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# Team Learning Goal Orientation and Innovation: Roles of Transactive Memory System and Task Interdependence

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## Abstract

Drawing from research on team climate and team learning process, this study examines whether, how and when team learning goal orientation influences team innovation. A three-wave research of 102 research and development (R & D) teams in China was conducted. The results reveal that team learning goal orientation interacts with task interdependence, and works through transactive memory system to facilitate team innovation. Specifically, team learning goal orientation has a positive effect on team innovation that is mediated by transactive memory system. Moreover, the direct effect of team learning goal orientation on transactive memory system is strengthened by task interdependence. The implications of these results for research and practice are discussed.

**Keywords**: Team learning goal orientation, Team innovation, Transactive memory system, Task interdependence

## Introduction

There has been a surge of research on team goal orientations in the past decade (e.g., [1-3]). A learning goal orientation in teams refers to a situation in which team members share a propensity for proactive learning and a desire to understand new things [4]. Team learning goal orientation has been found to be a robust predictor of several team outcomes, including team adaptation, team performance, team effectiveness, team efficacy and team commitment (cf. [5-8]). However, three gaps remain in the current scholarship on this topic.

First, although team learning goal orientation emphasizes the development of skill, knowledge, and competence, which are likely to generate new ideas [5] and learning has been found to be essential for creativity [9], the effect of team learning goal orientation on team innovation, which is an important team outcome, has received little attention. It is well documented that team climate affects team innovation (e.g., [10-14]). As team learning goal orientation is considered to represent a team climate of proactive learning [3] [5], there is likely to be a causal relationship between this orientation and team innovation. This study aims to determine whether team learning goal orientation does indeed have a direct effect on team innovation.

If team learning goal orientation does influence team innovation, then *how* it exerts this influence needs to be determined. As pointed out by Bunderson and Sutcliffe [5], consensual climate perceptions-in this study team learning goal orientation – "have important implications for group-level processes and outcomes" (p. 553). We draw on the team process framework of Marks, Mathieu, and Zaccaro [15] to test the mediating effect of transactive memory system, which is a blend of process and emergent state [16], on the team input-outcome relationship. As it is the means by which team members encode, store and retrieve information, we propose that transactive memory system is the mechanism that transforms team inputs (i.e., In this study, team learning goal orientation) into team outcomes (i.e., Team innovation).

Second, there is scant research concerning the boundary condition under which team learning goal orientation affects team outcomes. The failure to identify this boundary condition may explain the inconclusive results of studies on the effects of team learning goal orientation (i.e., [17]). Crossan, Lane and White [18] suggested that learning in organizations starts with intuition and progresses to information interpretation and then to information integration. This learning process is likely to be affected by task structure [19]. The formation of transactive memory system among members in learning-oriented teams essentially reflects Crossan's [18] learning process (To be discussed later). Accordingly, task interdependence, which is a structural variable that determines the degree to which members rely on each other to accomplish tasks [20,21], is likely to serve as the boundary condition in the relationship between team learning goal orientation and transactive memory system. Investigating the moderating effect of task interdependence also answers the called for greater attention to structural variable in the study of work groups [22,23]. This study thus adds to the team learning goal orientation literature by examining the boundary condition of task interdependence.

The third research gap relates to research designs and samples. Most of the existing studies of team learning goal orientation are cross-sectional, and thus their ability to determine causation is limited. Moreover, their generalizability is affected by the use of student samples and a laboratory setting, which prevents the results from being replicated in organizational settings (e.g., [7,3,8]). Additionally, most team learning goal orientation studies have been conducted in a Western context, and the effects of this factor in non-Western cultures have been ignored. To overcome these limitations, we conducted a three-wave research over eight months among 102 R & D teams from three large information technology companies in China.

In sum, this study examines *whether*, *how*, and *when* team learning goal orientation influences team innovation. It addresses these three gaps in the team learning goal orientation literature by formulating an integrated model in which team learning goal orientation affects team innovation through transactive memory system under the boundary condition of task interdependence, and testing it using a more refined research design in a Chinese context. This study also contributes to team innovation research by investigating the causal effect of team learning goal orientation, and adds to the literature on transactive memory system by examining team learning goal orientation as the antecedent to the establishment of transactive memory system and team innovation as their outcome. The study model is illustrated in Figure 1.

## Theory and Hypotheses

### Team learning goal orientation and team innovation

Team learning goal orientation refers to the shared perception that team

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goals are related to learning and competence development [5]. Members of learning-oriented teams engage in proactive learning behavior and set learning strategies [24,25]. They are also more likely to think about how to accomplish tasks [26,27] [28,29]. Team climate represents the enduring quality of a team environment in terms of perceptions of behavior and the potential outcomes of behavior [10,30]. It serves as a basis for team members to interpret situations [31]. As team learning goal orientation reflects the shared perception among team members that the team will engage in proactive learning, it represents a team climate in which the goal of learning is encouraged, emphasized, and rewarded [3,25,26,32].

Team innovation is defined as the introduction and implementation of ideas, processes, products, and procedures that are new and of benefit to the group [33,34]. It is suggested that team members as a whole may be channeled and directed toward innovation in certain kinds of team climate (e.g., [35-37,14]). Research into team climate has identified four factors that lead to team innovation: shared objectives or vision, group participation and safety, team support for innovation, and the group's task orientation [11,12] [33]. *Shared objectives or vision* is a higher order goal that members share and acts as a motivating force at work. *Group participation and safety* is the motivation to become involve in decision-making and the psychological safety inherent in proposing improved ways of doing things. *Team support for innovation* refers to practical, rather than rhetorical, support for attempts to introduce new ideas. *Group task orientation* is defined as a concern for the quality of task performance with through the use of constructive monitoring procedures. Previous empirical studies have rendered supports to the proposition that team climate such as achievement orientation can lead to innovation [38].

As team learning goal orientation is considered to represent a team climate of proactive learning [3,25,26] [32], we argue that it may be conducive to team innovation through its influence on the aforementioned four factors of team climate which leads to innovation in teams. As has been stated, team learning goal orientation essentially represents the shared perception that team goals relate to learning and competence development [3,4,32]. It is this shared perception that provides the necessary condition to form a *shared Objective or vision*. Learning-oriented teams also encourage collaborative decision-making [5], which encourages member *participation* in an interpersonally non-threatening environment. From a study of 51 work teams in a manufacturing company, Edmondson [39] found that team *psychological safety* is associated with learning behavior in organizational work teams. A learning goal orientation may also help to create an environment that *supports innovation*. Because team learning goal orientation promotes group decision-making and problem-solving [5]. Members with a learning goal orientation thus tend to share ideas and resources, and are more willing to cooperate in the generation and application of new ideas. Finally, team learning goal orientation regulates cognition by focusing individual attention on the task, rather than individual egos [4,40]. As such, even if innovation is not explicitly emphasized in their routine work, learning-orientated teams are likely to reflect a stronger *task orientation*.

The implicit relationship between team learning goal orientation and innovation has been identified in past research. For instance, the learning goals of team members have been found to result in adaptive behaviors and attitudes [41,42]. Accordingly, a team climate oriented toward proactive learning goals is likely to encourage a team to adapt to changing environments, continually refine practices, and discover new and better approaches to achieve objectives. Moreover, teams with a strong learning orientation are expected to engage in knowledge creation activities [8], to be more capable and likely to generate new ideas [25,32] and to be innovative [26]. We thus predict that team learning goal orientation has a positive effect on team innovation.

***Hypothesis 1:*** Team learning goal orientation is positively related to team innovation.

## The mediating role of transactive memory system

The framework of team effectiveness includes four important components: team inputs, team processes, team emergent states, and team outcomes [15,43]. This is encapsulated in the input-mediator (team process and/or emergent state)-output model (IMO model) [16]. Team learning goal orientation, which is considered to be a group-level input, is likely to have important implications for team processes and outcomes [5], including team innovation. To gain a thorough understanding of the effect of team learning goal orientation on team innovation, it is helpful to delve into the mechanism by which the former affects the latter. We study this mechanism by drawing on the IMO model.

Transactive memory system, which yields emergent states and is at the same time enacted by team processes [44], has been identified by Mathieu et al. [16] as a mediator blending team process and emergent state. Transactive memory system is dynamic in nature and generates relatively stable states over time [45]. We propose that transactive memory system serves as the mechanism that translates team learning goal orientation into innovation. The underlying logic of this is that teams that emphasize proactive learning continually refine knowledge and share information among members to develop new approaches to problem-solving [5].

A transactive memory system can be defined as shared cognition about the encoding, storing, and retrieving processes of information [46,47]. The metaphor of networked computers with common directories is used by Wegner [47] to describe such a system in teams. Transactive memory system involves three dimensions: *specialization* (An awareness of others' specialized knowledge), *credibility* (Trust in the reliability of this knowledge), and *coordination* (The effective orchestration of this knowledge) [48].

We argue that team learning goal orientation facilitates the formation of transactive memory system. Specifically, learning goals allow individuals to focus more on their interests [49], which in turn encourages them

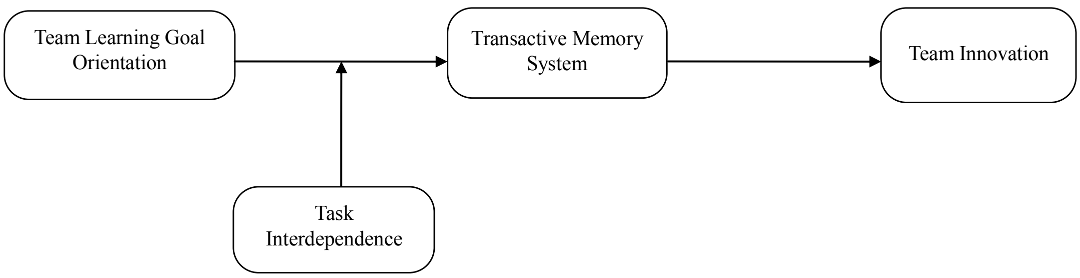


**Figure 1:** A Model of the Relationship between Team Learning Goal Orientation and Team Innovation.

to actively engage in their specific area of expertise. Bunderson and Sutcliffe [5] found that team learning goal orientation helps to promote collaborative problem-solving and intragroup coordination, through which team members understand who in the team possesses what *specialized knowledge*. According to Mehta et al. [3], team learning goal orientation is characterized by mutual support among team members. This environment of mutual support promotes trust in the reliability of other members' knowledge; it develops *credibility*. A learning orientation stands out as a motive for enactive mastery (e.g., [40,2,50]). Accordingly, teams with a learning goal orientation will encourage knowledge compilation and processes [7], thereby promoting the *coordination* aspects of transactive memory systems.

Team processes affect team innovation [51]. Transactive memory system has also been shown to produce creative products [46]. Cohen and Levinthal [52] suggested that the more team members develop an awareness of the capabilities and knowledge of others, the stronger the unit's absorptive capacity, which they argued is necessary for recognizing the value of creative ideas. In addition, the mutual accountability and assistance among members of teams using transactive memory system enable the development and implementation of novel ideas [51]. The effective coordination of a wide range of knowledge also facilitates team innovation, as it provides the knowledge basis for the quality and quantity of new ideas, which are important for team innovation [53,54]. Overall, transactive memory system is critical for a team's ability to generate new ideas and knowledge and turn them into innovative procedures, services, and products.

Based on this argument and the IMO model, we posit that transactive memory system links team learning goal orientation with team innovation. In other words, team learning goal orientation promotes team innovation through the formation of transactive memory system.

***Hypothesis 2:*** Transactive memory system mediates the relationship between team learning goal orientation and team innovation.

### The moderating role of task interdependence

Although increasing interest has been paid to the outcomes of team learning goal orientation, no studies have considered the boundary condition in this relationship. This oversight may be the reason for the inconclusive results in past team learning goal orientation studies. For instance, the literature documents the causal effect of team learning goal orientation on the fostering of approaches to problem-solving [55]. However, Redmond et al. [17] found a non-significant relationship between a learning orientation and solution generation in their laboratory study. It is clearly necessary to consider the moderators that may facilitate or inhibit the effect of team learning goal orientation.

Crossan et al. [18] suggested that learning begins with the subconscious intuition of team members and later conscious interpretation, which leads to information integration by the work team. Intuition refers to a team member's preconscious recognition of a pattern or possibility [56]. Interpretation is the explanation of information to oneself and to other team members, whereby it becomes embedded within the workgroup [18]. Integration is the development of a shared understanding and a collective mind among team members through mutual adjustment (see [18] for detailed discussion of learning process). There are many factors that may motivate and suppress this learning process [18], among which task structure is a contextual factor of particular interest in past research [19].

The development of a means of encoding, storing, and retrieving information (i.e., A transactive memory system) among team members with a shared perception of team learning goals (i.e., Team learning goal orientation) essentially mirrors Crossan's [18] learning process. Based on previous argument, task structure is likely to serve as the factor that moderates this process. We thus study task interdependence, a structural variable that has been identified as a boundary condition under which team inputs affect team performance (e.g., [57-59]) and team effectiveness (e.g., [60]), as the boundary condition in the relationship between team learning goal orientation and transactive memory system.

Interdependence refers to the perception of team members that the relationships among them are collective, and can affect and be affected by others [20,61-63]. Task interdependence reflects the nature of team tasks and the extent to which a team member believes that he or she depends on others to complete his or her tasks [20-64]. Research has found that with increasing levels of task interdependence, team members have a greater responsibility for the outcomes of others (e.g., [65,66]), which encourages an open flow of communication (e.g., [67-69]). Task interdependence requires mutual interaction among team members to decide on the inputs and outputs needed to complete the task [70]. The propensity to cooperate may thus be motivated by the recognition that substantial cooperation is needed to accomplish a task (e.g., [71-73]). The higher the level of task interdependence, the more necessary it is that work groups communicate, interact, and cooperate (e.g., [63,74-76]).

When levels of communication, interaction, and cooperation in teams are high, members displaying proactive learning behavior aroused by the team's learning goal are granted opportunities to (1) share knowledge [77] and thereby get to know the knowledge possessed by others (*specialization*); (2) reduce interpersonal uncertainty, thereby developing trust in the knowledge of others (*credibility*) ([78] and (3) inquire and learn about each other's skills and abilities [79], thereby improving the effectiveness of the knowledge process (*coordination*). We thus propose that the benefits of team learning goal orientation in establishing transactive memory system depend on the level of task interdependence in the team. More specifically, we posit that team learning goal orientation is more likely to facilitate the formation of transactive memory system in the presence of strong task interdependence.

***Hypothesis 3:*** Task interdependence moderates the relationship between team learning goal orientation and transactive memory system in such a way that team learning goal orientation has a stronger, positive relationship with transactive memory system when the level of task interdependence is high.

Finally, as the foregoing discussion indicates that transactive memory systems mediate the relationship between team learning goal orientation and team innovation, it is possible that the establishment of transactive memory system due to the interaction between team learning goal orientation and task interdependence will in turn contribute to team innovation. We thus posit that transactive memory system serves as the vehicle by which the team learning goal orientation/task interdependence interaction enhances team innovation.

***Hypothesis 4:*** Transactive memory system mediates the moderated relationship among team learning goal orientation, task interdependence, and team innovation.

## Method

### Sample and Procedure

Data were collected from R & D teams of three information technology companies in China. Members in these R & D teams were professional-level employees engaging in cell phone design, software development, and networking integrated system design. With the help of the human resources managers from the three companies, a list of randomly selected 113 teams was obtained (The number of team members ranged from 5 to 14 with the average of about 8). All 866 team members and 113 team leaders were surveyed.

Our data collection lasted eight months and included three phases. In

Phase 1, we administered questionnaires to all the 866 team members, and asked them to supply data on their demographics, perceptions of team learning goal orientation, and team task interdependence. Seven hundred and twenty-nine team members affiliated with 110 teams returned their questionnaires, indicating a response rate of 84.2%. Four months later, in Phase 2, questionnaires were distributed to the 729 team members to evaluate their team transactive memory system. We received usable survey responses from 628 team members affiliated with 107 teams, with a response rate of 86.1%. After deleting those teams with less than 3 respondents, 105 teams with 624 team members remained. After another four months, in Phase 3, questionnaires were distributed to the 105 team leaders to rate team innovation and provide information on their demographics and team demographics. We confirmed that all teams did not change their leaders across these eight months. Finally, 102 team leaders returned their questionnaires.

The final sample of this study consisted of 598 team members in 102 teams. Of the 102 teams, the average team size was 7.65 (s.d. = 2.07, excluding team leader) and average team age was 7.58 years (s.d. = 2.26). Of the 102 team leaders, 80.4% were men, the average age was 36.06 years (s.d. = 5.82) and all of them held bachelor or above degrees (51.0% Held bachelor degrees and 49.0% held postgraduate degrees). Of the 598 team members, 65.1% were men, the average age was 32.89 years (s.d. = 4.98), and most of them held bachelor or above degrees (2.5% High school degrees, 29.1% associate degrees, 36.6% bachelor degrees and 31.8% Postgraduate degrees).

## Measures

*Team Learning Goal Orientation:* We measured team learning goal orientation using a five-item scale developed by Bunderson and Sutcliffe [5]. A sample item was, "Our team looks for opportunities to develop new skills and knowledge". We averaged the five items to create a score for team learning goal orientation. The Cronbach's alpha of the scale was 0.81.

*Task Interdependence:* We measured team task interdependence using a three-item scale developed by Campion et al. [20]. A sample item was, "Within the team, jobs performed by team members are related to one another". We averaged responses to the three items to create a measure of team task interdependence. The Coefficient alpha was 0.83.

*Transactive Memory System:* We measured team transactive memory system using a fifteen-item scale developed by Lewis [80] and used by Zhang et al. [45] in China context. A sample item was, "Our team worked together in a well-coordinated fashion". A confirmatory factor analysis ([81]; CFA) suggested that the fit indices for a single second-order factor fell within a good range: $\chi^2$ (87) = 279.48, $p \leq 0.01$; CFI = 0.96, TLI = 0.96; RMSEA = 0.06. We thus averaged the fifteen items to create a single index measuring team transactive memory system. The Cronbach's alpha for the combined scale was 0.93.

*Team Innovation:* We measured team innovation using a four-item scale developed by Anderson and West [12]. A sample item was, "This team's members often implement new ideas to improve the quality of our products and services". We averaged responses to the four items to create a measure of team innovation. The Cronbach's alpha was 0.76.

*Control Variables.* Team age diversity, team gender diversity, team education background diversity, team size and team age were controlled for because of their potential effects on team processes and team innovation ([12,82-84]). Specifically, individual age (years), gender (0 = Male; 1 = Female) and education background (1 = Arts; 2 = Law; 3 = Humanity; 4 = Science; 5 = Engineering; 6 = Agriculture; 7 = Medicine; 8 = Business and Economics) were obtained from each team member. Following Allison [85] and Cannella, Park and Lee [86], we then measured team age diversity using the coefficient of its variation (its superlative standard deviation divided by its mean). Since gender and education background are categorical variables, following Cannella and colleagues [86], we used the variants of the Herfindal-Hirschman index calculated as $1-\sum Si^2$, where $Si$ is the percentage of team members in each of the categories.

## Analyses

***Attrition Analysis*:** Since data were collected from team members in both Phases 1 and 2, response differences between these two phases of data collection have to be assessed. Drawing on Goodman and Blum's [87] approach, a multiple logistic regression analysis was first conducted. Specifically, we used survey time as the dependent variable, team members' age, gender, education level, perception on team learning goal orientation and team task interdependence as the independent variables. Results showed that all logistic regression coefficients were insignificant. *t*-tests analyses were also conducted to assess whether there were significant mean differences in members' age, gender, education level, perception on team learning goal orientation and team task interdependence across Phase 1 and Phase 2. No significant results were gotten. These results indicate that team members randomly dropped out from the study.

*Data Aggregation*: To ensure that aggregation of data from individual team members to create team data was appropriate, inter-team-member agreement ($r_{wg}$) and intra-class correlation coefficients - ICC (1) and ICC (2) were assessed ([88,89]; see Table 1). As shown in Table 1, all teams except two had $r_{wg}$ values equal or greater than 0.70 for team learning goal orientation (98.0%) with the median $r_{wg}$ of 0.94, all teams had $r_{wg}$ values equal or greater than 0.70 for task interdependence (100%) (median $r_{wg}$ of 0.92) and all teams except one had $r_{wg}$ values equal or greater than 0.70 for team transactive memory system (99.0%) (median $r_{wg}$ of 0.94). The levels of inter-member agreements within teams thus justified our aggregation of individual-level data [89]. In addition, results showed that ICC (1) values ranged from 0.17 to 0.25 (0.25 for team learning goal orientation, 0.17 for team task interdependence and 0.23 for team transactive memory system, greater than the conventional cutoff values of 0.05) and all were significant, indicating that between-team variances were larger than within-team variances. The ICC (2) values ranged from 0.54 to 0.66 (0.66 for team learning goal orientation, 0.54 for team task interdependence and 0.64 team transactive memory system). All these values were higher than the conventional cutoff values of 0.50. These results indicated that it was appropriate to average the scores provided by team members to obtain the team-level scores.

# Results

Table 2 shows the variables' descriptive statistics, reliabilities and inter-correlations. Team learning goal orientation was positively correlated with team transactive memory system ($r$ = 0.38, $p \leq 0.01$) and team

| | Variance analysis across team (ANOVA test) | $ICC_{[1]}$ | $ICC_{[2]}$ | $R_{wg}$ | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Median | Minimum | Maximum | Number of teams below 0.70 | Percentage of total teams above 0.70 |
| 1. Team learning goal orientation | Significant[a] | 0.25 | 0.66 | 0.94 | 0.58 | 0.99 | 2 | 98.0% |
| 2. Task interdependence | Significant | 0.17 | 0.54 | 0.92 | 0.75 | 1.00 | 0 | 100% |
| 3. Transactive memory system | Significant | 0.23 | 0.64 | 0.94 | 0.56 | 0.99 | 1 | 99.0% |

**Note:** $N$ = 102; [a] 'significant' means that "between-team variance" is significantly larger than "within-team variance"

**Table 1:** Information for Justifying Aggregation of Individual Measurements to the Team Level.

innovation ($r$ = 0.28, $p \leq 0.01$). Team task interdependence was positively correlated with team transactive memory system ($r$ = 0.32, $p \leq 0.01$). Team transactive memory system was positively correlated with team innovation ($r$ = 0.44, $p \leq 0.01$).

**Indirect Effect of Team Learning Goal Orientation on Team Innovation via Transactive Memory System**

To test Hypothesis 1, we regressed team innovation on team learning goal orientation, together with control variables. As shown in Table 3, team learning goal orientation was positively related to team innovation ($\beta$ = 0.27, $p \leq 0.01$). Hence, Hypothesis 1 was supported.

To test Hypothesis 2, Baron and Kenny's [90] procedures to test mediating effects were used. They argued that there is a full mediation if four criteria are met: (1) The independent variable is significantly related to the mediator, (2) The independent variable is significantly related to the dependent variable, (3) The mediator is significantly related to the dependent variable and (4) When the independent variable and mediator are simultaneously presented, the relationship between the independent variable and the dependent variable becomes non-significant. The results of regression analysis showed that that: (1) Team learning goal orientation was positively related to transactive memory system ($\beta$ = 0.40, $p \leq 0.01$); (2) Team learning goal orientation was positively related to team innovation ($\beta$ = 0.27, $p \leq 0.01$); (3) Transactive memory system was positively related to team innovation ($\beta$ = 0.44, $p \leq 0.01$); (4) When both team learning goal orientation and transactive memory system were entered into the model, the effect of team learning goal orientation on team innovation became insignificant ($\beta$ = 0.11, *n.s.*). Hence, Hypothesis 2 was fully supported.

## Moderating Effect of Task Interdependence

Hypothesis 3 predicted that task interdependence moderates the relationship between team learning goal orientation and transactive memory system. As shown in Table 3, the interaction between team learning goal orientation and task interdependence was positively related to transactive memory system ($\beta$ = 0.19, $p \leq 0.05$). The interaction term accounted for 3% of the explained variance in transactive memory system ($\Delta R^2$ = 0.03, $\Delta F$ = 4.20, $p \leq 0.05$). We plotted this moderating effect and conducted simple slope tests [91]. Figure 2 clearly illustrated the significant interaction: the relationship between team learning goal orientation and transactive memory system was more positive when task interdependence was high ($\beta$ = 0.62, $p \leq 0.01$) rather than low ($\beta$ = 0.22, $p \leq 0.05$). The influence patterns thus supported Hypothesis 3.

| Variables | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age diversity | 0.14 | 0.05 | | | | | | | | | |
| 2. Gender diversity | 0.39 | 0.13 | 0.13 | | | | | | | | |
| 3. Education background diversity | 0.52 | 0.15 | 0.19 | 0.02 | | | | | | | |
| 4. Team size | 7.65 | 2.07 | 0.07 | 0.30** | 0.18 | | | | | | |
| 5. Team age | 7.58 | 2.26 | -0.19 | -0.14 | -0.20* | -0.14 | | | | | |
| 6. Team learning goal orientation | 4.51 | 0.73 | -0.04 | 0.02 | -0.11 | -0.02 | 0.26** | (0.81) | | | |
| 7. Task interdependence | 4.54 | 0.71 | -0.13 | -0.09 | -0.10 | 0.03 | -0.07 | 0.16 | (0.83) | | |
| 8. Transactive memory system | 4.53 | 0.69 | -0.16 | 0.09 | -0.13 | 0.01 | -0.00 | 0.38** | 0.32** | (0.93) | |
| 9. Team innovation | 4.54 | 0.80 | -0.07 | -0.00 | -0.10 | 0.04 | 0.10 | 0.28** | 0.17 | 0.44** | (0.76) |

**Note:** $N$ = 102; *p ≤ 0.05 (2-tailed); **p ≤ 0.01 (2-tailed); Internal reliability coefficients (alphas) appear on the main diagonal in parenthes

**Table 2:** Means, Standard deviations, Reliabilities and Correlations among Study Variables.

| Variables | TMS (T2) | | | | Team innovation (T3) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **M1** | **M2** | **M3** | **M4** | **M5** | **M6** | **M7** | **M8** | **M9** | **M10** | **M11** |
| **Controls** | | | | | | | | | | | |
| Age diversity | -0.16 | -0.16 | -0.13 | -0.13 | -0.04 | -0.05 | 0.03 | 0.02 | -0.03 | -0.03 | 0.02 |
| Gender diversity | 0.10 | 0.08 | 0.14 | 0.06 | -0.01 | -0.02 | -0.05 | -0.05 | -0.01 | -0.06 | -0.08 |
| Education background diversity | -0.11 | -0.08 | -0.06 | -0.05 | -0.09 | -0.07 | -0.04 | -0.04 | -0.06 | -0.05 | -0.03 |
| Team size | 0.01 | 0.00 | -0.02 | 0.02 | 0.07 | 0.07 | 0.07 | 0.07 | 0.06 | 0.10 | 0.10 |
| Team age | -0.04 | -0.14 | -0.10 | -0.12 | 0.08 | 0.01 | 0.10 | 0.07 | 0.03 | 0.01 | 0.05 |
| **Independent variable** | | | | | | | | | | | |
| TLGO (T1) | | 0.40** | 0.36** | 0.34** | | 0.27** | | 0.11 | 0.25* | 0.23 | 0.11 |
| **Moderator** | | | | | | | | | | | |
| Task interdependence (T1) | | | 0.25** | 0.24** | | | | | 0.12 | 0.11 | 0.03 |
| **Interaction** | | | | | | | | | | | |
| TLGO * Task interdependence | | | | 0.19* | | | | | | 0.20* | 0.13 |
| **Mediator** | | | | | | | | | | | |
| TMS (T2) | | | | | | | 0.44** | 0.40** | | | 0.35** |
| **Interaction** | | | | | | | | | | | |
| TMS * Task interdependence | | | | | | | | | | | 0.03 |
| $R^2$ | 0.05 | 0.20 | 0.26 | 0.29 | 0.02 | 0.09 | 0.20 | 0.22 | 0.10 | 0.14 | 0.23 |
| $F$ | 0.94 | 3.88** | 4.54** | 4.63** | .43 | 1.58 | 4.10** | 3.69** | 1.55 | 1.88 | 2.75** |
| $\Delta R^2$ | 0.05 | 0.15 | 0.06 | 0.03 | 0.02 | 0.07 | .18 | 0.13 | 0.01 | 0.04 | 0.09 |
| $\Delta F$ | 0.94 | 17.75** | 7.03** | 4.20* | .43 | 7.17** | 21.96** | 14.99** | 1.33 | 3.93* | 5.47** |

**Note:** $N$ = 102; *p ≤ 0.05 (2-tailed); **p ≤ 0.01 (2-tailed); TLGO = Team learning goal orientation; TMS = Transactive memory system

**Table 3:** Hierarchical Regressions for Hypotheses Testing.

To examine the mediated moderations predicted by Hypothesis 4, moderated causal steps approach of regression analysis was adopted [92]. Specially, five hierarchical steps were examined: control variables (step 1) were entered first, followed by the team learning goal orientation (step 2) and team task interdependence (step 3), then the team learning goal interaction-team task interdependence interaction (step 4) and transactive memory system while controlling transactive memory system-team task interdependence interaction (step 5). All interaction variables were mean-centered in order to minimize multicollinearity [93]. Results indicated that the interaction between team learning goal orientation and task interdependence was positively related to both transactive memory system ($\beta = 0.19$, $p \leq 0.05$) and team innovation ($\beta = 0.20$, $p \leq 0.05$). However, when transactive memory system was entered into the model while controlling for the interaction between transactive memory system and task interdependence, the interactive effect of team learning goal orientation and task interdependence on team innovation disappeared ($\beta = 0.13$, *n.s.*), while transactive memory system was still found to be positively related to team innovation ($\beta = 0.35$, $p \leq 0.01$). Hence, Hypothesis 4 was supported. We further plotted the interactive effect of team learning goal orientation and team task interdependence on team innovation. Figure 3 shows that team learning goal orientation was found to be positively related to team innovation when team task interdependence was high ($r = 0.43$, $p \leq 0.01$), but was unrelated to team innovation when team task interdependence was low ($r = 0.06$, *n.s.*). The pattern of the interaction was consistent with our arguments.

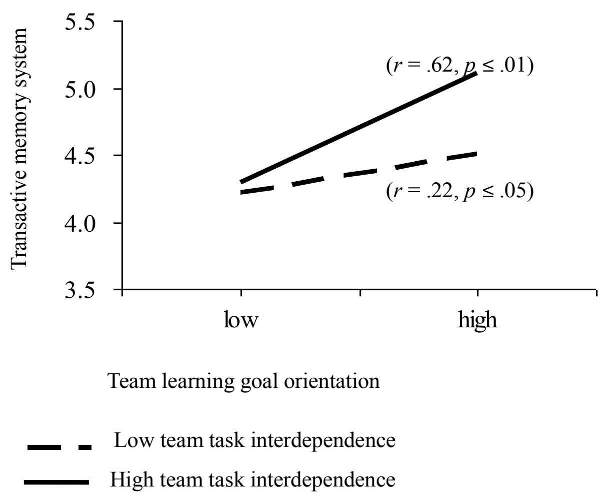


**Figure 2:** Interactive Effect of Team Learning Goal Orientation and Task Interdependence on Transactive Memory System.

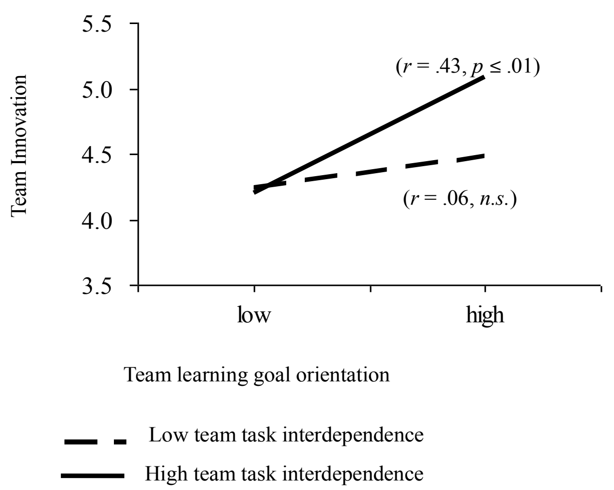


**Figure 3:** Interactive Effect of Team Learning Goal Orientation and Task Interdependence on Team Innovation.

## Discussion

Using an integrated model of whether, how and when team learning goal orientation affects team innovation, we find that team learning goal orientation is positively related to team innovation (Hypothesis 1), that transactive memory system mediates this relationship (Hypothesis 2), that task interdependence enhances the relationship between team learning goal orientation and transactive memory system (Hypothesis 3) and that transactive memory system mediates the interactive effect of team learning goal orientation and task interdependence on team innovation (Hypothesis 4).

## Theoretical Implications

This study suggests that caution is warranted in interpreting the growing body of research on team learning goal orientation. Although past research has convincingly demonstrated that team learning goal orientation affects various team outcomes, such as team adaptation, team performance, team effectiveness, team efficacy and team commitment (cf. [5-8]), there have been no attempts to examine its impact on team innovation. This study is the first attempt to empirically examine this effect. It finds that team learning goal orientation has a positive effect on team innovation. This finding is consistent with previous research that reports the positive effect of team learning goal orientation on various other team outcomes. We further identify that this positive effect is translated by transactive memory system. The examination of the underlying mechanism of the relationship between team learning goal orientation and team innovation allows the relationship to be better understood. This study is also the first to examine the boundary condition in the team learning goal orientation–team outcome relationship by investigating the moderating effect of task interdependence. This leads us to propose an integrated model. We also address the limitations of research design encountered in most existing team learning goal orientation studies (The use of cross-sectional student samples in a laboratory setting and in a Western context) by conducting a three-wave research of 102 R & D teams in China. This increases our ability to determine causation and the generalizability of the study findings.

This study makes a contribution to team innovation research. Innovation is a key factor in corporate sustainability [94], yet there is little research on team innovation [51]. Organizations often rely on work teams and especially R & D teams, for innovation [95.96], because the routine work of R & D teams involves not only the development and application of creative ideas, but also teamwork. Drawing on team climate research and the IMO model, this study adds to the team innovation literature by investigating in an R & D team setting the motivating effects of team learning goal orientation and transactive memory system. It empirically establishes the positive effect of team learning goal orientation and transactive memory system on team innovation. These results are consistent with the well-documented idea that learning is essential for creativity [9].

This study also adds to the emerging body of research on transactive memory system. Transactive memory system has been studied as a means of information processing and coordination in work teams [45], yet current research is limited to examining task interdependence, cooperative goal interdependence and support for innovation as its causal factors [45] and team performance as its consequence [97,45]. The results of this study show that team task interdependence is positively correlated with team transactive memory system ($r = 0.32$, $p \leq 0.01$), which is consistent with the study conducted by Zhang et al. [45]. What's more, this study represents the first attempt to examine team learning goal orientation as the antecedent and team innovation as the outcome of transactive memory system, thereby enriching research in this area. We also address the limitations of previous studies of transactive memory systems, which have been conducted in a laboratory setting with student samples [98-100], by sampling R & D teams in a work setting.

By explaining the effect of team learning goal orientation on team innovation, we extend the team climate literature. Aspects of team climate such as communication [101-103], rewards and structure [103] and achievement orientation [38] are known to contribute to innovation. We find empirical support for the causal effect of team learning goal orientation on team innovation. This result is consistent with the previous finding that teams that are achievement-oriented are more likely to innovate [38].

The theoretical contributions of this study are further strengthened by the research design. The direction of causality is firmly established through a three-wave data collection on team learning goal orientation, task interdependence, transactive memory system and team innovation. Furthermore, common method bias is eliminated by the collection of data from both team members and team leaders.

## Managerial Implications

This study augments practical managerial knowledge in several ways. Organizations in modern economies are faced with various challenges, such as rapidly advancing technology, changing environments, changing industrial structures and strategies, evolving societies, evolving customer desires, competitors with improved products and services and the loss of customers. These challenges make innovation increasingly important. Innovation, or the generation of new ideas and their implementation, leads to faster growth, increased market share and better corporate positioning. As organizations now place greater reliance on teams to innovate, team innovation has become particularly important. The findings of this study offer managers several hints for improving innovation in teams. First, we establish that a learning goal orientation facilitates team innovation. This indicates that to promote team innovation, a clear team goal orientation toward learning should be established. This can be achieved by educating team members about the importance of learning to team performance and their career development, encouraging team members to support each another to learn within the work group setting and asking team leaders to use their skills to influence the culture to promote learning. Second, we find that team learning goal orientation is translated into team innovation by transactive memory system. Thus, shared cognition of knowledge processing should be developed to promote innovation in teams with a clear learning goal orientation. The promotion of interaction and communication among team members is an obvious means of achieving this, but a trust culture in teams should also be encouraged and seminars and workshops to develop knowledge processing skills may also be helpful.

A learning goal orientation plays an important role in the formation of transactive memory system, which have an important influence on team performance (e.g., [45,46,97]). The formation of transactive memory system in learning-orientated teams can be further promoted through team tasks that encourage communication, interaction and cooperation among members. This can be realized by changing the distribution of individual tasks, redesigning individual jobs and adapting the rules governing how task-related decisions are made to make individuals more reliant on each other to complete tasks. These kinds of team tasks also help learning-orientated teams to innovate through the deployment of transactive memory system.

## Limitations and Future Research

The results of this study are subject to several caveats. The data on team innovation were self-reported and may this be subject to bias. Although self-reported data have recently been found to have fewer limitations than was previously believed [104] and leaders' ratings of team innovation are now widely used in team research (cf. [105]), it would be preferable for future studies to replicate our findings using objective measures of team innovation.

In addition, our data came from R&D teams in a single industry: the information technology industry. Although R&D teams in information technology firms emphasize teamwork [51] and pay great attention to team innovation in routine work, further research is needed in a range of team settings across different industries to determine the generalizability of our findings.

Drawing on theories derived from Western culture, this study examines the relationship between team learning goal orientation, task interdependence, transactive memory system and team innovation in a Chinese context. It offers initial support for the application of Western theories to Chinese companies and is helpful in establishing the generalizability of these theories. However, as China is higher on collectivism than Western countries, the work is more interdependence by nature, such that team members may have better developed transactive memory as a result of extensive coordination and sharing. Therefore, future research is needed to validate the study findings.

There are other related areas that deserve further investigation. This study examines the effect of team learning goal orientation, a type of team climate in which the goal of learning is encouraged, emphasized and rewarded [3,25,26,32], on team innovation. Future studies could be conducted to examine the causal effect of other types of team climate on innovation. This study is the first attempt to theoretically hypothesize and empirically test the boundary condition and underlying mechanism of the relationship between team learning goal orientation and team innovation. Future studies could explore new theories on other moderators and mediators of this relationship.

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