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Knowledge Disparity and Creativity in IT Project Teams - a Creative Synthesis Perspective

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KNOWLEDGE DISPARITY AND CREATIVITY IN IT PROJECT TEAMS – A CREATIVE SYNTHESIS PERSPECTIVE

Research Paper

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Abstract

IT project teams have become the modern way of organizing IT talents. However, despite its importance, the IT project team creativity has been understudied. Drawing on the literature of the creative synthesis perspective, we argue that creative synthesis process consisting of collective attention, similarity building, and enacting ideas, could affect the IT project team creativity. Additionally, we also argue that team knowledge disparity, as an understudied aspect of knowledge diversity, could moderate the relationship between creative synthesis processes and the IT project team creativity. We conducted an online survey to verify the conceptual framework and confirmed the relationships for the hypotheses, as predicted. The paper contributes to the IT project team literature by applying a new theoretical lens based on creative synthesis, as well as providing critical insight into how synthesis processes interact with team knowledge disparity to jointly influence team creativity in IT project teams.

Keywords: team creativity; creative synthesis perspective; team knowledge disparity.

1 Introduction

The complex and non-routine nature of IT development work requires project teams to collectively seek creative solutions for problems encountered (Venkatesh et al. 2018). Therefore, team creativity has been recognized as an important factor in system development, especially when addressing new business problems and developing new systems (Kudaravalli et al., 2017; Tiwana and Mclean 2005; Zhang, 2019).

Despite its significance, IT project team creativity has only been occasionally examined in the IS field. Team processes are direct predictors for team creativity as a team output (Zhou and Hoever, 2014). Thus, the examination on team processes has long been a focus for team creativity studies. A few studies have examined how general team processes, such as expertise integration (Tiwana and Mclean 2005) and task conflict (Farh et al. 2010) can influence IT project team creativity. While insightful, the mere consideration of these general team processes contributes little to understanding the nature of team creativity processes (Harvey 2014). How team creativity is generated thus remains a black box.

To fill this research gap, we extend recent theoretical development in team creativity research from the management literature, that of the creative synthesis perspective (Harvey 2014), to unveil the team creativity development processes in IT project teams. This theoretical perspective proposes three crucial aspects of team creativity development processes—*collective attention*, *similarity building*, and *enacting ideas*—to afford a nuanced comprehension from the micro level of what is happening when

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the collective generates creativity. Using this perspective in our context, we propose the first research question: *To what extent does creative synthesis process affect team creativity in IT project teams?*

Previous research has identified that knowledge diversity among members is the foundation for the development of team creativity (Jia et al. 2014; Parke et al., 2022; Shin and Zhou, 2007). Without diverse knowledge, surface consensus or "groupthink" might result, compromising team creativity (Janis, 1982; Miron-Spektor et al., 2022). The creative synthesis perspective particularly highlights the critical role of knowledge diversity in catalyzing the creative synthesis process (Harvey 2014). However, this perspective thus far focuses on the variety dimension of knowledge diversity, defined as the differences in information and knowledge content among members (Harrison and Klein 2007). This aspect of diversity has been commonly embraced in contemporary IT project teams in the form of cross-functional team composition (Ghobadi and D'Ambra 2013; Kudaravalli et al., 2017), therefore being less problematic.

An understudied aspect of knowledge diversity, yet particularly important in IT project teams, is knowledge disparity, defined as the distribution of member differences in the levels of valued assets of knowledge (Harrison and Klein 2007). This concept is commonly manifested as the difference in the levels of relevant working experience (Han et al. 2014; Pollok et al., 2021). While managers prefer to recruit experienced developers for their proven records to generate robust solutions with efficiency, the cost of hiring experienced developers drives organizations to have a tendency to hire junior staff (Moshe 2017). Furthermore, the fast-changing nature of the software development industry signifies the necessity of relying on junior developers for task completion as they seem to be better at learning new knowledge (Vasilescu et al. 2015). It is unclear what the best mix of experienced and junior developers should be. In practice, we do observe that the degree of mix between experienced and junior developers vary greatly across IT project teams. Thus, it is important to address this practical concern by examining the extent to which knowledge disparity contributes to team creativity in IT project teams.

However, knowledge disparity has received relatively limited research attention (Ren et al. 2016), with inconclusive results. Conceptually, knowledge disparity has been argued to have negative consequences due to the domination of the experienced in discussion and the suppression of juniors' idea expression (Harrison and Klein 2007). Empirically, however, prior research found knowledge disparity may exert different effects in the technology-mediated communication context, which is the case for IT project teams, as opposed to the face-to-face communication context (Carte and Chidambaram 2004; Ren et al. 2016; Robert et al. 2018). More importantly, to our study, while the significance of knowledge variety as an aspect of knowledge diversity has been recognized in the creative synthesis perspective (Harvey 2014), it is completely unclear what role that knowledge disparity, another important aspect of knowledge diversity, plays in catalyzing the creative synthesis process. This leads to our second research question: *to what extent knowledge disparity affects the relationship between creative synthesis process and team creativity in IT project teams?*

This study aims to contribute to the literature in the following ways. First, extending the new theoretical perspective based on creative synthesis (Harvey 2014), we offer a more nuanced understating of IT project team creativity by examining the applicability of the creative synthesis processes consisting of collective attention, similarity building, and enacting ideas in the IT project team setting. This research also adds to the IS literature on IT project team creativity by drawing on a powerful theoretical lens at the micro level of what is actually happening during team creativity development processes, thus going beyond the general team processes studied in the existing IT project team literature. In taking this approach, the study makes an empirical contribution by being the first to develop instruments and empirically test the creative synthesis perspective. Second, by considering the role of knowledge disparity, we provide a better understanding of how synthesis processes interact with team knowledge disparity to jointly influence team creativity in IT project teams. In doing so, this study not only provides a more contextualized understanding of how creative synthesis contributes to IT project team creativity, but also extends the original creativity synthesis perspective by accounting for another important aspect of diversity, i.e., knowledge disparity.

2 Theoretical Background

2.1 Team creativity and the creative synthesis perspective

Team creativity is broadly defined as the generation of novel and useful ideas on products, services, processes, and procedures by a group of members interdependently working together in the context of team objectives (Amabile 1988; Shin and Zhou 2007). Both novelty and usefulness are desirable for team creativity. Team creativity occurs in social interactions among team members, where individuals build on and link each other's unique ideas, knowledge, and skills, jointly creating "a collective system of creative actions" (Tiwana and Mclean 2005). Team processes where both informal and planned interaction occur are therefore important and direct predictors for team creativity. Harvey (2014) put forward the creative synthesis perspective to explain the processes that can improve the creative level of the output generated by a collective. The key idea rooted in creative synthesis is the integration of input from different team members to form a shared and inventive understanding that is unique to the team (Harvey 2014), and this understanding can serve as the map or framework that guides how team members comprehend and solve problems. A shared creative framework increases the possibility that the final solutions will also be creative. Three aspects of the creative synthesis perspective (Harvey 2014) are examined herein—that of collective attention, building similarities, and enacting ideas—wherein team members transform various resources such as knowledge and skills into team-level creative outputs. These processes afford researchers a further and closer look at team creativity development processes (Chen and Adamson 2015).

Collective attention refers to the extent to which team members keep sustained and concentrated attention on exchanged information in their communications (Harvey 2014). While maintaining collective attention is necessary for team members to effectively progress their task (Metiu and Rothbard 2013), relying on collaboration technologies for communication presents challenges. Similarity building refers to the extent to which team members identify associations and relationships among knowledge elements held by each other to facilitate knowledge utilization (Harvey 2014). Examples of similarity building include the use of techniques such as analogies to search and identify similarities among otherwise disconnected and different ideas. Particularly, when members have different knowledge backgrounds, searching and building similarity while being exposed to differences amongst themselves will likely lead to creative association. Enacting ideas, as in trying out ideas that have been generated, means the extent to which ideas generated by team members are experimented with among the group before final implementation (Austin 2016; Harvey 2014). Along with experimentation, enacting ideas goes beyond purely cognitive or verbal activities such as elaborating or identifying the disadvantages and advantages of a solution (Harvey 2014). Common ways to idea enact ideas include drawing (Carlile, 2004), building prototypes (Hargadon 2002), and even conversations about how to realize an idea (Harvey 2014). IT enables enacting with a comparatively low cost (Austin 2016).

The creative synthesis process opens up the "black box" of team creativity development. Harvey (2014), along with other scholars (e.g., Hoever et al., 2018; Parke et al., 2022), has further argued diversified knowledge is necessary if the creative synthesis process is to generate high level of team creativity, emphasizing the importance of knowledge diversity as an important contextual factor. Thus, we considered the moderating role of team knowledge disparity, one dimension of team knowledge diversity, in the relationship between creative synthesis and team creativity.

2.2 Team knowledge disparity

Team knowledge diversity is a team level construct, which measures the knowledge structure within the team. Diversity takes various forms, including variety, separation and disparity, where different types of diversity are conceptualized and found to exert effects in quite distinct ways (Harrison and Klein 2007). In the present study, we focus on the type of disparity. Knowledge disparity refers to the distribution of differences in the levels of team members' relevant working experience in the software

development industry (Han et al. 2014; Harrison and Klein 2007). When knowledge disparity is low in the team, team members have similar levels of relevant working experience; when knowledge disparity is high, at least one member has a higher level of relevant working experience than other members.

Team knowledge disparity is not considered conducive to creative group processes because it may foster conformity and suppression of ideas from disadvantaged or less-empowered members, such as new or younger developers (Harrison and Klein 2007). In this case, those who do not share the valued resources may have a feeling of injustice or fewer opportunities to express their opinions, and thus rely more on members who possess the valued social assets to make decisions (Harrison and Klein 2007). As knowledge disparity suggests that team members have different levels of knowledge, they can also be expected to have different perspectives on organizational know-how as well as varied informational networks (Nishii and Mayer 2009). Members with different work tenures will also bring more variety to the collective knowledge base (Bell et al. 2011), which is found to increase team creativity.

We argue that the effects of knowledge disparity may be influenced by communication contexts and the nature of work that the teams perform. First, the IT-mediated communication context may influence the direction of knowledge disparity effects. Visual anonymity due to the use of technology-mediated communication will make cues including working tenure less visible (Carte and Chidambaram 2004). For example, working tenure can be inferred by observing an individual's overt appearance, such as gray hair. When team members communicate via technologies, those cues cannot be directly observed, thus alleviating its potentially negative effects of suppression. These IT-mediated communication contexts make it difficult to conclusively explain how knowledge disparity will affect team creativity, however.

Second, the characteristics of the work that teams perform may also contribute to restraining the negative effect of knowledge disparity. For example, software development, characterized by meritocracy instead of bureaucracy (Ren et al. 2016), signifies a suppression effect of IT-mediated communication (Carte and Chidambaram 2004). Specifically, the criterion for success in industries engaged in software development is whether the coding can work or not (meritocracy) but not whether the person who is coding is senior or not (bureaucracy). As the employees who provide coding or bug-fix methods will have more discursive power, the influence exerted by obtaining higher knowledge levels may be further weakened, as it is not the knowledge level but whether the coding works successfully that matters to the organization.

3 Research Model and Hypotheses

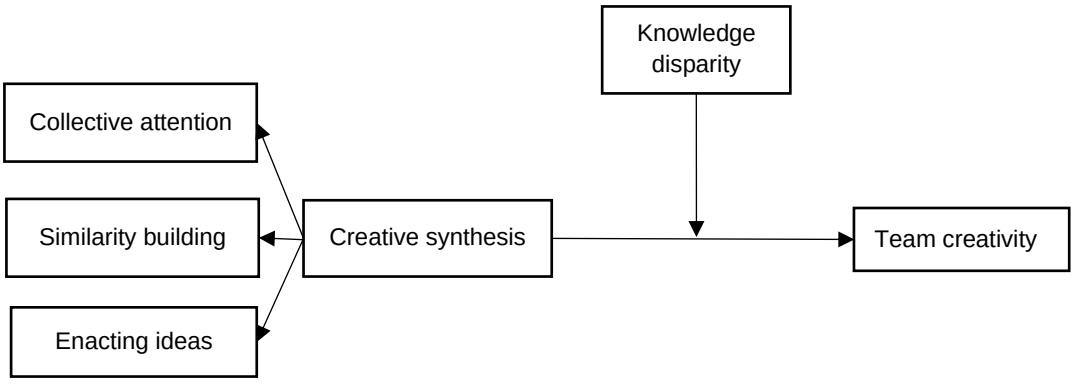

Figure 1. Research model.

3.1 Creative Synthesis and Team Creativity

We propose that the processes involved in creative synthesis are conducive to IT project team creativity. First and foremost, the nature of an IT project task signifies the role of enacting ideas for IT project team

creativity. Enacting ideas provides team members with opportunities to experiment with different ideas, which is particularly crucial for IT project teams. For example, business analysts and developers in the IT project team may prefer different solutions for a specific challenge or problem. Through trying out potential approaches, they can compare and combine those ideas to address specific tasks. This process can help team members form a better cognitive understanding of how their ideas can contribute to the whole picture of the task, and how altering one's own idea, or that of others, may lead to changes in the whole picture (Harrison and Rouse, 2015). Such a broader understanding provides opportunities for members to better know each other and take each other's perspectives into consideration (Harvey, 2014). Particularly, due to the intellective nature of IT project tasks, team members can demonstrably decide the most creative solution(s) from the idea pool through enacting ideas. Also, after engaging in the process of enacting ideas in IT project teams to meet business challenges, it is unlikely that team members would choose suboptimal or uncreative solutions. Lu et al. (2019) verified that by demonstrating thinking in a concrete way, idea enactment help related others to assess and connect different ideas. Enacting ideas thus provides a sound mechanism for team members to integrate and select ideas for the sake of creativity.

In addition, the outcomes of enacting ideas have the potential to add emotional value to team creativity. When the task goal is being approached in a smooth or flowing manner, members perceive their thinking processes as progressing coherently or favorably (Mason and Bar, 2012), and they will likely have more positive attitudes about workplace operations (Amabile and Kramer, 2011). Even when there are setbacks or failures in experimentation, progress can be made. For example, determining some approaches are not feasible, or allowing team members to reflect on problematic outcomes, may lead to new and innovative solutions (Konradt et al., 2016). Motivated or inspired as such by group synergy, team members will be more likely generate creative ideas. Enacting ideas will thus promote IT project team creativity and personal value through the very process of exploration and experimentation.

Second, similarities that exist among different team members' perspectives can serve as the basis for building new and creative connections. IT project team members with different informational backgrounds, such as business analysts and developers, tend to have varying viewpoints concerning task-related issues (Majchrzak et al. 2012). People may naturally react negatively or defensively to ideas that are different from their own (Muller and Ulrich, 2013), especially when they are not presented in a comparative or balanced manner. When similarities are identified between concepts that are different in this case, or a new or existing idea is presented, team members are more likely to cognitively accept the ideas in spite of their differences (Ford and Ford, 1994). This encourages a combination of creative ideas as the ultimate outcome. Such acceptance by other team members may also make the contributing members feel that they are respected and their ideas make a meaningful contribution to the group (Tekleab and Quigley, 2014). Furthermore, similarity building can help team members extract a higher-level abstract understanding of task-related issues. For example, the similarity between solution A and solution B to a singular problem is that they are both related to architectures at a higher construal level, where people think abstractly and look at the bigger picture instead of focusing on details. High construal levels can also lead to more exploratory learning (Reyt & Wiesenfeld, 2015), facilitate remote and flexible associations (Sassenberg et al., 2017), reframe the logic on how the team interprets problems (Trope and Liberman, 2010), and in the long run exert a positive effect on problem resolution. Similarity building among members with diversified backgrounds is thus expected to enhance team creativity.

Finally, collective attention will benefit team creativity in IT project teams. Team members, consisting of people with different backgrounds (He et al., 2007), tend to draw attention to different perspectives on task-related issues more relevant to their own domain of expertise (Majchrzak et al., 2012). For example, business analysts and developers may have distinct ideas concerning task priorities. These differences could be further exaggerated when they rely heavily on collaboration technologies for communication, because of problems afforded by IT-mediated communication, such as misunderstandings and asynchronous interactions (Cramton, 2001; O'Leary et al., 2012). In this situation, collective attention serves to bridge the focus from different perspectives in IT project teams that rely on collaboration technologies for communication. Further, in the process of explaining,

discussing, and evaluating an idea or an issue, collective attention helps team members to cognitively attend to the information exchanged among other members (Harvey, 2014), allowing them to better comprehend the basic logic and reasons behind the specific idea being addressed. The increased cognitive engagement in each other's perspectives can provide opportunities for team members to approach the task and problems from a more comprehensive and nuanced perspective (Milliken et al., 2003).

In the real teamwork context, it is usually that the inter-relationships among three sub-dimensions improve team creativity. Consistent with Harvey's original literature, team creativity is achieved through a shared and new framework to connect the different perspectives among team members, which could be achieved through the mutual influence among the three process facilitators. Specifically, team members collectively attend a discussion that builds the basis for them to understand the potential similarities among disparate perspectives. Common attraction to the same idea can fuel the interactions among team members to enact and further develop an idea. Furthermore, enacting ideas is the process to help team members collectively attend to an idea through team members illustration of what is and is not collectively known about an idea. In this way, the three synthesis processes interact with each other to provide a foundation for novel ideas to develop. Hypothesis 1 is thus proposed:

H1: Creative synthesis is positively related to team creativity.

3.2 The Moderating Role of Team Knowledge Disparity

Team knowledge disparity will moderate the relationship between synthesis processes and team creativity. When knowledge disparity is high, there is at least one member who is disproportionately experienced in working tenure compared with others. The effects of collective attention, similarity building, and enacting ideas on team creativity will be stronger in this setting compared with low team knowledge disparity. First, a high level of knowledge disparity means that team members are socialized into the industry at different times. This allows them access to broader perspectives of know-how (e.g., programming methods) as well as varying informational networks (Nishii and Mayer 2009). Members with different tenures can bring a variety of information sources to the group (Bell et al. 2011). Newcomers with less or even little working experience, for example, can provide fresh ideas and approaches and challenge existing methods, while more tenured team members can offer insights about the team's existing structure, responsibilities, opportunities, and challenges already being experienced.

A particularly important factor here is IT-mediated communication. Studies in face-to-face contexts have argued that the existence of experienced members will tend to suppress the ideas of junior employees (Han et al. 2014; Harrison and Klein 2007). IT-mediated communication, however, allows different perspectives and ideas to be expressed by weakening this suppression effect, achieved through the "reduction capabilities" of the media (Carte and Chidambaram 2004; Giambatista and Bhappu 2010). Specifically, visual anonymity can lower evaluation apprehension based on work tenure status (Robert et al. 2018). IT-mediated communication can in this way better afford equal participation of team members, allowing minority opinions to be voiced and debated. (Carte and Chidambaram 2004).

Second, experienced members have more experience, and less-tenured members usually have new energy and are motivated by the desire to learn (Vasilescu et al. 2015). Thus, mixed-tenure teams provide more opportunities to leverage the energy and experience brought forward by both groups (Daniel et al., 2013), allowing them to solve problems in a more efficient and timely manner. Seniors will have knowledge about how to fix bugs while junior developers tend to have more flexible minds and perhaps increased exposure to novel technologies initiated by the young and adventurous. Teams consisting solely of seniors may be stuck on their past paths, yet teams consisting entirely of new developers may not know how to handle the range of issues one learns to manage by experience. Use of both is therefore optimal.

Knowledge disparity will add great value to team creativity if it is understood as both novelty and usefulness (Miron-Spektor and Beenen 2015; Zhou et al. 2017). Novelty refers to ideas that are new,

while usefulness refers to concepts that are feasible or practical (Anderson et al. 2014; Sullivan and Ford 2010). As high team knowledge disparity creates an expanded knowledge base, associations among diversified and remote information sources can lead to novelty in the workplace, while having extensive work experience can help in examining the usefulness and feasibility of generated ideas.

Through these mechanisms, team knowledge disparity will interact with key synthesis processes, ideally leading to high levels of team creativity. Specifically, collective attention to a focal idea improves team members' cognitive engagement to that idea. Team members will evaluate this idea from a range of perspectives, providing opportunities to integrate their different ideas. Identifying relationships among disparate ideas can lead to team creativity as members with diversified knowledge will react differently to the same enacted idea. Building similarities among different ideas and perspectives to achieve an end is essentially what is expected of a creative team. Team members' different interpretations of concept's ideal outcomes versus the reality of achieving them will lead to a more comprehensive understanding of the concept and task at hand. Improving and correcting the focal idea from various perspectives means the solution to its challenges will more likely to be a creative one.

Knowledge disparity is low when team members have similar working tenures and less varied perspectives and social networks. Of the three synthesis processes contributing to team creativity, collective attention without diverse knowledge encourages group-thinking (Janis, 1982). The process of similarity building will be less likely to form new associations that have not existed before. Team members may have similar or even the same interpretations of topic discrepancies or challenges when enacting ideas, and are thus more likely to generate similar solutions. When team knowledge disparity is low, the relationship between the three synthesis processes and team creativity will be weak. Hypothesis 2 are thus proposed:

H2: When knowledge disparity is high, creative synthesis is more positively related to team creativity.

4 Methods

4.1 Sample and Data Collection Procedures

We conducted an online survey to collect data from a Chinese corporation that provides software development service to its customers. Before data collection, 8 interviews were conducted with managers, team leaders and members from the company to ensure that this is a proper empirical context. The interview showed that 1) creativity matters in their work, and 2) there are different levels of knowledge disparity across teams. The company identified 62 IT project teams with 566 members and 62 team leaders for this research. The calculation of disparity requires demographic information of all team members. Otherwise, random and systematic bias—the situation where the team cannot be represented by the selected individual members—may occur (Allen et al. 2007). However, one hundred percent participation from all team members could not be guaranteed in the survey due to leave, business trips, and other limitations. Initially, we sent survey to 62 teams, with 546 team members and 62 team leaders. We finally collected data from 485 individual members and 62 leaders from the 62 surveyed teams. The overall useful response rate is 89.97%, with each team having a response rate of more than 80%.

As the survey was conducted in China while the measurements were in English, a back-translation process (Brislin 1986) was used to ensure that the English and Chinese versions of the scale are comparable and compatible. After the completion of the final Chinese version of the measurement, the survey was created and published online. The data were collected from different sources, including team members and leaders, in order to alleviate the concern for common method bias procedurally (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). We distributed different questionnaires to team leader and members separately at the same time. Team leaders were required to provide information on team size and team length (in months), and rated the creativity of their teams. Team members provided their demographic information and reported their perception of creative synthesis and knowledge sharing. In

order to guarantee that participants paid attention throughout the survey, the questionnaire was designed to be completed in a rather short time period, i.e., within 12 minutes. In the survey, an attention-trap question was included in the second half of the survey (Liu and Wronski, 2018) to ensure the measurement quality. If participants fail in answering this question, the response will be considered invalid. The attention-trap question in the online survey was, "Please select '2' as the answer for this question". Once the respondents selected the wrong answer for this question, they would be removed from the sample. 23 team member respondents were removed from the data analysis due to their wrong answer to the attention-trap question.

In order to match members with their leaders and protect the privacy of participants, the following procedures were adopted. First, the staff from the HRM department gave a unique number to each participant and provided this number to researchers. Importantly, the numbers were categorized to the teams that the participants belong to. Researchers used this number in the survey instead of names to ensure the privacy of participants. Second, we created a unique questionnaire along with a corresponding unique link for each participant labeled by their unique number, and made a list with the number, email, and questionnaire link. Then, the staff from the HRM department sent each number (i.e., representing each participant) an email using their internal email system. The email explained the objective of the survey, promised the protection of privacy to the participants, and provided the link each participant should click to start their online surveys. We sent four follow-up emails requesting participants to complete the survey. Finally, we provided an aggregated report to the company, without giving detailed data of each participant (only the research team had access to the survey data for each individual).

4.2 Measurements

Measurement items were adapted from previous studies when established scales from the literature were in place to guarantee measurement validity and reliability. Minor adjustments were made to make sure that the measurement items are appropriate in the research context. Items were measured using a seven-point Likert scale, ranging from 1 = strongly disagree to 7 = strongly agree. The measurement scale for team creativity was adapted from Gong et al. (2013) and Shin and Zhou (2007), and includes four items. For the measurement of knowledge disparity, we used the coefficient of variation for the work tenure of all team members (Han et al. 2014), which is widely used in the literature (Harrison and Klein 2007; Ren et al. 2016). Tenure was measured using the number of years working in the software development industry. Several control variables were also incorporated, including team size, the length of time since the team was established (labeled as team length), gender diversity, age diversity, team members' average working tenure, and knowledge sharing. Both gender diversity were measured with Blau's (1977) index and age diversity was measured with the standard deviation of members' age (Harrison and Klein, 2007). The measurement for knowledge sharing comes from Choi et al. (2010).

Creative synthesis process is specified as a second-order reflective construct, with three first-order sub-constructs: collective attention, similarity building, and enacting ideas. As this study is the first to operationalize the three key dimensions of the creative synthesis perspective, we followed the procedures suggested by Hoehle and Venkatesh (2015), and Mackenzie, Podsakoff and Podsakoff (2011) from the established literature. to develop items. The constructs that used self-developed measures include collective attention, similarity building, and enacting ideas. We first collected items from the literature and then conducted interviews with five developers from two software development teams for additional items related to the constructs. Second, we conducted card sorting practice to establish the content and discriminant validity of the measures, with the results shown in Appendix A. Then in the pilot study, we distributed the items to 29 developers from 3 IT project teams to collect data for exploratory factor analysis (EFA), with the results shown in Appendix B. After revisions and adjustment based on the results from card sorting and EFA, we have our finalized scales ready for the large scale survey. The measure of all variables is shown in Table 1.

Variables	Items
Collective attention (Self-developed)	1. In our team's communication, team members had a shared focus. 2. In our team's communication, team members focused on the same topic, task or goal. 3. In our team's communication, team members could follow each other's topic. 4. In our team's communication, team members had no confusions over focus. 5. In our team's communication, team members are on the same page in terms of topic.
Similarity Building (Self-developed)	1. Team members attempt to figure out the similarities among each other's ideas. 2. Team members actively searched for ways relating each other's perspectives. 3. Team members used various techniques (e.g., analogy, figures, models) to help identify connections among each other's viewpoints. 4. Team members emphasize the commonality among the knowledge they held.
Idea Enacting (Self-developed)	1. Team members talk about how to try out an idea. 2. Team members experiment with their ideas. 3. Idea experimentation is necessary in daily work. 4. Team members generate prototypes to illustrate their thoughts.
Knowledge sharing (Choi et al., 2010)	1. We share our work reports and official documents with other team members. 2. We provide our manuals and methodologies for other team members. 3. We share our work experience or know-how with other team members.
Team Creativity (Gong et al. 2013; Shin and Zhou, 2007)	1. Our team produce new ideas. 2. The new ideas produced by our team is useful. 3. This is a creative team. 4. The ideas from our team are significant to our organization.

Table 1. Measurement table.

5 Data Analysis and Results

A three-step approach was adopted to analyze the data. As the data to measure the team level constructs were reported by individual members, an aggregation test was conducted. A measure model was then tested to examine the validity and reliability of the scale. Finally, hypothesis test results were reported.

5.1 Aggregation Test

As the data of team variables were collected from individual respondents, it is necessary to test whether it is appropriate to average individuals' responses to represent team level variables. The indicator of rwg recommended by the literature was used to assess whether it is appropriate to aggregate individual level responses to represent team level scores (Chan 1998; Klein and Kozlowski 2000). The results show that the minimum values of rwg of each team for all constructs are greater than 0.70, suggesting that responses at individual levels can be aggregated to team levels.

5.2 Measurement Model

Table 2 shows the factor loadings, Cronbach's alpha and composite reliability (CR) of all constructs and Table 3 shows the descriptive statistics of all variables, including means, standard deviation and correlations. Convergent validity was assessed via two indicators (Fornell and Larcker 1981). First, the loadings of the items on their own constructs were greater than 0.70, as shown in Table 2. Second, all values of the square root of Average Variance Extracted (AVE) were greater than 0.5 as shown in Table 3. Both indicators suggest a satisfactory convergent validity. Discriminant validity of reflective constructs was examined with two indicators. First, the construct correlations were lower than the square root of the AVEs of their constructs. Table 3 shows that the largest correlation was 0.46, less than the recommended threshold of 0.71 (MacKenzie et al. 2011). Second, all the items loaded well on their own construct and less well on other constructs as shown in Table 2, confirming good discriminant validity.

Reliability of the measures were assessed using Cronbach's alpha (Nunnally 1967) and CR (MacKenzie et al. 2011), both with a threshold of 0.70. Results in Table 2 showed that all the values of Cronbach's alpha and CR were greater than 0.70, confirming good reliability for all the measures.

Constructs	Items	1	2	3	4	5	Cronbach's α	CR
1. Collective Attention	1	**0.94**	-0.03	0.00	-0.08	-0.01	0.92	0.94
	2	**0.89**	0.15	0.04	-0.05	0.07		
	3	**0.92**	-0.04	0.01	-0.18	-0.15		
	4	**0.79**	-0.42	0.40	0.23	0.14		
	5	**0.82**	0.32	-0.44	0.13	0.04		
2.Similarity Building	1	0.07	**0.92**	0.44	-0.14	0.01	0.94	0.96
	2	-0.04	**0.92**	0.08	-0.06	0.02		
	3	0.09	**0.94**	-0.28	-0.10	-0.00		
	4	-0.13	0.89	-0.24	0.320	-0.03		
3.Enacting Ideas	1	-0.01	-0.09	**0.93**	0.19	-0.02	0.94	0.96
	2	-0.18	-0.03	**0.95**	-0.220	0.02		
	3	0.09	0.22	**0.93**	-0.140	-0.02		
	4	0.10	-0.11	**0.87**	0.19	0.03		
4.Knowledge Sharing	1	0.09	-0.10	-0.03	**0.92**	-0.07	0.92	0.95
	2	-0.07	0.04	0.24	**0.95**	0.08		
	3	-0.01	0.06	-0.22	**0.92**	-0.02		
5.Team Creativity	1	0.06	-0.15	0.01	-0.02	**0.92**	0.94	0.96
	2	0.01	-0.05	0.05	0.04	**0.95**		
	3	-0.03	0.01	-0.16	0.18	**0.94**		
	4	-0.03	0.20	0.120	-0.21	**0.88**		

Table 2. Factor loadings, cross-loadings and Cronbach's alpha of reflective constructs.

Variables	1	2	3	4	5	6	7	8	9	10	11
1.Team size	NA										
2.Team length	0.12	NA									
3.Age diversity	-0.01	-0.02	NA								
4.Gender diversity	0.17	-0.02	0.16	NA							
5. Ave. work tenure	-0.11	0.17	0.19	0.03	NA						
6.Knowledge sharing	0.17	0.05	0.05	0.14	-0.24	**0.93**					
7.Knowledge disparity	0.14	0.00	0.01	0.03	0.05	-0.16	NA				
8.Collective attention	0.17	0.04	-0.09	0.21	-0.17	0.38**	-0.16	**0.88**			
9.Similarity building	0.22	0.14	-0.05	0.24	-0.42**	0.18	-0.07	0.30*	**0.92**		
10.Enacting ideas	0.17	0.03	-0.09	0.30*	-0.22	0.25*	-0.05	0.42**	0.46**	**0.91**	
11.Team creativity	0.08	-0.14	0.07	0.08	-0.01	-0.19	0.21	0.19	0.14	0.30*	**0.92**
Mean	11.32	2.62	2.65	0.33	5.05	5.73	0.42	5.66	5.50	5.63	5.59
SD	5.43	2.87	2.74	0.17	1.27	0.43	0.26	0.57	0.60	0.64	0.91

Table 3. Descriptive statistics

*Notes: 1. Team's n=62. * for p<0.05, ** for p<0.01. The values in bold on the diagonal are the square root of AVE.*

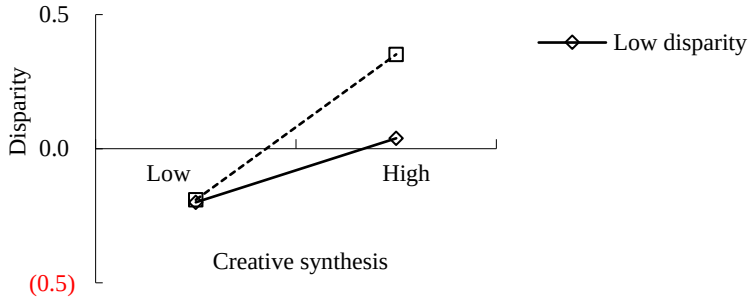

Figure 2. The moderating role of knowledge disparity in the relationship of creative synthesis-team creativity

6 Discussion

6.1 Findings

The present study aims to investigate how the team creativity development process, or the critical creative synthesis processes, will facilitate team creativity, and how knowledge disparity moderates the relationship from the team creative synthesis processes and team creativity. Generally, the empirical analysis of the data collected from 62 IT project teams supports the proposed research model. First, our empirical results show that creative synthesis consisting of collective attention, similarity building, and enacting ideas, is positively and significantly related to team creativity. The finding is consistent with the propositions and predictions of Harvey (2014), yet verified in the context of IT project teams. Second, results of this study confirm that team knowledge disparity indeed plays a positive moderating role in the relationship between the creative syntheses process and team creativity for IT project teams.

6.2 Theoretical Contributions

This study makes several important theoretical contributions to the literature. First, it adds to the IT project team literature by extending the novel creative synthesis perspective to explain and predict IT project team creativity. Although team creativity has been established as a research topic of concern in the broad management field (Zhou and Hoever 2014), previous studies in both the IS and organizational behavior literature have primarily focused on general team process predictors of team creativity. In particular, in studies on team creativity in IT project teams, the effect of team processes such as knowledge integration (Tiwana and Mclean 2005) and task conflict (Farh et al. 2010) have examined. The the nature of the collective processes for team creativity, however, is still under-explored. We expand on this line of thought by developing and operationalizing the creative synthesis process consisting of three distinctive aspects, that of collective attention, similarity building, and enacting ideas, while also examining its impact on creativity of IT project teams. In doing so, this study goes beyond the existing theoretical understanding that focuses on the general team processes of information integration and elaboration (Zhou and Hoever 2014) by providing subtle insights on team creativity development processes at more of a micro level (Chen and Adamson 2015).

Second, we contribute to the creative synthesis perspective. According to Harvey (2014), team knowledge diversity, variety in particular, helps determine whether the outcome of the synthesis process is creative or not. We extend this perspective by incorporating knowledge disparity as another important source of knowledge diversity into the creative synthesis process and justifying its theoretical significance in the IT project team context. This complements to Harvey's (2014) creative synthesis theory that only accounts for knowledge variety. By subjecting the creative synthesis perspective to empirical investigation, this study also makes a novel empirical contribution by developing and validating survey measures on creative synthesis, thereby providing future empirical research with useful instruments (Harvey 2014). Results also confirm that the importance of the creative synthesis processes still holds when teams focus on IT projects and team members rely on technologies for teamwork.

Finally, we contribute to the limited team knowledge disparity literature. Although knowledge disparity is argued to be dysfunctional to creativity (Harrison and Klein, 2007), we find its value by investigating how it catalyzes the effect of creative synthesis on team creativity, particularly in the IT project team context. In addition, we also find its positive direct effect on team creativity in the same context. This finding adds to our understanding toward the boundary by which knowledge disparity exerts its effect on creativity.

6.3 Practical Implications

This study also holds significance for practitioners. First, the present study shows the straightforward processes, namely, the creative synthesis processes, that can directly predict and enhance team creativity. Managers and leaders may provide encouragement and directional suggestions when members are performing tasks involving creativity. For example, team leaders can direct team member certain topics or tasks in their communication so as to keep collective attention, which is particularly critical for virtual teams; leaders can also help and guide team members actively search for associations and similarities among team members' expertise knowledge; managers and team leaders may also encourage team members to enact and experiment with their ideas, even talking about how to realize the ideas with team members will also help them to understand the ideas better.

Second, the results of the current study suggest a more proactive view of team knowledge disparity in IT project teams. For example, managers can facilitate team creativity development processes by selecting team members with different levels of working experience. From a different perspective, managers and leaders may also encourage team members in face-to-face teams to communicate via information technologies, which may decrease the negative effects of knowledge disparity.

6.4 Limitations and Future Research Directions

This research has some limitations. First, team creativity is rated by team leaders. Although this is the common practice, there will inevitably be some level of bias due to subjectivity. Thus, whenever possible, additional objective data should be incorporated in the future research to confirm the findings out of subjective data. Second, this study was conducted in China, where tradition favors harmonious relations, respect for authority, and finding commonalities that are often integral to teamwork, which can also influence team creativity development (Zhou & Hoever, 2014). Research in other countries or regions might show different cultural or socio-political tendencies that could affect creativity dynamics in team contexts (e.g., Western cultures). Whether our conclusions are applicable in different cultural contexts thus needs further research. Finally, the survey data used to test hypotheses are multiple-sourced and cross-sectional, where the causal effects cannot be tested. Further studies may consider the longitudinal design of data collection. Finally, this study is limited by the characteristics of the sample. For example, the IT project teams in the current study primarily face-to-face teams. Future research may consider the role of communication context (face-to-face vs IT mediated) in influencing team creativity development.

7 Conclusions

Contemporary IT project teams are increasingly leveraged by organizations to address innovation development work. Nevertheless, extant research on team creativity provides few insights into the processes of how team creativity is developed. In the present study, we develop and test a research model that first identifies the critical processes of collective attention, building on similarities, and enacting ideas, and then explain how team knowledge disparity affect team creativity development processes and outcomes in IT project teams. We find that the creative synthesis process is an important predictor for team creativity. As knowledge disparity is found to play a positive moderating role for team creativity in teams that rely heavily on technologies, this study calls for academic and practitioner attention to the unique characteristics of these technologies in IT project teams.

Appendix

Appendix A Results of carding sorting practices

We first conducted the card-sorting procedures for synthesis processes and team creativity (Table A-1). In the first round, three judges created seven categories and one judge created six categories. The average value of the inter-judge raw agreement is 0.88; the average value of Cohen's Kappa is 0.86. The overall placement ratio of items within the target constructs is 95 percent. Then judges independently labeled and defined each category. Small changes were made to the items to remove ambiguity. In the second round, a different group of four judges were invited into the card-sorting task. A "too ambiguous/doesn't fit" category was provided to ensure that the judges did not force any item into a particular category they found to be improper. The average value of the inter-judge raw agreement shows an increase to 0.90. The average value of Cohen's Kappa is 0.89. The overall placement ratio of items within the target constructs is 95 percent.

	Raw agreement		**Cohen's Kappa**		**Placement Ratio Summary**		
	Round 1	**Round 2**	**Round 1**	**Round 2**	**Constructs**	**Round 1**	**Round 2**
	0.81	0.96	0.77	0.95	Collective attention	1.00	0.95
	0.96	0.92	0.95	0.91	Similarity building	0.92	0.92
Mean	1.00	0.92	1.00	0.91	Enacting ideas	0.95	0.94
	0.77	0.88	0.73	0.87	Team creativity	0.75	0.94
	0.88	0.90	0.86	0.89		0.91	0.95

Table A-1. Inter-Judge Agreements for Synthesis processes and Team creativity

Appendix B Results of exploratory factor analysis

We collected data from 29 developers to conduct exploratory factor analysis. The results are shown in Table A-2. Two items (CA6 and CA7) were deleted in the final survey due to their low loading in EFA.

Variable	**Items**	**Loading**	**Cronbach's α**
Collective attention	In our team's communication,		0.82 (0.91 after deletion of CA6 and CA7)
	CA1. team members had a shared focus.	0.92	
	CA2. team members focused on the same topic, task or goal.	0.87	
	CA3. team members could follow each other's topic.	0.90	
	CA4. team members had no confusions over focus.	0.75	
	CA5. team members are on the same page in terms of topic.	0.79	
	CA6. we were not clear about the communication focus.	0.55(Del)	
	CA7. it's difficult to understand what other members are discussing	0.62(Del)	
Similarity Building	SB1. Team members attempt to figure out the similarities among each other's ideas.	0.90	0.92
	SB2. Team members actively searched for ways relating each other's perspectives.	0.91	
	SB3. Team members used various techniques (e.g., analogy, figures, models) to help identify SBconnections among each other's viewpoints.	0.93	
	SB4. Team members emphasize the commonality among the knowledge they held.	0.89	
Idea Enacting	IE1. Team members talk about how to try out an idea.	0.91	0.92
	IE2. Team members experiment with their ideas.	0.94	
	IE3. Idea experimentation is necessary in daily work.	0.93	
	IE4. Team members generate prototypes to illustrate their thoughts.	0.85	

Table A-2. Measurement model results for EFA

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