and relationship conflict is presented in Table 7.

Insert Table 7 about here

In summary, hypothesis set 2 received mixed support. Hypothesis 2f was supported, as individual-level self-efficacy was negatively related to both team-level task and relationship conflict. Hypothesis 2a and 2b were not supported, as neither individual-level divergent thinking nor individual-level openness to experience were found to be significant predictors of team-level task or relationship conflict. Hypothesis 2c received partial support; the conscientiousness sub-facet of perfectionism was positively related to task conflict, but no dimension of conscientiousness was related to relationship conflict. Hypothesis 2d and 2e were unsupported, as neither extroversion nor agreeableness were related to either team-level task or relationship conflict. Finally, Hypothesis 2g was not supported, as personal innovativeness in information technology was not related to team-level task conflict, and computer playfulness was positively related to team-level relationship conflict.

While the HLM models demonstrated that a large proportion of variance in team-level task and relationship conflict is due to individual-level differences, it does not account for the proposed relationships between such conflict and team-level creative performance. With regard to these effects, hypothesis 3 predicted that team creative performance would be primarily influenced by the development of a team climate for innovation. Furthermore, hypothesis 4 predicted that team climate for innovation would mediate the effect of team task and relationship conflict on team creative performance. In order to test these proposed relationships, a set of structural equation models were tested in SPSS AMOS 19.0, in which team climate variables mediate the relationship between team-level task and relationship conflict and team creative performance.

As an initial step, the direct effects of team task and relationship conflict on team creative performance were tested via hierarchical regression analyses. First, project quality was regressed on task conflict and relationship conflict. This model did not explain a significant proportion of variance in project quality ($R^2 = .002; R^2_{adj} = -.04$) and neither task conflict ($\beta = .05, ns$) nor relationship conflict ($\beta = -.004, ns$) emerged as significant predictors. Next, project originality was regressed on these same pair of conflict variables. These predictors explained a nontrivial proportion of variance in originality ($R^2 = .08; R^2_{adj} = .05$). Furthermore, while relationship conflict was not related to originality ($\beta = -.03, ns$), task conflict exhibited a marginally significant relationship with this facet of creative performance ($\beta = .30, p < .10$).

An initial saturated model was constructed, in which all paths between team conflict and team climate variables were estimated, along with all paths between these climate variables and team creative performance. A depiction of this model is presented in Figure 2a. In examination of the fit statistics for this model, the overall fit was judged to be poor (X^2 *= 233.66, p<.001; RMSEA = .45; CFI = .33*). As such, a reduced model was tested, in which only paths that had been identified as significant in the full model were estimated. This reduced model is presented in Figure 2b. As with the full model, the overall fit of this model to the data was judged to be poor (X^2 *= 242.29, p<.001; RMSEA = .35; CFI = .34*)

Insert Figure 2a about here

Insert Figure 2b about here

Overall, Hypothesis 3 received minimal support. Hypothesis 3a was unsupported, in that team cohesion was surprisingly *negatively* related to both project quality and project originality. Hypothesis 3b received mixed support. Support for innovation was positively related to both facets of creative performance, but shared vision was negatively related to both facets of creative performance, and participative safety was unrelated to project quality, and negatively related to project originality.

Hypotheses 4a and 4b likewise received minimal support. While *task* and *relationship conflict* were found to be negatively related to both *participative safety* and *team viability*, and *task conflict* was negatively related to *shared vision*, the other expected relationships between the proposed predictors and mediators were not found. Coupled with the above minimal support for the relationship between the proposed mediators and dependent variables, sufficient evidence for mediation could not be established within this SEM framework.

The poor fit of the SEM models suggests that there is an alternate explanation for the identified relationship between task conflict and creative performance, in particular on the dimension of originality. While the significant paths from *support for innovation* to the creative performance outcomes were positive (as expected), *cohesion*, *shared vision*, and *participative safety* were all negatively related to creative performance outcomes. Further, exploratory analyses were required in order to begin explaining these unexpected relationships. While the negative relationship between cohesion and creative outcomes is perhaps not surprising, given some of the extant literature on cohesion (c.f., Gully et al., 2002; Hunter et al., 2011), the negative relationship between participative safety and originality is counter to much of the literature on team climate for innovation (c.f. Anderson & West, 1998; Edmonson, 1999; West, 1990), and warrants further examination.

One potential explanation for this relationship could be an interaction between participative safety and task conflict, such that the relationship between participative safety and originality is different depending on the amount of conflict within the team. In order to test this, a hierarchical stepwise regression was conducted, in which project originality was the dependent variable. *Task conflict* and *participative safety* were entered in the first block of the regression, and an interaction term was computed and entered into the second block. This model accounted for a significant proportion of variance in project originality ($R^2 = .22; R^2_{adj} = .17$). Furthermore, while both *participative safety* ($\beta = -3.71, p < .01$) and *task conflict* ($\beta = -2.28, p < .01$) were negatively related to project originality, the interaction term demonstrated a strong, positive relationship with originality ($\beta = 4.60, p < .01$). Taken together, these findings suggest support for the proposed interaction between participative safety and task conflict; in teams with low levels of task conflict, there is a negative relationship between participative safety and originality. However, at higher levels of task conflict, the there is a strong, positive relationship between *participative safety* and *originality*. A summary of the regression coefficients for this exploratory analysis are presented in Table 8, and a graph of the interaction is presented in Figure 3. In order to aid interpretability of the interaction effect, values were standardized prior to graphing.

Insert Table 8 about here

Insert Figure 3 about here

Discussion

Summary of Findings

The purpose of the present study was to identify individual and team-level factors that influence team creative performance. Overall, the results of this study portray the process of team creative performance as highly complex, consisting of relationships among individual and team-level constructs that change and develop as a result of team members' continued interactions with one another.

Individual-level differences had limited direct effects on team-level creative performance, but multi-level analyses showed that number of these individual differences were predictive of team-level task and relationship conflict. In turn, structural equation models provided evidence that such conflict is related to several elements of team climate for innovation, particularly participative safety, shared vision, team viability. Of the climate variables, support for innovation, participative safety, shared vision, and team cohesion were all related to team creative performance.

However, several of these findings were quite surprising, in that the observed relationships were negative. Such unanticipated results demand further examination, and so preliminary exploratory analyses were conducted to explicate these unexpected relationships. In particular, a strong interaction effect was found between participative safety and team task conflict. This effect constitutes an especially noteworthy contribution, and will be discussed in detail later.

Individual Differences and Creative Performance

Regarding the relationships between individual differences and team conflict, several interesting patterns emerged, including some that were not anticipated by the study's hypotheses. For ratings of project quality, the prudence sub-dimension of conscientiousness was found to be positively related to team-level project quality. This is to be expected, as prudent individuals tend to be quite practical, and likely to adhere to the status quo (Ashton, Lee, & Goldberg, 2007; Lee & Ashton, 2004). Though this is unlikely to aid in project originality, for the facet of quality, "playing it safe" is will result in solutions that, while perhaps overly straightforward, are likely highly effective.

Quite surprisingly, individual-level self-efficacy was *negatively* related to quality. One potential explanation is that, since self-efficacy is associated with a belief that the individual has the wherewithal to handle problems on his or her own (Bandura, 1982), he or she may elect to work primarily independently, instead of with the group. This may lead to the individual's ideas not being well-integrated with the group's product, resulting in a lower rating of team-level project quality.

The flexibility sub-dimension of agreeableness was also negatively related to team creative performance. This is perhaps understandable, in that this dimension is associated with a willingness to compromise and yield to the ideas of others (Lee & Ashton, 2004). This may result in agreeable members allowing sub-par ideas to become incorporated into the final project, rather than inciting an argument.

Additionally, though not part of a formal hypothesis, the sociability dimension of extroversion was positively related to project quality. Since this personality characteristic is associated with enjoying conversation and interactions with others (Lee & Ashton, 2004), it is likely that individuals high on this dimension will share ideas and solicit feedback through conversation more readily. This exchange of information is likely associated with better integration of ideas among team members, leading to a more cohesive final project.

Perhaps unexpectedly, the creativity sub-dimension of openness to experience was found to be negatively related to project quality. Since quality was assessed as a facet of team creative performance, this result may initially appear confusing. However, when examined more closely, this specific sub-dimension of openness to experience is associated with thinking and proposing novel, unexpected ideas (Ashton, Lee, & Goldberg, 2007; Lee & Ashton, 2004) Such ideas, while highly original, may not be the most effective. Moreover, this dimension is associated with individuals who seek out novel solutions and desire to experiment (Lee & Ashton, 2004). It could be that individual high on the creativity sub-facet of openness to experience seek to experiment throughout the design process, attempting to introduce novel elements into the design even at late stages in the creative process, when the goal should be focusing on practical issues and implementation of the design. Such experimentation may result in derailment that could potentially undermine the ultimate quality of the final product. However, given the structure of this present study, this potential effect could not be tested, as the relative influence of each individual in the team could not be assessed across the creative process.

For divergent thinking, both originality and flexibility were positively related to project quality, as was expected. The positive relationship between the originality facet of divergent thinking and project quality may initially appear to be in contradiction to the aforementioned negative relationship between the creativity facet of openness and quality, but further examination reveals that a key distinction is that divergent thinking is focused on the *generation* of novel ideas (Guilford, 1967), and not necessarily the *pursuit* of such ideas. Therefore, this dimension is likely to exert an influence early in the creative process, when the team is attempting to generate ideas to pursue. Early in the creative process, the range of unusual, unexpected ideas produced by individuals high in this dimension of divergent thinking are likely become integrated into solutions that address the given problem in unexpected, but effective ways.

For flexibility, the interpretation is more straightforward; flexibility is associated with the ability to generate multiple distinct groups of ideas, and to pursue different streams of ideas simultaneously (Guilford, 1967). This ability likely allows individuals to approach multiple elements of a design problem and integrate design considerations from different perspectives, potentially leading to higher quality solutions.

Unexpectedly, although the previous two dimensions of divergent thinking were positively related to project quality, fluency exhibited a negative relationship. Though this was unexpected, it can perhaps be understood in that this dimension of divergent thinking is simply associated with an individual's ability to produce a large *quantity* of ideas, irrespective of their quality or originality. As such, this dimension, particularly in absence of other beneficial characteristics, may be associated with providing a large number of lower-quality ideas early in the creative process, potentially saturating the group and preventing more effective ideas from coming to the fore.

Fewer individual-level predictors of project originality emerged. First, unlike for project quality, individuals' self-efficacy was found to be positively related to project originality. Given the ambiguous nature of creative problem solving (Lubart, 2001), this relationship was unsurprising. Individuals high in self-efficacy have a great deal of confidence in their own abilities (Bandura, 1982) and likely have what it takes to overcome this ambiguity and inject structure into the design process. Since this structure will by nature be self-imposed, individuals high in self-efficacy likely create more surprising, unusual connections between concepts, in contrast to individuals lower in self-efficacy, who likely need to rely more on external resources or other people to solve these problems.

The expressiveness sub-dimension of extroversion also emerged as a significant, positive predictor of originality. Expressive individuals tend to present themselves as excitable and dramatic (Lee & Ashton, 2004), and are therefore better able to get others excited about unconventional ideas, which can be spun to sound more intriguing and thus more likely to succeed than they would if proposed by less expressive individuals. Excitement induced by expressive individuals is likely associated with getting the team to rally around and embrace unusual ideas, which are therefore more likely to survive the design process to make it into the final design.

Finally, the divergent thinking sub-dimension of fluency was also found to positively predict project originality. Although fluency was found to be negatively related to project quality, simply generating a large number of ideas is likely still to positively impact project originality, since having more ideas to pick from increasing the likelihood of original ideas making it into the final design. However, it is important to remember that while some of these ideas may be original, it does not mean that they are effective or useful, thus again accounting for the negative relationship between fluency and project quality. In essence, producing a large number of ideas early in the creative process is associated with the development of projects that are more unusual and unexpected, but overall less effective than projects that were developed via a more focused idea generation process.

Individual Differences and Team-Level Conflict

Regarding individual-level predictors team conflict, the expected negative relationships between self-efficacy and task conflict and relationship conflict were observed. As expected, it is likely that individuals high in self-efficacy believe that they have the ability to overcome adversity (Bandura, 1982), which may include both task-related and interpersonal disagreements within the team. From this perspective, the negative relationships between self-efficacy and team conflict makes intuitive sense.

The positive relationship between the perfectionism facet of conscientiousness and team task conflict was also unsurprising. Although other facets of conscientiousness did not emerge, the effect of this element makes sense, as it is associated with thoroughness and intolerance for error (Lee & Ashton, 2004). Individuals high in this dimension are likely to openly disagree with other team members when they do not feel the team is proceeding toward the ideal solution.

Unexpectedly, one element of computer orientation, personal innovativeness in information technology, exhibited the expected positive relationship with team task conflict, the other facets relating to cognitive absorption when using computers did not. This may be due to the fact that individuals who become highly absorbed in technology focus simply on using the technology for its own sake (Agarwal & Karahanna, 2000), not using it to inject new methods or ideas into the team. Furthermore, the results show some evidence that this absorption may actually have a negative impact, as was seen in the relationship between computer playfulness and relationship conflict.

More specifically, although most of the expected predictors of relationship conflict did not emerge, the computer playfulness sub-facet of computer orientation emerged as being positively related to team relationship conflict. However, upon further examination, this relationship is perhaps less surprising than would be expected. Conceptually, computer playfulness describes individuals who enjoy using computers for their own sake (Agarwal & Karahanna, 2000), and not to address problems or design issues the team is dealing with. Such individuals may be seen as not pulling their weight, or slacking off, and as such, can potentially generate animosity within the team.

Team Conflict, Team Climate, and Team Creative Performance

Having examined the influences of individual characteristics on team-level task and relationship conflict, it is now important to consider the mechanisms by which such conflict impacts team creative performance. However, a lack of support for the overall expected mediated relationships between team conflict and team creative performance means that it is necessary to look at the components of the proposed mediation model in more detail, to determine where potential effects may lie.

It is noteworthy that no predictors or outcomes of team task orientation were identified and, as such, it is thought to not be a variable of concern in the team conflict-team performance relationship. Additionally, while team viability was predicted by both task and relationship conflict, its lack of relationship to team creative performance suggests that it does not have a meaningful place in the model as defined here. Perhaps the effects of team viability on performance would become clearer if teams were required to work together for multiple full projects, over a longer span of time. Regarding those climate variables that were found to predict creative performance, the lack of identified predictors of some of these variables (support for innovation and team cohesion), suggests that there are other causal influences on these team dynamics which should be examined further in future research. However, despite being somewhat incomplete, the results of the present study bear several noteworthy findings.

First, team task conflict was found to have a non-trivial, positive relationship with the originality dimension of team creative performance. Since task conflict is associated differences of opinion and ideas regarding a team's work (Jehn, 1995; Jehn & Mannix, 2001), it is likely that such conflict is associated with increased variability in ideas and proposed directions within team, leading to the development of more original solutions. Such a finding is in line with a portion of the task conflict literature (c.f., Chen, 2006; DeChurch & Marks, 2001; Gully et al., 2002; Isaksen, Lauer, & Ekvall, 1999; Zellmer-Bruhn & Gibson, 2006). However, task conflict was not found to have a direct relationship to project quality. With regard to this dimension of creative performance, while increased disagreement about team tasks and ideas may help with the development of more original solutions, such lack of consensus will not help team members ultimately not help individuals integrate their ideas in a way that is more effective than teams with lower levels of conflict. In contrast to task conflict, team relationship conflict was not related to project quality or project originality. However, such conflict was related to team climate variables, particularly participative safety, and therefore may exert indirect effects on creative performance.

Although task and relationship conflict did not exhibit all of the expected relationship with team creative performance, such conflict still exerts an influence on these outcomes by impacting the development of a team climate for innovation. While not all of these relationships were in the expected directions, they are worth examining more closely. As expected, team task conflict was found to be negatively related to the climate dimensions of participative safety, shared vision, and team viability. Similar to task conflict, while several expected relationships were not found, there were still unsurprising, negative relationships between relationship conflict and participative safety and between relationship conflict and team viability. In essence, disagreement among team members, be it conflict about team tasks or interpersonal quarrels, can serve to undermine a team climate for innovation.

While not necessarily surprising, such findings are important, given the relationships between team climate variables and team creative performance. As expected, team support for innovation was positively related to both project quality and originality. Given that support for innovation is associated with teams that actively encourage novel approaches to problem solving (Anderson & West, 1998; West, 1990), it makes sense that teams high in this dimension would excel in both aspects of team creative performance.

Less expected, team cohesion was found to be negatively related to project quality, and unrelated to originality. Though counter to what was predicted, this finding can still be readily explained. Specifically, Hunter and colleagues (2011) note that high levels of cohesion may impair creative performance by reducing team members' willingness to violate the status quo and introduce disagreement into the team. Since a degree of problem-focused disagreement can help enhance creative performance (Isaksen, Lauer, & Ekvall, 1999), this finding is quite understandable.

Additionally, shared vision was negatively related to both dimensions of team creative performance. Although this effect appears counterintuitive, the nature of the sample used in this study may account for this finding. Specifically, shared vision is associated with team members possessing a unified set of long-term goals regarding innovation (Anderson & West, 1998). In this study, team members were ultimately only working together for a single semester, and thus may not have had time to pursue such a long-term vision. With regard to project quality, teams with a strong vision for innovation may not be able to make sufficient project toward their grand goals within the span of the project, and may experience frustration and discontent that leads to them ultimately putting less effort into their performance. In terms of originality, it could be that, in the short-term, sharing a common vision results in a team who focuses too closely on one possible outcome, reducing the variety of ideas shared within the team and ultimately limiting project originality.

Most unexpectedly, participative safety exhibited a strong negative relationship with ratings of project originality. Such a finding is counter to much of the work on team climate and creative performance (e.g., Anderson & West, 1998, Edmonson, 1999; West, 1990). This surprising effect is likely best understood by the identified interaction between participative safety and task conflict, which will now be discussed in detail.

Exploratory Findings

Initial examination of the team-level task conflict revealed a direct, positive relationship with ratings of project originality. Further examination revealed that task conflict was negatively related to several team climate variables, particularly participative safety. While this finding is largely counter to the literature on participative of psychological safety (e.g., Anderson & West, 1998; Edmonson, 1999; West, 1990), it is thought that complacency may be a driving force behind this unexpected effect. Specifically, although such safety is associated with a climate in which team members feel comfortable sharing novel ideas and criticizing one another in a constructive manner (Anderson & West, 1998; Edmonson, 1999), teams high on this dimension may not necessarily feel *compelled* to do so. In fact, similar to the potential detrimental effects of high levels of team cohesion, teams in which members feel extremely safe with one another may be characterized by a lack of desire to incite disagreement.

In this way, the positive interaction of participative safety and task conflict on project originality is far more understandable; task conflict moderates the relationship between participative safety and project originality, such that when teams are high in participative safety but low in task conflict, originality will be low, due to complacency and a lack of desire to deviate from the status quo.

When teams similarly high in participative safety also have a high level of task conflict, task-related disagreement will be viewed as constructive (Edmonson, 1999), and will spur team members to integrate these disparate ideas into more original solutions. Such an effect is not without support in the extant literature. For instance, a recent study by Chen (2006) proposed that psychological safety and task conflict may interact, such that task conflict may lead to high levels of team performance when psychological safety is also high. Examination of such interactions is likely a fruitful avenue for research in team creative performance, and warrants continued examination.

Implications for Research and Practice

With regard to contributions to future research, the present study points to a need to team climate not being a set of variables with stable, positive relationships to creative performance. Instead, these variables warrant examination in interaction with one another, and with other team dynamics, such as team conflict. Various bodies of literature examine sets of such dynamics in isolation, but in order to understand how they impact creative performance, more comprehensive analyses are required. Furthermore, team creative performance cannot be effectively assessed solely in terms of a single outcome, and is best conceptualized as a process.

Future effective research in this area should therefore emphasize longitudinal designs, in which teams' experiences are allowed to exert interactive, even recursive effects, with performance and team dynamics at one stage impacting both the continued development of team climate and also the trajectory of team creative performance. Such a recommendation is in line with Ilgen and colleagues' (2005) IMOI model of team creative performance, as well as Mumford and colleageues' (e.g., Mumford, et al, 1991; Baughman & Mumford, 1995; Mumford et al. 1996, 1997) model of the creative process.

In terms of implications for practice, these findings suggest that effective teams require a great deal of careful balance. Traits that are commonly thought to have either positive or negative effects on individual creative performance may exhibit wholly different effects at the team level, and team conflict and climate can also have quite complex relationships with performance. If organizations are to foster successful creative teamwork, special care must be paid to not only to seeding teams with members whose personality traits orient them toward creative work, but also to cultivate an environment creative performance is likely to arise. Such an environment should not involve only the fostering of a climate of participative safety or encouraging team members to share ideas with one another; within the context of the team, either of these elements without the other is likely to hurt creative performance.

Limitations and Future Directions

In spite of the contributions of this study, there are still some limitations that must be addressed. First, the use of a student sample was perhaps not ideal. Although individuals in this study worked on in-depth design tasks, they likely do not have the variability in knowledge and skills that may be seen in a true field sample. This may have restricted the range of several individual differences, limiting their impact on other measured variables.

Also relevant to the student sample, the projects that teams undertook were ultimately class assignments. In the present sample, certain constraints may have been imposed for the purposes of the assignment, which may have impacted how teams navigated the tasks in ways that were not able to be assessed. Furthermore, since the sample was drawn from several different courses, different constraints may have been imposed in different classes, potentially impacting ratings of team performance.

Additionally, the response rates within teams must be noted as a possible limitation. While every effort was made to obtain a viable response rate to each survey, the rate of response within each team was quite variable. While this was accounted for by removing teams with only one respondent, meaningful data were likely lost this way. Furthermore, there may have been something quantitatively different about team members who chose not to respond to surveys, which could potentially lead to a biased interpretation of team-level data. Future studies should endeavor to obtain a greater intra-team response rate.

Furthermore, ratings of creative performance were not found to vary systematically by course, but the nature of these ratings makes it difficult to be certain that there was no such effect. Since ratings were conducted by individuals without specific engineering expertise, it is possible that raters overlooked design elements that may have been indicative of varying levels of quality or originality to a more expert coder. All efforts were made to base ratings on a consistent set of criteria, but it is still a possibility that such oversights may have occurred. Future study should ideally include coders with domain-specific expertise, as these individuals would be able to make more fine-grained assessments of creative performance.

Also relevant to the assessment of creative performance, it is worth noting that the projects assessed in this study were not necessarily the true final products produced by the teams, but instead proxies in the form of reports and presentations that the teams composed about their projects. While these reports contained a great deal of detail, and were intended to explain both the components of the final product and the process followed, having access to physical prototypes or models of teams' designs would have allowed for more in-depth assessment of creative performance. Future research in this domain would certainly benefit from obtaining such tangible products.

Perhaps more importantly, although teams were assessed longitudinally, due to class time constraints, there was limited opportunity to survey team members throughout the semester. Therefore, particularly salient team experiences may have gone undetected in data collection efforts and analyses. Additionally, interactions between team members that occurred outside of class could not necessarily be assessed, but such events would likely exert an influence over the development of team dynamics. Future study should attempt to examine team interactions and the effects of team conflict at a closer level, potentially in the form of a diary study of team creative performance. Additionally, in light of the potential difficulty in controlling for interactions outside of class, it may be worthwhile to examine aspects of the relationships among individual differences, team dynamics, and creative performance in a more controlled, laboratory setting.

Finally, and most importantly, temporal limitations may have impaired the ability to collect data and accurately interpret the effects of team performance over time. While this study examined team interactions longitudinally, creative performance data was only collected at the end of the team's interaction. Future studies should endeavor to collect performance data throughout the team process, as well as across successive projects. Furthermore, the processes as depicted in this study are assumed to be linear, when this is likely not the case. Literature on the creative process (e.g., Mumford, et al, 1991, 1996, 1997) indicates that there are recursive loops between process stages, which were not captured by the present study. Collecting more frequent performance data could therefore give insight into how team dynamics shape day-to-day performance, as well as how momentary performance may further influence team conflict and team climate.

Bearing these limitations in mind, the present study still makes a noteworthy contribution to the literature on team creative performance, underscoring multilevel influences on such performance, as well as the need to examine such influences across time.

Appendix: Tables and Figures

Table 1. *Descriptive statistics and correlations for individual-level variables.*

		Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Age	20.30	1.51	1															
2	Gender	1.16	0.26	-.267**	1														
3	Conscientiousness: Diligence	3.78	0.33	-.001	.055	1													
4	Conscientiousness: Perfectionism	3.73	0.35	.086	.018	.687**	1												
5	Conscientiousness: Prudence	3.42	0.33	.090	-.022	.609**	.504**	1											
6	Extraversion: Expressiveness	2.89	0.40	.067	.075	.210**	.132	.005	1										
7	Extraversion: Sociability	3.68	0.31	-.051	-.117	.176*	.133	.070	.640**	1									
8	Agreeableness: Flexibility	3.07	0.25	-.048	-.138	.018	-.204**	.215**	-.001	.154	1								
9	Agreeableness: Patience	3.54	0.45	-.045	-.002	.035	-.058	.230**	-.232**	.026	.593**	1							
10	Openness: Creativity	3.64	0.31	.199*	-.203**	.218**	.392**	.214**	.232**	.247**	.083	.082	1						
11	Openness: Inquisitiveness	3.40	0.30	-.026	-.016	.271**	.352**	.090	.219**	.221**	-.144	-.114	.305**	1					
12	Openness: Unconventionality	3.03	0.34	.082	.025	-.164*	-.035	-.270**	.081	-.181*	.006	-.082	.231**	.161*	1				
13	Personal Innovativeness in IT	3.40	0.42	.102	-.198*	.069	.244**	.151	.239**	.346**	.075	-.053	.402**	.237**	.090	1			
14	Cognitive Absorption	3.66	0.37	.002	-.155*	.051	.277**	.089	.056	.256**	-.038	.059	.284**	.026	.018	.527**	1		
15	Computer Playfulness	3.41	0.33	.101	-.230**	.103	.281**	.067	.163*	.262**	.000	-.030	.419**	.218**	.113	.699**	.599**	1	
16	Generalized Self-Efficacy	3.84	0.25	.125	-.079	.418**	.484**	.360**	.240**	.141	-.105	.082	.471**	.265**	.110	.238**	.158*	.255**	1
17	Perceived Relationship Conflict	3.00	0.85	-.114	.144	-.027	.091	-.178*	.089	.073	-.132	-.028	-.018	.071	.125	.150	.053	.192*	-.139
18	Perceived Task Conflict	3.14	0.69	-.215**	.031	-.021	.107	-.054	-.053	.020	-.132	-.122	-.082	.071	.089	.124	.047	.044	-.258**
19	Perceived Participative Safety	3.93	0.43	.236**	-.054	.138	-.018	.210**	.018	.098	.020	-.022	.199*	.000	-.107	-.113	.006	-.052	.312**
20	Perceived Support for Innovation	3.66	0.31	-.151	-.070	.045	-.109	-.022	.053	.213**	.199*	.091	.065	-.091	-.012	-.150	.068	.032	.075
21	Perceived Task Orientation	3.51	0.31	-.378**	-.012	.073	-.027	.031	.097	.260**	.084	-.051	.082	-.077	-.046	-.032	.187*	.104	.094
22	Perceived Shared Vision	3.79	0.35	-.178*	-.042	.245**	-.010	.059	.117	.222**	.218**	.031	.042	-.089	-.145	-.055	.030	.002	.152
23	Perceived Task Cohesion	3.00	0.83	-.580**	.151	-.073	-.142	-.127	-.028	.056	.046	-.008	-.178*	-.138	-.010	-.197*	.099	-.028	-.107
24	Perceived Team Viability	3.83	0.61	.186*	-.154	.039	-.112	.063	.020	.044	.004	.019	.200*	-.059	-.047	-.065	.020	.010	.297**
25	Divergent Thinking: Originality	4.61	2.94	-.494**	.203**	.124	.105	-.024	.096	.138	.085	.148	-.071	-.008	-.012	.039	.122	.030	.043
26	Divergent Thinking: Fluency	7.19	1.41	-.083	.095	.205**	.100	.036	.228**	.087	.026	.025	.048	.015	.052	.048	.081	.047	.125
27	Divergent Thinking: Flexibility	5.49	0.99	.176*	-.033	.150	.067	.003	.168*	.015	.027	-.006	.172*	.033	.166*	.003	-.046	.008	.133
28	Creative performance: Quality	3.25	1.22	.056	-.116	-.068	.001	.050	.018	.142	-.064	.032	-.094	.080	-.068	.096	.120	.056	-.125
29	Creative Performance: Originality	2.98	1.27	-.148	.026	-.065	.030	-.011	.073	.022	-.076	-.015	-.061	.100	.032	-.062	-.091	.010	-.192*

		17	18	19	20	21	22	23	24	25	26	27	28	29
17	Perceived Relationship Conflict	1												
18	Perceived Task Conflict	.539**	1											
19	Perceived Participative Safety	-.531**	-.546**	1										
20	Perceived Support for Innovation	-.130	-.268**	.378**	1									
21	Perceived Task Orientation	.010	-.069	.262**	.696**	1								
22	Perceived Shared Vision	-.149	-.257**	.328**	.633**	.641**	1							
23	Perceived Task Cohesion	.051	-.089	-.072	.470**	.610**	.473**	1						
24	Perceived Team Viability	-.429**	-.513**	.655**	.578**	.374**	.488**	.099	1					
25	Divergent Thinking: Originality	.146	.165*	-.273**	-.115	.073	-.036	.297**	-.271**	1				
26	Divergent Thinking: Fluency	.303**	.135	-.149	-.016	.045	.041	.079	-.167*	.561**	1			
27	Divergent Thinking: Flexibility	.197*	.047	-.092	.018	-.011	.023	-.064	-.055	.148	.768**	1		
28	Creative performance: Quality	.012	.029	-.060	.060	-.039	-.133	-.140	-.101	-.050	-.008	.080	1	
29	Creative Performance: Originality	.079	.188*	-.226**	.090	.044	-.111	.065	-.125	.013	-.025	.004	.456**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 2. *Descriptive statistics and correlations for team-level variables.*

		Mean	SD	ICC(2)	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Mean Age	20.30	1.51	X	1												
2	Mean Gender	1.16	0.26	X	-.380**	1											
3	Mean Conscientiousness: Diligence	3.78	0.33	X	.000	.090	1										
4	Mean Conscientiousness: Perfectionism	3.73	0.35	X	.079	.078	.683**	1									
5	Mean Conscientiousness: Prudence	3.42	0.33	X	.117	.084	.715**	.530**	1								
6	Mean Extraversion: Expressiveness	2.89	0.40	X	.161	.024	.292*	.174	.176	1							
7	Mean Extraversion: Sociability	3.68	0.31	X	-.074	-.010	.185	.089	.149	.708**	1						
8	Mean Agreeableness: Flexibility	3.07	0.25	X	-.016	.072	.100	-.241	.201	-.091	-.060	1					
9	Mean Agreeableness: Patience	3.54	0.45	X	-.080	.206	.083	-.192	.107	-.188	-.100	.507**	1				
10	Mean Openness: Creativity	3.64	0.31	X	.306*	-.107	.456**	.539**	.493**	.253	.131	.162	.084	1			
11	Mean Openness: Inquisitiveness	3.40	0.30	X	-.005	.102	.333*	.472**	.183	.177	.094	-.129	-.074	.289*	1		
12	Mean Openness: Unconventionality	3.03	0.34	X	.148	-.168	-.116	-.074	-.230	.185	-.004	-.067	-.022	.179	.169	1	
13	Mean Personal Innovativeness in Information Technology	3.40	0.42	X	.137	-.083	.187	.314*	.354**	-.028	.041	.149	.029	.409**	.236	.041	1
14	Mean Cognitive Absorption	3.66	0.37	X	-.023	-.078	.079	.151	.154	.071	.301*	-.011	.110	.132	-.158	-.066	.453**
15	Mean Computer Playfulness	3.41	0.33	X	.173	-.243	.201	.337*	.228	.177	.226	-.068	-.161	.405**	.179	.063	.770**
16	Mean Generalized Self-Efficacy	3.84	0.25	X	.266*	-.181	.599**	.572**	.402**	.373**	.117	-.121	.030	.565**	.231	.020	.139
17	Mean Divergent Thinking: Originality	4.61	2.94	X	-.726**	.397**	.081	.000	-.060	-.005	.140	.064	.217	-.165	.005	-.075	-.062
18	Mean Divergent Thinking: Fluency	7.19	1.41	X	-.084	.184	.282*	.159	.175	.308*	.179	.059	.201	.155	.139	.100	.024
19	Mean Divergent Thinking: Flexibility	5.49	0.99	X	.402**	-.134	.173	.133	.155	.249	.012	.135	.173	.344*	.188	.189	.049
20	Mean Relationship Conflict	3.00	0.85	0.78	-.064	.212	-.112	.124	-.128	.062	.057	-.279*	.020	-.026	.193	.273*	.208
21	Mean Task Conflict	3.14	0.69	0.86	-.344*	.223	-.074	.130	-.131	-.148	.039	-.161	.022	-.073	.198	.258	.204
22	Mean Climate: Participative Safety	3.93	0.43	0.74	.390**	-.246	.353**	.136	.361**	.219	.190	.030	-.130	.285*	-.108	-.156	-.111
23	Mean Climate: Support for Innovation	3.66	0.31	0.83	-.104	-.122	.155	-.088	.066	.243	.439**	-.036	.012	-.070	-.276*	-.044	-.336*
24	Mean Climate: Task Orientation	3.51	0.31	0.71	-.381**	.007	.166	.007	.125	.172	.504**	-.078	-.102	-.090	-.301*	-.171	-.170
25	Mean Climate: Shared Vision	3.79	0.35	0.81	-.111	-.123	.269*	-.030	.163	.106	.231	.210	.126	.040	-.381**	-.237	-.167
26	Mean Task Cohesion	3.00	0.83	0.75	-.654**	.204	-.242	-.309*	-.307*	.011	.261	-.133	-.009	-.383**	-.266*	-.055	-.287*
27	Mean Team Viability	3.83	0.61	0.82	.319*	-.306*	.233	.000	.276*	.185	.119	-.053	-.064	.255	-.138	-.114	-.140
28	Creative Performance: Quality	3.25	1.22	X	.111	-.191	-.010	.017	.167	.136	.313*	-.055	.029	-.046	.108	-.052	.129
29	Creative Performance: Originality	2.98	1.27	X	-.155	.020	.011	.086	.057	.169	.115	-.054	-.015	-.027	.231	.048	-.036

	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
14	1															
15	.566**	1														
16	.010	.217	1													
17	.089	-.176	-.118	1												
18	-.026	-.055	.231	.431**	1											
19	-.132	.015	.383**	-.142	.716**	1										
20	.138	.230	-.212	.178	.401**	.137	1									
21	.013	.060	-.290*	.322*	.163	-.080	.622**	1								
22	-.062	.034	.490**	-.423**	-.099	.112	-.592**	-.593**	1							
23	.076	-.059	.132	-.137	.052	.065	-.137	-.163	.436**	1						
24	.239	.087	.030	.132	.002	-.246	.009	.030	.235	.748**	1					
25	.094	-.046	.291*	-.071	-.002	-.037	-.320*	-.374**	.416**	.708**	.692**	1				
26	.171	-.124	-.280*	.407**	-.010	-.351**	.134	.093	-.280*	.422**	.636**	.405**	1			
27	-.011	.041	.474**	-.403**	-.197	.086	-.528**	-.597**	.808**	.549**	.313*	.499**	-.072	1		
28	.174	.158	-.107	-.056	.035	.191	.025	.044	.002	.120	-.034	-.197	-.211	-.053	1	
29	-.159	.078	-.182	.051	.088	.121	.155	.282*	-.236	.137	.080	-.170	.021	-.128	.493**	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 3. *Standardized regression coefficients for individual-level predictors of project quality.*

Model	β	t	Sig.
(Constant)		.420	.677
Computer Playfulness	.108	.481	.633
Generalized Self-Efficacy	-.427	-2.100	.042
Agreeableness: Flexibility	-.298	-1.709	.096
Agreeableness: Patience	.164	1.062	.295
Conscientiousness: Diligence	-.012	-.049	.961
Conscientiousness: Perfectionism	.096	.421	.676
Conscientiousness: Prudence	.399	1.943	.059
Extraversion: Expressiveness	.012	.056	.955
Extraversion: Sociability	.409	2.191	.035
Openness: Creativity	-.326	-1.696	.098
Openness: Inquisitiveness	-.001	-.009	.993
Openness: Unconventionality	-.004	-.031	.975
Personal Innovativeness in Information Technology	.086	.370	.713
Divergent Thinking: Originality	.410	1.971	.056
Divergent Thinking: Fluency	-.997	-3.185	.003
Divergent Thinking: Flexibility	1.165	3.939	.000

Table 4. *Standardized regression coefficients for individual-level predictors of project originality.*

Model	β	t	Sig.
(Constant)		.889	.380
Computer Playfulness	.384	1.533	.134
Generalized Self-Efficacy	-.648	-2.860	.007
Agreeableness: Flexibility	-.132	-.678	.502
Agreeableness: Patience	.181	1.051	.300
Conscientiousness: Diligence	-.064	-.231	.819
Conscientiousness: Perfectionism	.283	1.116	.271
Conscientiousness: Prudence	.262	1.143	.260
Extraversion: Expressiveness	.411	1.728	.092
Extraversion: Sociability	-.170	-.814	.420
Openness: Creativity	-.128	-.599	.553
Openness: Inquisitiveness	.167	1.015	.316
Openness: Unconventionality	-.004	-.029	.977
Personal Innovativeness in Information Technology	-.362	-1.404	.168
Divergent Thinking: Originality	.345	1.488	.145
Divergent Thinking: Fluency	-.555	-1.589	.120
Divergent Thinking: Flexibility	.661	2.002	.052

Table 5. *Standardized regression coefficients for individual-level predictors of perceived task conflict.*

Model	β	t	Sig.
(Constant)		1.875	.069
Cognitive Absorption	-.269	-1.611	.116
Computer Playfulness	-.081	-.352	.727
Generalized Self-Efficacy	-.496	-2.557	.015
Agreeableness: Flexibility	-.246	-1.478	.148
Agreeableness: Patience	.210	1.359	.182
Conscientiousness: Diligence	.037	.156	.877
Conscientiousness: Perfectionism	.489	2.209	.033
Conscientiousness: Prudence	-.175	-.894	.377
Extraversion: Expressiveness	-.238	-1.174	.248
Extraversion: Sociability	.300	1.634	.111
Openness: Creativity	-.059	-.320	.751
Openness: Inquisitiveness	-.072	-.479	.635
Openness: Unconventionality	.300	2.261	.030
Personal Innovativeness in Information Technology	.408	1.852	.072
Divergent Thinking: Originality	.165	.831	.411
Divergent Thinking: Fluency	.129	.435	.666
Divergent Thinking: Flexibility	-.028	-.100	.921

Table 6. *Standardized regression coefficients for individual-level predictors of perceived relationship conflict.*

Model		β	t	Sig.
1	(Constant)		1.595	.119
	Cognitive Absorption	-.102	-.717	.478
	Computer Playfulness	.339	1.731	.092
	Generalized Self-Efficacy	-.463	-2.810	.008
	Agreeableness: Flexibility	-.281	-1.989	.054
	Agreeableness: Patience	.338	2.573	.014
	Conscientiousness: Diligence	-.290	-1.442	.158
	Conscientiousness: Perfectionism	.432	2.300	.027
	Conscientiousness: Prudence	-.078	-.473	.639
	Extraversion: Expressiveness	.097	.563	.577
	Extraversion: Sociability	-.084	-.538	.594
	Openness: Creativity	-.024	-.157	.876
	Openness: Inquisitiveness	.046	.362	.720
	Openness: Unconventionality	.178	1.586	.121
	Personal Innovativeness in Information Technology	.016	.088	.930
	Divergent Thinking: Originality	-.308	-1.827	.076
	Divergent Thinking: Fluency	.961	3.802	.001
	Divergent Thinking: Flexibility	-.509	-2.136	.039

Table 7a. *Summary of multilevel effects on team task conflict.*

Fixed Effect	γ	Standard Error	T-Ratio	Approx. df
Self-Efficacy	-.817**	.140	-5.842	156
Conscientiousness: Perfectionism	.303**	.116	2.593	156
Personal Innovativeness in Information Technology	.157*	.079	1.994	156
Openness: Originality	.021	.012	1.700	156

*

Table 7b. *Summary of multilevel effects on team relationship conflict.*

Fixed Effect	γ	Standard Error	T-Ratio	Approx. df
Computer Playfulness	.278**	.100	2.790	155
Self-Efficacy	-.548*	.218	-2.508	155
Divergent Thinking: Fluency	.046	.026	1.788	155

Table 8. *Standardized regression coefficients for the interaction of task conflict and participative safety.*

Model		Beta	t	Sig.
1	(Constant)		3.320	.002
	Task Conflict	.062	.455	.651
	Climate: Participative Safety	-.247	-1.811	.076
2	(Constant)		3.829	.000
	Task Conflict	-3.711	-3.114	.003
	Climate: Participative Safety	-2.282	-3.504	.001
	Interaction (Task Conflict x Participative Safety)	4.607	3.184	.002

Figure 1. *Proposed model of individual and team-level effects on team creative performance.*

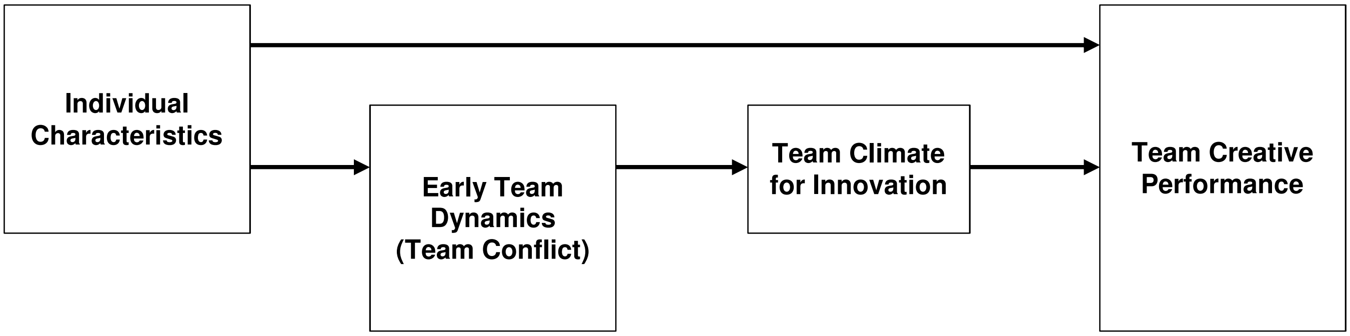


Figure 2a. *Full structural equation model of individual differences, team conflict, and team climate.*

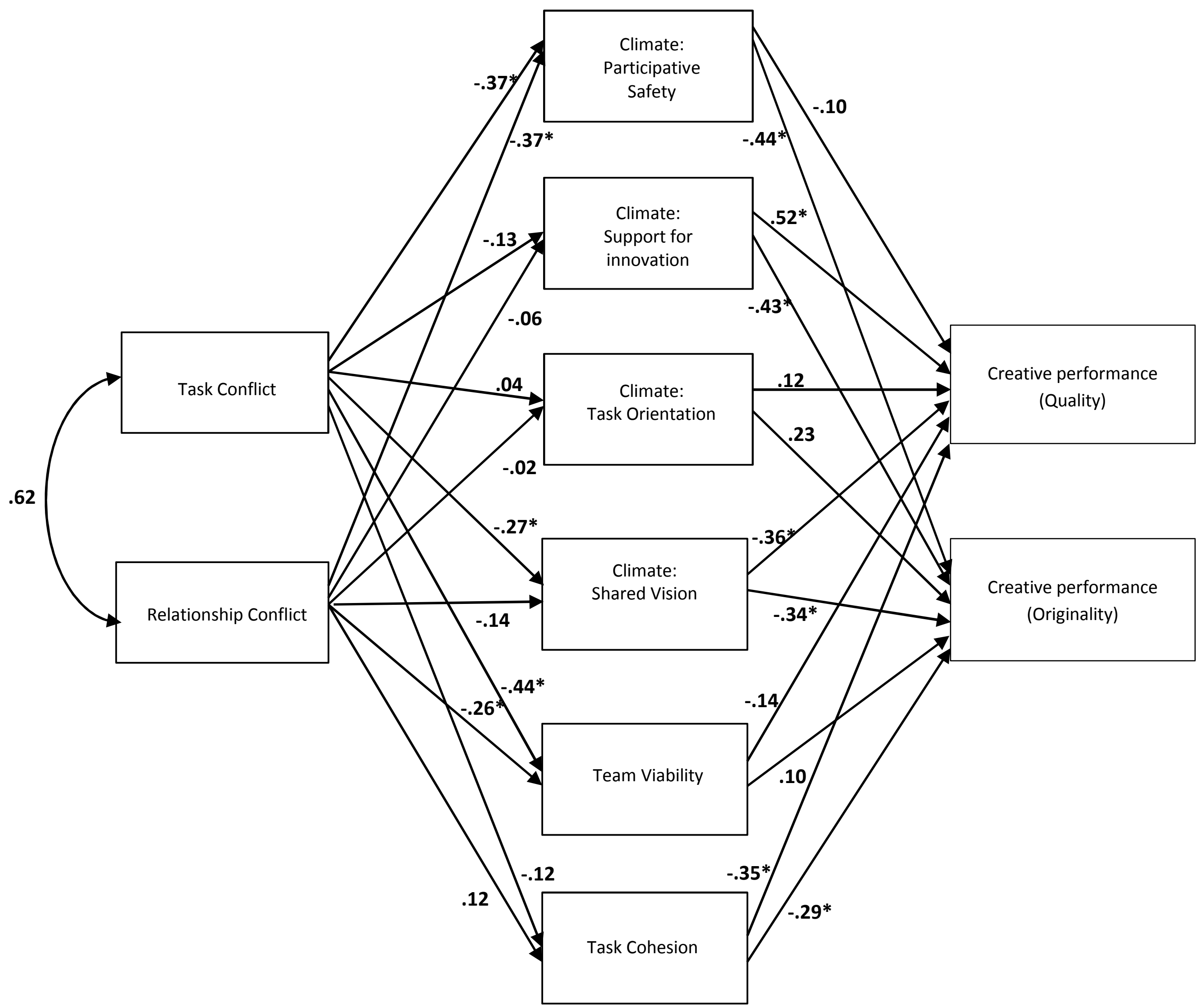


Figure 2b. *Reduced structural equation model of individual differences, team conflict, and team climate.*

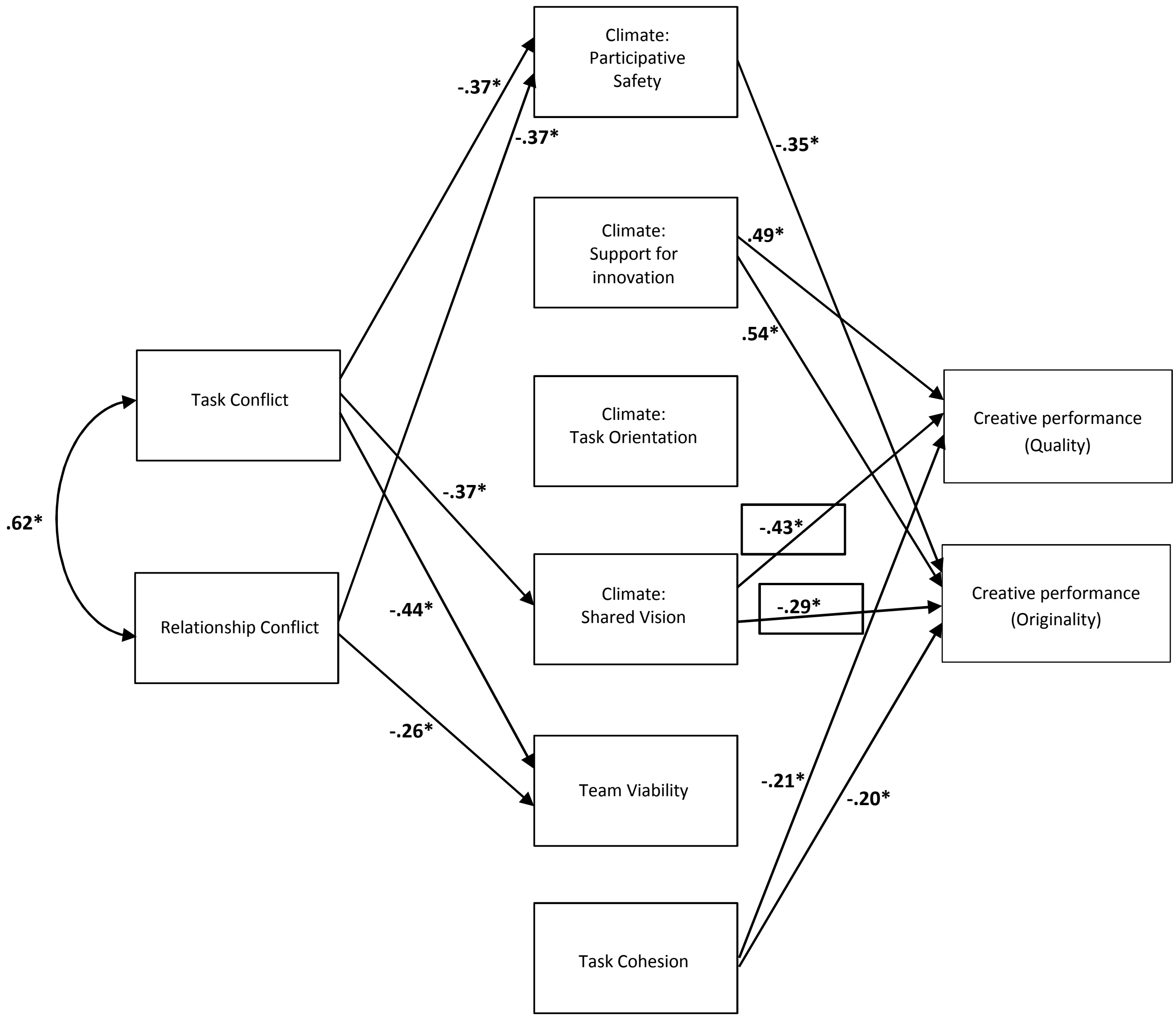
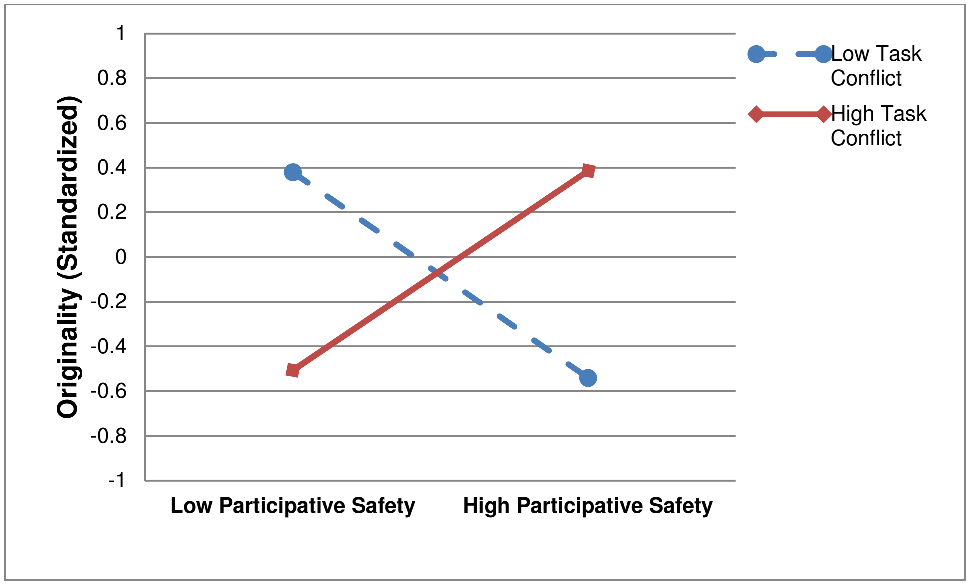


Figure 3. *Interaction of Team task conflict and participative safety on project originality*



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