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Representational Gaps, Team Integration and Team Creativity: The Mediating Roles of Conflict and Coordination

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ABSTRACT

Functional diversity is central to the performance of product development teams in that multiple perspectives increase the team's creativity. Failures in cross-functional product development teams (CFPDTs) are often attributed to a team's inability to capitalize on their diversity. In this study we develop and test a model based on the representational gaps perspective (Cronin & Weingart, 2007a; Weingart, Cronin, Houser, Cagan, & Vogel, 2005) to determine factors that promote or limit creativity in CFPDTs. In particular we examine how representational gaps and cognitive and affective integration in CFPDTs affect coordination and conflict, which in turn influence the novelty and usefulness of the products designed. Furthermore, we investigate when conflict resulting from the representational gaps stimulates or harms creativity. We test these relationships using a path analysis on data across two time periods from cross-functional product development student teams. Representational gaps, affective integration, and cognitive integration were found to collectively improve team creativity via task conflict, relationship conflict, and coordination. Representational gaps and cognitive integration largely influenced creativity through task conflict, coordination, and conflict management. Affective integration operated via its effect on relationship conflict and an interactive effect with cognitive integration on task conflict. Furthermore, the effects of conflict and coordination on creativity depended on the conflict management approach used by the group. We discuss these findings in detail and end by considering the implications for the management of cross functional teams engaged in potentially creative work.

Organizations often rely on cross-functional teams to innovate because of their diverse skills, access to a broad range of information, and the creativity potential these teams bring to the task at hand (Amabile, 1983; Williams & O'Reilly, 1998; van Knippenberg & Schippers, 2007). However, the very diversity that is designed into the team can interfere with their ability to integrate their different ideas and information (Cronin & Weingart, 2007a). This occurs because team members' background and training influence their beliefs about the nature of the task and how to best approach and solve task-related problems. Differences in task understanding and task perceptions make it difficult for team members to relate to one another, drive conflict, and make it difficult to coordinate activity. We see these differences, called representational gaps, as the root cause of much conflict and subsequent creativity in cross-functional teams.

In this paper, we investigate the effects of representational gaps on creativity in teams. Representational gaps (rGaps), a new construct developed out of the information processing psychology tradition (Chi, Feltovich, & Glaser, 1981; Newell & Simon, 1972), captures differences in problem definitions held by team members. Drawing on a framework of performance in cross-functional product development teams (Weingart et al., 2005), we argue that the inability of members to view the task similarly (i.e. rGaps), and the level of team integration (cognitive and affective), influence conflict and coordination and ultimately drive team creativity (see Figure 1). We also investigate the impact of conflict management approaches on the effects of rGap-resultant conflict. We argue that the effect of task and relationship conflict on creativity depends on the conflict management approach used by team members.

Insert Figure 1 about here

Cross functional teams are often assembled with the expressed purpose of developing creative ideas that will then be commercialized (and become successful innovations). A creative idea is generally considered to be one that is novel and useful (Amabile, Conti, Coon, Lazenby, &

Herron, 1996; Borghini, 2005; Oldham & Cummings, 1996). Thus product development teams are creative when they can come up with a novel product – one that has yet to be tried in a particular domain – that also adds value to the end customer. The hope is that the intersection of different thought worlds (Dougherty, 1992) will spur unique combinations of knowledge that lead to new ideas, and that the span of expertise will help the team bring the idea to fruition.

Interest in the factors that help or hinder the realization of the potential benefits of broader knowledge bases in diverse teams has driven a good amount of the research on team creativity. A new perspective on the potential liabilities associated with cross functional team composition, proposed by Cronin & Weingart (2007a) and Weingart et al. (2005), is that diverse teams experience gaps in team members' understanding and framing of the task (i.e., rGaps). Weingart and colleagues (2005) theorize that these gaps in turn influence team conflict. If conflict is not managed properly, rGaps ultimately degrade the novelty and usefulness of the new products that teams create. In this way, the rGaps are a process loss phenomenon that takes resources away from the creative development process. Weingart and colleagues (2005) propose that the "cure" for rGaps involves team integration across functional divides. They suggest that team integration, both cognitive and affective, will help team members to bridge rGaps.

We contribute to theories and research on group creativity and diversity in several ways. First, this research provides the first test of the role of rGaps in teams (Cronin & Weingart, 2007a). A second contribution is the direct examination of the processes of cognitive and affective integration in diverse teams as they relate to rGaps, conflict, and coordination processes and ultimately to creativity. Prior research has focused on cognitive integration (e.g., work on team mental models) or affective integration (e.g., work on trust and team conflict), but little work has focused on both. Third, we investigate simultaneously the effects of types of conflict and conflict management approaches on creativity. While scholars of team creativity propose

that conflict management style determines whether task conflict is beneficial or not (Kurtzberg & Amabile, 2001), we provide empirical evidence on how different types of conflict management styles can affect the creativity outcomes of task and relationship conflict.

The paper is structured as follows. In the next section, we define the new constructs in our model – cognitive integration, affective integration, and representational gaps. Then, we build the hypotheses starting with representational gaps, the central construct in the framework. First, we focus on how rGaps influence conflict and coordination which in turn influence team creativity. We also elaborate on the moderating effects of conflict management approaches. Second, we discuss the independent and joint effects of cognitive and affective integration on rGaps, conflict, and coordination. Finally, we present our research methods and the results of our study. Finally, we discuss our findings, their implications, and suggest new avenues for further research.

Representational Gaps, Cognitive, and Affective Integration Defined

Cronin and Weingart (2007a) define the concept of representational gaps as differences between team members' fundamental definition of a given problem or task faced by the team. These gaps can occur in team members' *goals* for task achievement, *assumptions* about task characteristics, understanding about the *elements* (or components) of the task or about the actions that need to be taken (*operators*) (Hayes & Simon, 1974; Newell & Simon, 1972). For example, team members who hold conflicting goals for team performance (e.g., maximize market share versus target a specific user group) or assumptions regarding the value of types of information (e.g., mass survey data versus in depth interviews) have rGaps. In CFPDTs, rGaps occur because team members' functional backgrounds provide different, and often conflicting, frameworks for understanding the task at hand (Cronin & Weingart, 2007a; Weingart et al., 2005). Thus, rGaps arise when a team is given a specific problem or task, and the team members create inconsistent

representations of the team's problem.

In contrast to rGaps which are task-related, cognitive and affective integration characterize the relationships between team members and persist across time and tasks. Cognitive integration exists when team members are able to understand, anticipate, and integrate one another's perspectives, much like being able to speak another's language. In this way, cognitive integration reflects the ability of a team to capitalize on the information processing advantage of diverse teams. Affective integration reflects the psychological bonds of trust and respect that team members can develop for each other (Weingart et al., 2005). Whereas trust allows team members to rely on one other, respect reflects the value team members place on one another's contributions.

Representational Gaps, Conflict, Coordination, and Creativity

Representational gaps influence team creativity because they change the way team members interact. Teams with larger rGaps will experience more conflict and have more difficulty coordinating their actions (Cronin & Weingart, 2007a). In this section, we begin by discussing how rGaps influence conflict and coordination. Then, we elaborate on the effects of different types of conflict and coordination on creativity. We propose that effect of conflict on team creativity depends on the conflict management style.

The effects of representational gaps on conflict and coordination. Conflict involves the discussion of disagreements among team members. Prior research has differentiated between two types of conflict: task and relationship (Jehn, 1995). Task conflict involves disagreements about how to perform the task at hand. Relationship conflicts are more emotional and tend to focus on more personal issues. The literature is mixed on the efficacy of task conflict, however relationship conflict has largely been found to be detrimental to teams (De Dreu & Weingart, 2003b). Representational gaps should increase task conflict because team members who hold different perspectives on team goals, importance of task characteristics, and/or actions to be taken are more

likely to disagree when they attempt to complete their joint task (Cronin & Weingart, 2007a; Weingart et al., 2005). RGaps should also increase relationship conflict. Over time, as team members repeatedly encounter fundamental differences in how they define their shared task, frustration and feelings of being different or even marginalized can build resulting in the experience of relationship conflict (Cronin & Weingart, 2007a).

Coordination problems may *not* be actively discussed, but rather surface in the team's inability in act in a coordinated fashion. Thus, an important indicator of coordination is not the amount of discussion regarding coordination per se, but team members' perceptions of how well the team coordinates their actions. RGaps can interfere with coordination when team members misinterpret others' actions and respond inappropriately (Cronin & Weingart, 2007a), a pattern that is especially likely to happen when diverse teammates do not share their mental models of the situation (Rico, Sanchez-Manzanares, Gil, & Gibson, 2008). Coordination problems make the already difficult problem of translating foreign ideas into action even more difficult.

Hypothesis 1: Representational gaps will be positively related to task conflict.

Hypothesis 2: Representational gaps will be positively related to relationship conflict.

Hypothesis 3: Representational gaps will be negatively related to coordination.

The effect of conflict and coordination on team creativity. As defined earlier, task conflict involves discussions of disagreements about what should be done in order to accomplish team objectives (Jehn, 1995). When team members engage in task disagreement they learn about divergent viewpoints, and if task conflict is managed properly then team members should discover ways to integrate incompatible opinions, and these should produce novel understandings or creative approaches (e.g., through analogical reasoning, reflective reframing, or knowledge recombination, see Dunbar, 1995; Galunic & Rodan, 2004; Hargadon & Sutton, 1997). Thus, task conflict is a way to surface information that can rectify the underlying

incompatibility evidenced in rGaps. By generating solutions that satisfy the multiple goals held by diverse team members, the product is more likely to meet the multiple needs of the end user, and thus usefulness of the final product should improve. Since the solution has the potential to be one that bridges thought worlds, it is likely to also be novel. Thus, task disagreement is a central process necessary for realizing the benefits of the diversity of ideas (DeDreu & Weingart, 2003a; Jehn, 1995). In teams without task conflict, team members will share fewer discrepant ideas and as a result, no novel configurations of knowledge can occur.

Although results of a meta-analysis show that on average task conflict decreases team performance (De Dreu & Weingart, 2003a), task conflict has been shown to positively impact creativity and innovation in some situations (DeDreu, 2006; Nemeth & Nemeth-Brown, 2003; Van Dyne & Saavedra, 1996). De Dreu and Weingart (2003a) and Jehn and Bendersky (2003) suggest that these conflicting results might be explained by the conflict management approaches used by the teams. Research suggests that the impact of task conflict on performance depends on the way team members manage their task disagreements (Kuhn & Poole, 2000; Weingart et al., 2005). We argue that the use of appropriate conflict management approaches is likely to result in a positive effect of task conflict on creativity (De Dreu & Weingart, 2003b; Ury, Brett, & Goldberg, 1989).

Ury et al. (1989) present three conflict management approaches that are differentially effective at resolving disputes: interests, rights, and power. An interests-based approach identifies and attempts to satisfy the central needs and desires of all parties involved and typifies a purely collaborative approach in which people exchange information and problem-solve. Rights-based (or regulation-based) approaches resolve conflict by referring to external standards for judging the fairness or appropriateness of potential solutions. When using a rights-based approach, the parties attempt to resolve the dispute by appealing to norms, precedent, contract, or law. A power-based approach is used to resolve disputes by determining who is able to force their desired outcome –

who is stronger, has higher status, is able to coerce the other, or can force a concession from the other party. In any given interaction, team members concurrently use interests, rights, and power in their attempt to resolve their disputes (Lytle, Brett, & Shapiro, 1999; Tinsley, 1998, 2001).

Although Ury et al. (1989) suggests that groups that rely on interests will reach higher quality agreements than those using rights or power, Weingart et al. (2005) suggest that rights-based approaches can also be adaptive depending on the task at hand. In diverse team settings where standard operating procedures are not shared (such as the one studied in this research), both interests-based and rights-based approaches can facilitate the surfacing and integration of divergent information. Teams relying on rights-based approaches focus on what standard operating procedures to use and how to use them. In that one functional area's standard procedures may not be realized by the other team members (much like others' interests are rarely transparent to negotiators), rights can surface new information in the same way that interests are expected to. Rights-based conflict management also allows the team to coalesce around a unified approach that will help them integrate their different perspectives into their product specifications. In contrast, team members who rely on power-based approaches will tend to ignore others' perspectives, instead forcing their own solution through. By ignoring others' perspectives, teams using power-based approaches to resolve conflict should produce less creative products.

Hypothesis 4: The conflict management approach used by the team will moderate the relationship between task conflict and creativity. The positive relationship between task conflict and creativity will be stronger for teams using more interests- and rights-based approaches and weaker for teams using more power-based approaches.

Relationship conflict should decrease team creativity because it reduces team members' motivation to work together, as well as their capacity to think about others' ideas. Synthesizing information is an effortful process (Hasher & Zacks, 1979) that relationship conflict can undercut.

Teams wrought with emotional, personal conflicts will not want to cooperate with one another, will make negative attributions about others' motives, and will generally experience more negative moods. Negative emotions resulting from relationship conflict crowd out cognitive capacity for thinking (Bless & Schwarz, 1999). They can lead one to either selectively attend to or encode particular details (Forgas, 1995), limiting comprehension of the information to only the affect-congruent parts (which would be negative). In addition, relationship conflict increases negative feelings toward others and thus may increase withdrawal (Brockner, Shaw, & Rubin, 1979) and therefore reduce the motivation to learn from others. All these will provide a disincentive for team members engaged in relationship conflicts to work jointly to discover creative solutions.

Just as the use of alternative conflict management approaches should moderate the effects of task conflict on team creativity, we expect conflict management approaches to moderate the effects of relationship conflict on team creativity. When teams attempt to resolve relationship conflicts by integrating the interests of the team members involved, those conflicts are less likely to be detrimental to the team. This occurs for two reasons. First, an interests-based approach allows team members to voice their perspective and be heard (Ury et al., 1998). This could diffuse the emotionality of the situation if done well. Second, interests-based solutions are more likely to satisfy the true needs of team members, providing a more satisfying solution and reducing the likelihood that the dispute will recur (Ury et al., 1998). In that relationship conflicts tend to interfere with team performance, minimizing its recurrence is paramount. In contrast, when team members use their rights and/or power to resolve relationship conflicts, team members will react more defensively or reciprocate the tactic, resulting in conflict escalation and lower team creativity. Attempts to apply external standards (rights) to resolve a personal, emotional conflict will only exacerbate the conflict because team members are unlikely to accept standards that are not their own. Similarly, attempts to force team members to change their perspectives in a

relationship conflict are likely only to be met with incredulity and counterattacks.

Hypothesis 5: The conflict management approach used by the team will moderate the relationship between relationship conflict and team creativity. The negative relationship between relationship conflict and creativity will be weaker for teams using more interests-based approaches and stronger for teams using more rights- and power-based approaches.

Team coordination is an important predictor of team performance (Kraut, Fussell, Lerch, & Espinosa, 2003; Marks, Zaccaro, & Mathieu, 2000; Mathieu, Goodwin, Heffner, Salas, & Cannon-Bowers, 2000) and has been shown to improve with team experience (Hollenbeck, Ilgen, LePine, Colquitt, & Hedlund, 1998). However, extant research tends to look at how teams improve the way they execute extant solutions, not the way they create novel ones. We believe that poor coordination should also decrease the creativity of team work because it hinders the combination of member inputs. In a cross functional team, the knowledge about what is possible is distributed across team members. Thus to be able to access the domain relevant information that other teammates possess, a team must be well coordinated in how they process and share information.

Hypothesis 6: Coordination will be positively related to team creativity.

Team Integration, Representational Gaps, Conflict, and Coordination

In the previous section, we discussed how and when representational gaps reduce the ability of members of cross-functional teams to benefit from the diverse resources. However, members of some cross-functional teams are able to overcome the problems of working with different others. Weingart et al. (2005) discuss how cognitive and affective team integration help team members bridge rGaps. We extend their theorizing by exploring the direct influence of team integration on creativity-enhancing and creativity-limiting team processes. In this section, we discuss the independent and joint effect of the two integration types on rGaps and conflict and coordination processes in functionally diverse teams. We argue that cognitive integration will

influence team creativity via direct effects on rGaps and coordination whereas affective integration will operate via direct effects on task and relationship conflict.

The effect of cognitive integration on representational gaps and coordination. As defined earlier, cognitive integration occurs when team members understand, anticipate, and integrate one another's perspectives into their own, and exists independent of the task at hand. Cognitive integration is likely to influence creativity through minimizing rGaps and improving team members' ability to coordinate their actions. When team members understand one another's general perspectives on task performance (i.e., are cognitively integrated) they should be more likely to understand how diverse teammates interpret the task at hand, reducing the rGap. For example, cognitive integration would allow an organizational psychologist to understand the way an economist would apply subjective expected utility theory to understand a choice problem. Thus, cognitive integration should decrease rGaps in functionally diverse teams (and reduce subsequent task conflict) because people will make allowances for the default approaches and assumptions of others. Cognitive integration should also make it easier for teams to coordinate their actions. When team members are able to understand inputs from different thought worlds, they are better able to anticipate others' actions and behave accordingly. When team members are not able to correctly anticipate the actions of others, coordination deteriorates (Wittenbaum, Vaughan, & Stasser, 1998).

Hypothesis 7: Cognitive integration will be negatively related to representational gaps.

Hypothesis 8: Cognitive integration will be positively related to coordination.

The influence of affective integration on conflict. Affective integration should enhance creativity through its effect on task conflict and should reduce creativity through relationship conflict. Teams with high levels of trust will exhibit more open communication about relevant work issues and therefore will express more openly their task disagreements (Alper, Tjosvold, &

Law, 1998; Jones & George, 1998). Diverse team members who do not trust nor respect one another will be less likely to openly discuss their task disagreements because they do not believe the other party will fairly consider their perspectives and they do not value their teammates input (Cronin & Weingart, 2007b). When these interpersonal bonds are missing, team members will be less willing to share information with others and less accepting of information from diverse team members, depressing the expression of task conflict. Rather than openly discuss their differences, teams with low affective integration will avoid confrontation, resulting in less task conflict.

Affective integration reflects the social and interpersonal dynamics in groups and thus should also be related to more emotional, interpersonal forms of conflict in teams (i.e. relationship conflict, see Jehn 1995; De Dreu & Weingart, 2003a). We expect affective integration to reduce the levels of relationship conflict in teams because the more trust one has in another, the less likely they are to infer malice in that person's actions (Deutsch, 1958). The more respect one has for another, the more likely they are to treat each other with dignity and see each other as an important part of the group (Smith, Tyler, Huo, Oritz, & Lind, 1998), the absence of which will engender hostility and resentment.

Hypothesis 9: Affective integration will be positively related to task conflict.

Hypothesis 10: Affective integration will be negatively related to relationship conflict.

The interplay between cognitive and affective integration. Weingart and colleagues (2005) propose that affective integration will increase cognitive integration. That is, team members will invest more effort in understanding the ideas and opinions coming from team members from different thought worlds when they trust and respect those team members. Prior research shows that trust encourages knowledge sharing and knowledge use (Hansen, 1999; Reagans & McEvily, 2003). Similarly, respect encourages people to voice their beliefs, and comply with ideas that are not in their favor (Tyler, Degoey, & Smith, 1996). In an atmosphere of trust, group members

engage in more open debates and dissent among group members (Nemeth & Nemeth-Brown, 2003), while respect promotes consideration of these ideas. Both of these should foster cognitive integration, as they are the groundwork for a willingness to learn about others' viewpoints. Therefore, affective integration is likely to increase cognitive integration.

Weingart at al. (2005) suggest that closing rGaps and integrating different views occurs via two distinct processes: developing the ability to understand and integrate the ideas of different functional perspectives (i.e. cognitive integration) and developing the motivation to try to understand each other (i.e. affective integration). We extend their argument by suggesting that in addition to their direct effects on both rGaps and the processes resulting from rGaps, cognitive and affective integration will interact to influence the positive processes resulting from rGaps, i.e. task conflict. Specifically, we propose that the tendency for affective integration to increase open communication and thus stimulate task disagreement will be stronger in teams where team members are having more difficulty understanding each other. In these teams, affective integration provides the motivation needed to overcome the initial lack of understanding and acts as a substitute for the lower ability to understand other thought worlds. In contrast, teams that are cognitively integrated already possess the necessary understanding of their colleagues' perspectives, thus their task conflict should be lower regardless of level of affective integration. Thus, we predict that cognitive integration will moderate the relationship between affective integration and task conflict.

Hypothesis 11: Affective integration will be positively related to cognitive integration.

Hypothesis 12: Cognitive integration will moderate the relationship between affective integration and task conflict. In teams with low cognitive integration, affective integration will be more positively related to task conflict than in teams with high cognitive integration.

METHODS

Sample

Engineering, industrial design, and MBA students enrolled in a multi-disciplinary product development course participated in this study. Data were collected from 21 integrated product development teams consisting of 5-6 students (n = 122 participants). Students were assigned to teams at the beginning of a 15-week semester, and the teams were composed of at least 2 engineers, 2 designers, and 1 MBA student. Both undergraduate and graduate students were enrolled in the course, which was sponsored by a company.

Task

Teams worked through a four-phase product development process over 15 weeks to develop a useful, usable, and desirable product. The process focused on early stages, or "fuzzy front end" of product development, including Phase I: identifying an opportunity, Phase 2: understanding the opportunity, Phase 3: conceptualizing the opportunity, and Phase 4: realizing the opportunity (Cagan & Vogel, 2002). At the end of each phase, each team turned in a written report, made a verbal presentation to the class and company representatives, and completed an online survey regarding their team processes. At the end of the 4^{th} phase for the final presentation, students also fabricated a prototype of their product. The team project was highly engaging for students. The entire class met once weekly to learn about the product development process. Each team also met at least once weekly with the faculty teaching team (comprised of four professors – mechanical engineering, industrial design, marketing, and organizational behavior). Adding to the level of realism of the course, the sponsoring company could patent any products that emerged from the course and team members' names were listed on any resulting patents. Finally, team members whose products were patented (or used in any other way by the sponsoring company)

were financially compensated.

Measures

All data was collected via the end-of-phase surveys. Measures of affective and cognitive integration, and rGaps were collected at the end of Phase 2 (7 weeks into the semester). Measures of task conflict, relationship conflict, coordination, conflict management styles, and creativity were collected four weeks later, at the end of Phase 3. We used data from separate phases to avoid problems of mono-method bias and to provide more definitive tests of causality across the measures of team cognition/attitudes and team dynamics.

In measuring two of the phase 2 variables (affective integration and cognitive integration), participants were asked to think about team members from a given functional area (i.e., engineers, designers, or MBAs) and respond to a series of questions about the people from that function. Thus each team member responded to the affective and cognitive integration items for each of the three functional areas (including their own). Responses for each scale were averaged across target functional areas and across team members to determine group scores. In measuring phase 3 variables (task conflict, relationship conflict, coordination, conflict management styles, and creativity), each measurement was taken once (e.g., each person reported on task conflict within the team) and averaged across team members to create team level variables.

Affective integration. Affective integration was measured using a 10-item scale to assess members' feelings of trust and respect for each function (designers, engineers, and MBAs - Cronbach's alpha ranged from .89 to .94) (see Appendix A). For each relevant team member, participants responded using a 5-point Likert-type scale (1=strongly disagree to 5 = strongly agree). Higher scores represented higher levels of affective integration.

Cognitive integration. Cognitive integration was measured using a 4-item scale assessing

the ease with which team members felt they could integrate the ideas of team members' from particular functional areas with their own (alpha ranged from .73 to .81) (see Appendix A). For each relevant team member, participants responded using a 5-point Likert-type scale (1=strongly disagree to 5 = strongly agree). Higher scores represented higher levels of cognitive integration.

Representational gaps. Representational gaps, defined as differences in how team members define a given problem, situation, or task, were measured by comparing team members perceptions of an optimal product development process (i.e., how they perceive the task process parameters) (see Appendix A). We used a Q-sort methodology (Block, 1961) to measure how different team members' perceptions of the team's task were. We asked participants to rate how well 14 adjectives described the way integrated product development processes *should* go using a 5-item scale ranging from strongly disagree to strongly agree. We then aggregated the ratings across the adjectives within function, calculated the pairwise correlation between each function's ratings on these adjectives, and took the average as a measure of the rGaps between functions within a team. In other words, the rGap score was the average of three correlations: engineer-designer, engineer-MBA, and MBA-designer. The correlations were between the scores on the 14 adjectives, which is equivalent to the Q-sort method of examining how each function would sort the importance of each adjective (Block, 1961). Thus the higher the correlation, the more similarly the team views the task they are given.

Task and relationship conflict. The conflict items were taken verbatim from Jehn (1995). Task conflict was measured using a 4-item scale assessing the amount of disagreements around how to perform the task at hand (alpha = .83). Relationship conflict was measured using a 4-item scale assessing the amount of interpersonal/emotional conflict within the team (alpha = .87).

Ease of coordination. Ease of coordination was measured using a 4-item scale assessing the degree to which team members felt they were informed about what they and their teammates

should be doing at any point in time (alpha = .77) (adapted from Kraut et al., 2003). Higher scores represented a well-coordinated team. Items included: It is very easy for me to get information from other team members when I need it. I wish I was more aware of what my teammates were doing. I always receive the information I need from other team members on time. I am always kept up to date on changes in my teammates' plans and activities.

Conflict management approaches. The three conflict management approaches described by Ury and colleagues (Ury et al., 1989) were measured: interests, rights, and power. Building on a measure developed by Tinsley (1998), team members were asked to evaluate how frequently their group used each approach to resolve differences on a 6 point scale ranging from *never* to *continually*. Interests was a three item scale (alpha = .65), rights was a two item scale (alpha = .72), and power was a three item scale (alpha = .81) (see Appendix A).

Creativity. Team members were asked to rate the quality of their product along the dimensions commonly used to describe creativity (Amabile, 1988): novelty of the solution and usefulness of the solution to the end user. Three items were used to assess the novelty of the solution (alpha = 71) in terms of styling, construction, and functioning. The novelty items asked team members to rate how innovative they thought the product was in terms of styling, construction, and functioning – tapping into both the engineering and design perspectives. Drawing on research on design and new product development, we developed a scale consisting of three components of usefulness: usefulness, usability, and desirability (Cagan & Vogel, 2002; Sanders, 1992, 2006). We used three items to assess each component (see Appendix A). The usefulness items asked team members to rate the product in terms of its perceived usefulness from the perspective of the actual user, as one of the team's goals was to produce a product that would fill a need. The usability items asked team members to evaluate the extent to which the product will be easy to use. To assess desirability of the new product, we asked team members to evaluate

how pleasing and desirable the final product is from the perspective of the customer. The variable *usefulness* was composed by averaging the responses to the 9 items assessing usefulness, usability, and desirability (alpha = .89). Participants responded to these items using a 5-point scale ranging from strongly disagree to strongly agree.

RESULTS

Table 1 shows the correlations among the variables. Below we present the results of a path analysis and hierarchical regressions, used to investigate the hypothesized relationships.

Insert Table 1 around here

Our path analysis was conducted using Partial Least Squares with Bootstrapping, which is recommended for testing structural models with small sample sizes (Chin & Newsted, 1999). Partial Least Squares (PLS) represents an alternative technique for causal modeling which remedies some of the limitation of Structural Equation Modeling (SEM) (Wold, 1974, 1985). Just like SEM, PLS allows representation of more complex theories but it can be used for smaller samples. In contrast to SEM, which involves the close reproduction of the observed covariance matrix using Maximum Likelihood Estimation, PLS has as a primary objective the minimization of error in all endogenous constructs and uses Ordinary Least Squares estimation. Therefore it provides no overall goodness of fit measures. The standard errors of the coefficients in PLS are calculated using the Bootstrap technique included in the PLS software (Rice, 1995; Young, 1994). Bootstrapping allows the researcher to create multiple subsamples from the original database through random drawing with replacement. The parameter distributions are examined relative to each of the spawned samples. The bootstrapping sampling distribution is rendered free from the restrictions of assumptions of normality. It is concrete and it allows for comparison of parameter values over repeated samples. The results of the PLS analysis are depicted in Figure 2.

Insert Figure 2 about here

Representational gaps and cognitive integration were found to work together to directly influence task conflict, coordination, and ultimately the usefulness of the product developed. Affective integration influenced creativity through its effects on cognitive integration and conflict. We first present results as related to rGaps, team integration, and their effects on team processes. We then examine how team processes influence creativity of the product.

Representational Gaps, Team Integration, and Team Process

The effects of representational gaps. Our findings suggest that rGaps influence creativity via two paths – task conflict and ease of coordination. Groups with larger rGaps at the end of Phase 2 experienced more task conflict during Phase 3 ($b = .37$, $p < .05$) (supporting H1). And although rGaps did influence coordination, they made it easier, rather than more difficult, for teams to coordinate (rejecting H3) ($b = .37$; $p < .05$). Finally, larger rGaps did not increase relationship conflict in the teams, rejecting H2.

The effects of cognitive integration. Results of our analysis supported the hypothesized negative relationship between cognitive integration and rGaps ($b = -.47$; $p < .01$) (H7) and the hypothesized positive relationship between cognitive integration and coordination ($b = .46$; $p<.05$) (H8). Groups who were more cognitively integrated experienced smaller rGaps regarding the product development process and were more coordinated in their actions.

The effects of the affective integration. Team members' feelings about one another directly influenced their relationship conflict and cognitive integration. First, teams with higher affective integration experienced more cognitive integration during Phase 2 (supporting H11). Second, affective integration (after Phase 2) was found to decrease the relationship conflict that occurred during Phase 3 (supporting H10). We did not find evidence of a direct effect of affective integration on task conflict in the PLS analysis, rejecting H9.

Interactive effects of cognitive and affective integration. We predicted that affective and

cognitive integration would interact to influence level of task conflict (H12). Since tests of moderation cannot be conducted within the PLS framework, we turned to a hierarchical OLS regression analysis to test for moderation. Regression results indicated that the model including the main effects and the interaction between affective and cognitive integration was significant (R^2= .50, $F(3,20) = 5.58$, $p < .01$), and inclusion of the interaction over the main effects was significant (change $R^2 = .33$, $F(1,17) = 11.14$, $p < .01$). First, there was a significant positive relationship between affective integration and task conflict in both the main effects and the model including the interaction (supporting H9). However, this positive relationship between affective integration and task conflict was stronger in teams with low cognitive integration than teams with high cognitive integration (see Table 2.3 and Figure 3).

Team Processes and Creativity

Results of the PLS show that the two dimensions of product creativity are correlated ($r = .58$, $p < .01$), but only share 34% of their variance. Thus we chose to test Hypotheses 4, 5, and 6 using both as dependent variables.

Determinants of creativity: Usefulness. As expected, coordination had a positive influence on perceived usefulness of the product ($b = .47$; $p < .01$) (supporting H6). We predicted that conflict management would moderate the effects of conflict on creativity (H4, H5). Due to our small sample size, we tested the moderating role of interests, rights, and power in separate equations, but found no evidence of significant interaction effects on usefulness. Instead, PLS results suggest that teams with more task conflict believed their products to be somewhat more useful ($b = .28$, $p < .10$).

Determinants of creativity: Novelty. Novelty was influenced by interactions between conflict and conflict management approaches. Again, we tested the moderating role of interests, rights, and power in separate equations. Hypothesis 4 states that interests and rights-based conflict

management approaches will strengthen the positive relationship between task conflict and creativity and a power-based approach will weaken the relationship. Only the model including the interaction between task conflict and rights predicting novelty of the product was significant (R^2 = .40, F (3, 20) = 3.69, p < .05), and inclusion of the interaction over the main effects was marginally significant (change R^2 = .15, F(1,17) = 4.12, p < .06), providing partial support for H4 (see Table 2.1). That is, task conflict had a stronger positive effect on product novelty in teams that more often engaged a rights-based approach. In the setting of this study, the standards engaged most likely refer to the tools and knowledge introduced in the IPD course and in previous course work. This finding should be interpreted in light of the fact that rights also had a marginal negative effect on novelty (see Table 2.1) – teams that relied more on standard operating procedures in general produced slightly *less* novel products, but teams that used SOPs to resolve their task conflicts produced slightly *more* novel products.

Hypothesis 5 states that an interests-based approach will weaken the negative relationship between relationship conflict and creativity, and rights- and power-based approaches will strengthen the relationship. We used hierarchical OLS regression analysis to test for moderation. Only the model including the interaction between relationship conflict and power predicting product novelty was significant (R^2 = .39, F(3,20) = 3.66, p < .05), and inclusion of the interaction over the main effects was marginally significant (change R^2 = .11, F(1,17) = 2.99, p < .10), providing weak support for H5 (see Table 2.2). That is, the use of a power-based approach marginally strengthened the negative effect of relationship conflict on product novelty.

Insert Table 2 about here

DISCUSSION

This study provides an initial test of a model based on the Weingart et al. (2005) representation gaps perspective on cross-functional teams. The model suggests that rGaps interfere

with team performance and that these gaps can be bridged when team members understand one another's approach to problem solving (cognitive integration) and feel positively about one another (affective integration). Team cognitive and affective integration are posited to operate by influencing both the gaps and resultant conflict and coordination that lead to team creativity. Our results provide a somewhat different picture of the role of rGaps. RGaps were shown to result in team processes that increase rather than interfere with team creativity, and team integration supported these effects via their effects on conflict and coordination.

How representational gaps influence creativity: coordination and conflict as mediating team processes. Representational gaps influenced team creativity by increasing both the level of task conflict and the ease of coordination among team members, but not the level of relationship conflict. As argued by Cronin & Weingart (2007a), since rGaps relate to performing a task, they should have their strongest influence on information processing, coordination, and task conflict. In this vein, rGaps increased the level of task conflict – teams that had larger differences in their perceptions of how an IPD team should perform were more likely to engage in debate and discussion about the task. Whether this was good for the team depends on whether task conflict positively or negatively influenced creativity. As we discuss later, task conflict largely increased team creativity, suggesting that rGaps ultimately helped rather than hindered team creativity.

Surprisingly, rGaps increased (rather than decreased) the team's ease of coordination. That is, teams who disagreed about ideal IPD team processes found it easier to coordinate. We speculate that the positive effect of rGaps on coordination might occur because rGaps can influence coordination explicitly and implicitly (Cronin & Weingart, 2007a). We postulated that rGaps would influence coordination *implicitly* such that team members would interfere with one another's task performance. However, it appears that teams with larger rGaps may

have dealt with coordination issues *explicitly* by tackling them directly and experienced better coordination as a result. This suggests that as rGaps become more extreme, team members might become more aware of their differences, leading to discussion of how to coordinate their activities (instead of assuming that there is agreement on how to behave) and to solve coordination problems before they occur. It would be interesting to discover what might drive team members to realize their rGaps and proactively correct them. In the current study, teams consisted of students who were working toward learning goals as well as outcome goals, and were sensitive to the challenges of interdisciplinary teams. Perhaps organizational groups can also benefit from training that raises teammates' awareness of the challenges associated with rGaps. RGaps could be touch points for enacting positive change in team coordination.

How cognitive and affective integration bridge representational gaps. Weingart et al. (2005) suggest that cognitive and affective integration counteract the negative effects of rGaps on team performance. However, our results suggest that rGaps play a more positive role in team creativity and affective and cognitive integration largely support its functioning. Cognitive integration both supports and interferes with the positive effects of rGaps. It supports the positive effect of rGaps by jointly improving the coordination in the team. These coordination improvements might reflect the implicit coordinating we referred to above. Team members who understand one another's approach to problem-solving will find it easier to predict what behaviors others might engage and adjust accordingly. Cognitive integration interferes with rGaps' positive influence by directly reducing the rGaps in the team. Given rGaps increased task conflict, then cognitive integration may serve to (indirectly) reduce task conflict (a direct relationship that one might expect if rGaps was not in the model). In this way, cognitive integration might be hindering team creativity be reducing effective rGaps and task conflict.

Affective integration supports the positive functioning of rGaps in three ways: reducing

relationship conflict, improving cognitive integration, and stimulating task conflict when cognitive integration is low. That affective integration reduced relationship conflict is most intuitive – team members who trust and respect one another experienced less emotional conflict, tension, and friction. Perhaps more interesting is that affective integration was also related to improved cognitive integration – teams that trusted and respected one another also reported understanding one another better. Although our theory suggests this causal relationship occurs because affectively integrated team members will be motivated to try to understand one another, it is also possible that the reverse occurs – higher understanding drives higher respect and trust. Future research should examine the drivers and dynamics of cognitive and affective integration.

Even more interesting are the interactive effects of affective and cognitive integration on task conflict. As predicted, affective integration had a stronger, positive influence on task conflict for teams that were not already cognitively integrated. That is, teams that had difficulty understanding one another's perspectives benefited from higher trust and respect within the team by engaging in more (hopefully, effective) task conflict. In addition, the pattern of means was as we would expect. All teams reported a high amount of task conflict, but those who had less understanding (low CI) and high respect and trust (high AI) engaged in the most. This makes sense in that the shared trust and respect allowed team members to work through task-related problems that resulted from their lower cognitive integration.

The relationships between rGaps, cognitive integration, and affective integration (all team states) and conflict and coordination (both team processes) are especially striking in light of the fact that the effects occurred across time periods. That is, the team states at the end of one work phase influenced the level of conflict during the next work phase, allowing us to be confident about the direction of causality.

How conflict and coordination affect creativity. Prior research on the effects of team

conflict on performance is clear on the negative effects of relationship conflict and equivocal on the positive effects of task conflict (DeDreu & Weingart, 2003a). DeDreu & Weingart (2003a, 2003b) suggest that knowledge about the conflict management approaches used may help to explain the mixed effects of task conflict. Our results suggest that this may be the case for both task and relationship conflict, although our results are only marginally significant (which may be due to our small sample size). Our regression results suggest that the use of power to resolve conflicts might exacerbate the negative effects of relationship conflict on the novelty of products developed by the team. (However, we did not observe a direct negative path between relationship conflict and novelty, and could not test for the interaction, in the path analysis.) Theoretically, the regression results make sense. Similarly, our results suggest that the positive effects of task conflict on product novelty are strengthened when teams use standards/rights to resolve them. Task conflict can help a team produce useful, creative products, but teams need to use mutually accepted procedures (i.e., a rights-based conflict management approach) to resolve task conflict to improve product novelty.

More research is needed into discovering what it was about a rights-based approach that was so useful in this setting. One possibility is that using standards to resolve task conflict may be necessary to increase product novelty because novelty is a uni-dimensional criterion and might require coalescing around a single approach (in contrast to usefulness that is determined via multiple criteria). More generally, what is standard practice to one function may be quite novel to another, and a rights-based approach is the process through which teams discuss which standard practice should be employed.

We provide evidence that conflict and coordination have effects on different aspects of creativity. While conflict largely stimulates or hinders the novelty aspect of creativity, ease of

coordination is associated with the usefulness aspect of creativity. Disagreements on ideas can lead to more novel solutions because they allow for integration of diverse functional perspectives. However, the development of a useful product requires both the implicit coordination of task-related activities and the explicit discussion of coordination concerns. In contrast to prior research which has not distinguished between predictors of novelty and usefulness of creativity, we suggest that the two dimensions of creativity may require the effective use of different team processes.

Limitations and Avenues for Future Research

There are several limitations to this study that deserve mention. The first is our small sample size. Cutting against this limitation is the fact that our results appear stable using PLS modeling, which is ideal for analyzing small samples. Second, our measure of creativity is self-report. There are two potential problems with this approach – the possibility of demand effects and of halo effects. A demand effect would imply that our respondents rated the creativity of their products based on their beliefs about how their team process should affect their outcomes. That is, teams that felt their team process was a good one would also have rated their creativity as high because they expected team process to lead to more creativity. Alternatively, a halo effect would imply that respondents' who felt things were going well in their group rating all aspects positively – including processes and creativity. While possible, we believe both of these explanations are unlikely because of the interaction effects we found predicting novelty of the product. Regarding demand effects, participants' mental models of the relationship would have to be quite complex for their responses to reflect a contingency between their level of conflict and the conflict management approach they used. Regarding a halo effect, a halo wouldn't allow for those subjects who reported high task conflict (a good thing) and lower novelty, as occurred

for the groups who relied less on rights to resolve their task conflicts. However, other factors may be affecting self-ratings of creativity that we haven't identified. Therefore, we are currently collecting independent expert ratings of the team's product and final report along several creativity dimensions including useful, usable, desirable, novel, etc. We expect to have those results and hope to present them at the conference, should be paper be accepted.

Third, student teams were not interacting in an organizational context. Thus, the teams were not influenced by the pull of functional areas in terms of functional silos and misaligned incentives that often occur within organizations. If anything, these forces should exacerbate the effects of rGaps and increase the importance of team integration, conflict management, and coordination. In addition, student teams received instruction and coaching within the context of the course that organizational teams might not receive. While this could result in demand effects when responding to the survey, we attempted to mitigate the problem by collecting data over time. In addition, the variance amongst teams suggests that while team members might be aware of issues relating to team processes, they were not reporting their team as being the best or brightest. Finally, whereas the quality of their product mattered to the sponsoring company, participants' personal careers were not at stake. While this might limit the engagement students had with the course, the presence of the company sponsor and the possibility of receiving a patent did raise the stakes for students.

Despite these differences in context, many proxies for organizational realities were in place, including: 1) prior course experience mostly in their own discipline served as a proxy for the reality of functional silos and independent thought worlds, 2) simultaneously having to satisfy course goals and company sponsor's goals served as a proxy for having to serve multiple constituents such as a functional boss and project leaders, 3), the compressed time frame in

having to complete the project in 15 weeks with no possibility for deadline slippage represented working under time pressure in an organizational setting, and 4) students were enrolled in other courses simultaneously, just as team members often have to work with competing demands for their time when working on multiple projects. We believe that the cognitive and affective mechanisms that we tested are basic to interpersonal interaction. While our context is in an educational rather than organizational setting, thinking is thinking and relating is relating. These basic processes may be influenced by other factors within organizations, but their basic functions should remain relatively constant.

Organizational Implications

There are several points at which organizational practices can influence the intra-team states and processes found to be important in this research. First, organizations can try to manage and bridge rGaps in functionally diverse teams. Second, organizations (and team leaders) can provide opportunities for affective and cognitive integration. Cognitive integration can be improved through job shadowing, high quality job rotation programs, and increased affective integration. The goal for cognitive integration would be to increase understanding of how other functional areas think about the task without gaining all the specific functional knowledge about task performance. Affective integration can be improved by providing opportunities for team members to interact in a resource-supported environment. We assume that it will easier for teams to develop trust and respect when they are not competing for resources and when the external environment is relatively stable. Third, organizations can influence the norms of conflict management used in the organization through training and role modeling by team leaders. Modeling the use of interests and rights, but not power, can help teams capitalize on task conflict and minimize the negative impact of relationship conflict on creativity.

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Appendix A: Selected Survey Items

TEAM INTEGRATION

Affective integration:

1. I trust him/her
2. I believe s/he is dishonest
3. I am willing to rely on his/her work related judgments
4. I am willing to depend on him/her to support me in difficult situations
5. S/he works hard
6. I respect him/her
7. S/he is unprofessional
8. There is usually some value in his/her perspective
9. I think s/he has a good work ethic
10. I have little faith in the things s/he says [r]

Cognitive integration:

1. I understand his/her ideas
2. I tend to dismiss what s/he says [r]
3. His/her ideas are difficult to build on [r]
4. It is hard to incorporate his/her ideas in with my own [r]

REPRESENTATIONAL GAPS: Adjectives for describing a well-functioning product development team

Analytical	Flexible	Open to inspiration
Chaotic	Fluid	Planned out
Clear leadership	Informal	Predictable
Decisions made based on gut	Intuitive	Process driven
Democratic	Logical	

CONFLICT MANAGEMENT APPROACHES (how often do you…)

Interests

1. Try to integrate your needs with other party's needs
2. Brainstorm novel or innovative solutions
3. Share truthful information about your priorities and needs

Rights

1. Follow standardized procedures that are applicable
2. Search for pre-established rules or procedures that might apply to the substance of the problem

Power

1. Make threats or ultimatums
2. Provide false information
3. Use Intimidation

CREATIVITY – Usefulness

The product …

Usefulness	**Usability**	**Desirability**
… fulfills a need	… is ergonomic	… is desirable
… fits in with people's lifestyle	… is easy to use	… is pleasing
… performs a useful task	… is intuitive.	… is wanted

Table 1
Correlations of variables in the model

		rGaps	Cog. Int.	Aff. Int.	Task conf	Rel. conf	Coord	Interests	Rights	Power	Novel
Represent. Gaps	Pearson Correlation	1									
	Sig. (2-tailed)										
	N	21									
Cognitive Integration	Pearson Correlation	-.470(*)	1								
	Sig. (2-tailed)	.032									
	N	21	21								
Affective Integration	Pearson Correlation	-.366	.814(**)	1							
	Sig. (2-tailed)	.103	.000								
	N	21	21	21							
Task conflict	Pearson Correlation	.202	.111	.318	1						
	Sig. (2-tailed)	.379	.631	.159							
	N	21	21	21	21						
Relationship Conflict	Pearson Correlation	.253	-.405	-.613(**)	-.252	1					
	Sig. (2-tailed)	.269	.069	.003	.270						
	N	21	21	21	21	21					
Coordination	Pearson Correlation	.157	.170	.494(*)	.424	-.271	1				
	Sig. (2-tailed)	.497	.460	.023	.055	.235					
	N	21	21	21	21	21	21				
Intrests	Pearson Correlation	.112	-.034	-.050	.239	.061	.124	1			
	Sig. (2-tailed)	.628	.885	.830	.297	.793	.591				
	N	21	21	21	21	21	21	21			
Rights	Pearson Correlation	-.226	.254	.075	-.117	-.054	-.433(*)	.592(**)	1		
	Sig. (2-tailed)	.325	.266	.745	.614	.817	.050	.005			
	N	21	21	21	21	21	21	21	21		
Power	Pearson Correlation	.241	.065	-.183	.027	.260	-.171	-.020	.016	1	
	Sig. (2-tailed)	.292	.779	.426	.907	.255	.458	.930	.947		
	N	21	21	21	21	21	21	21	21	21	
Novelty	Pearson Correlation	-.091	.296	.344	.475(*)	-.527(*)	.219	.078	-.202	.061	1
	Sig. (2-tailed)	.695	.193	.127	.030	.014	.340	.738	.381	.793	
	N	21	21	21	21	21	21	21	21	21	21
Usefulness	Pearson Correlation	.116	.103	.156	.401	-.301	.315	-.066	-.266	.123	.582(**)
	Sig. (2-tailed)	.617	.658	.499	.072	.186	.165	.777	.244	.596	.006
	N	21	21	21	21	21	21	21	21	21	21

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

TABLE 2

Moderation analysis (1): The interaction effect of task conflict and rights on innovation (novelty dimension of creativity)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.833	.076		50.500	.000
	Task conflict	.689	.232	.578	2.969	.009
	Rights	-.327	.171	-.439	-1.904	.074
	Interaction: Task conflict*rights	1.362	.697	.443	1.954	.067

a Dependent Variable: innovate

Moderation analysis (2): The interaction effect of relationship conflict and conflict management style on innovation

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.883	.077		50.591	.000
	Relationship conflict	-.338	.132	-.569	-2.563	.020
	Power	.112	.266	.093	.421	.679
2	(Constant)	3.957	.085		46.788	.000
	Relationship conflict	-.279	.130	-.470	-2.153	.046
	Power	.210	.258	.176	.814	.427
	Interaction: Relationship conflict*Power	-.797	.461	-.361	-1.729	.102

a Dependent Variable: innovate

Moderation analysis (3) The interaction effect of affective integration and cognitive integration on task conflict

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.170	.053		78.720	.000
	Cognitive integration	-.541	.344	-.397	-1.570	.135
	Affective integration	1.019	.303	.860	3.366	.004
	Interaction: Cognitive integration* Affective integration	-2.131	.463	-.683	-4.601	.000

a Dependent Variable: task conflict

Figure 1

Theoretical model

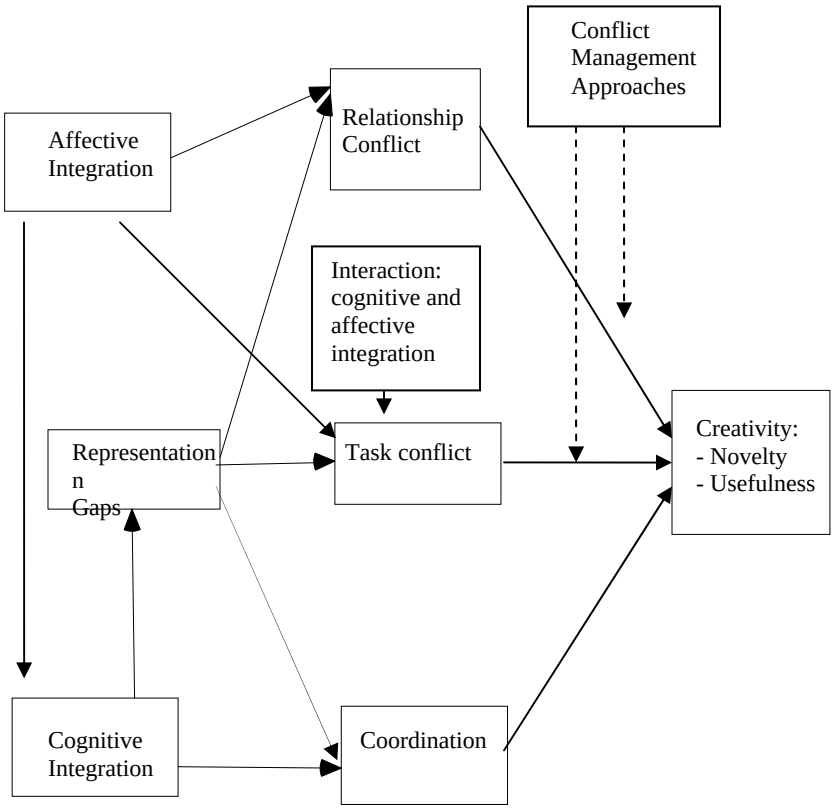
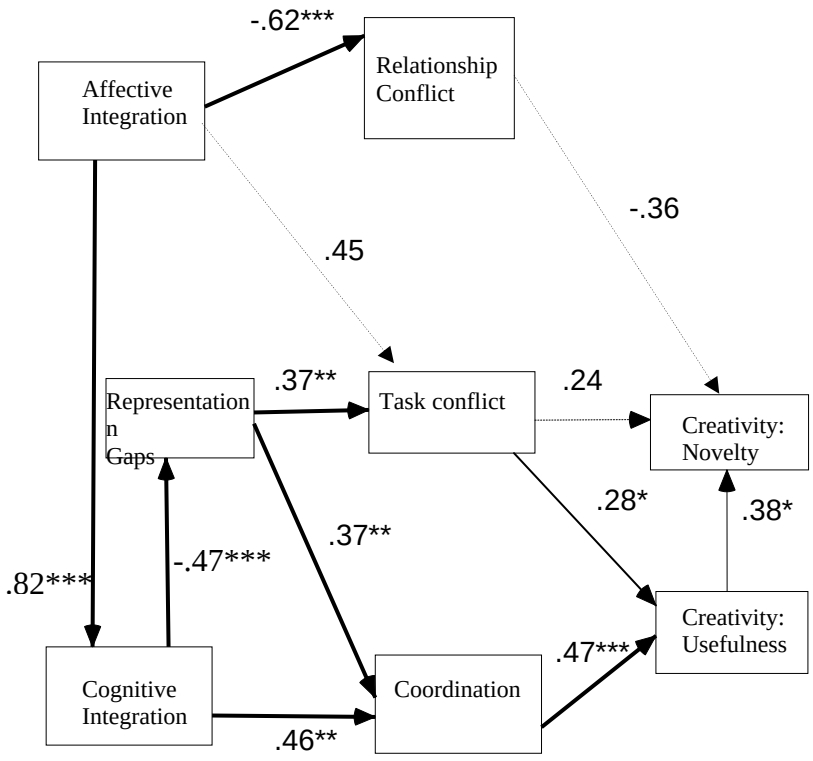


Figure 2

Path analysis: Structural model



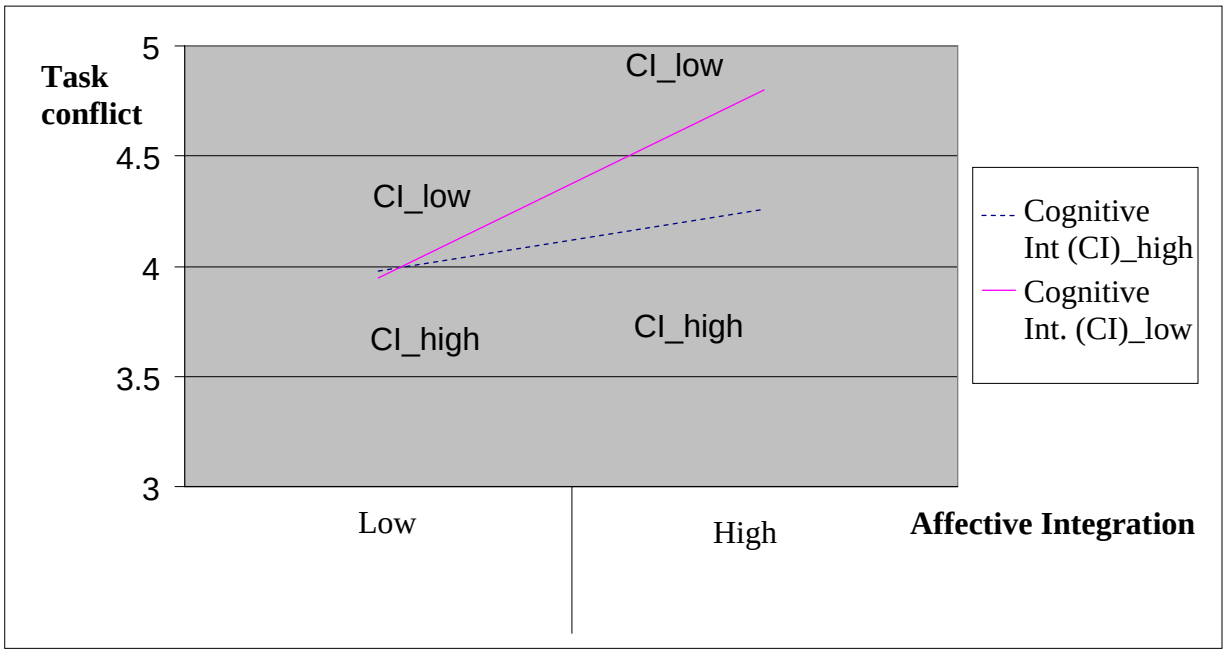
Note 1: *** and bold line: path coefficient is significant at .01; ** and bold line: path coefficient is significant at .05; * and thin line: path coefficient is significant at .10; No star and dashed line: path is not significant in the path model but it is a part of an interaction effect in the regression analysis.

Note 2: The moderation effects from the theoretical model are not included in the path analysis.

Note 3: Regression results show that affective integration and cognitive integration interact to influence task conflict; task conflict and rights interact to influence creativity (novelty); relationship conflict and power interact to influence creativity (novelty).

Figure 3

Interaction effect of cognitive and affective integration on task conflict (based on Aiken and West, 1992)



Note: High and low on all variables means one standard deviation above and one standard deviation below the mean respectively.