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When and how is team cognitive diversity beneficial? An examination of Chaxu climate

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ABSTRACT

The workforce is becoming increasingly heterogeneous in terms of age, gender, race/ethnicity, education, values, cognition, and culture. Thus, team diversity management is regarded as an important development strategy that organizations can use to gain advantages. However, in the diversity literature, empirical studies investigating the effects of cognitive diversity on creativity have not yielded conclusive findings. This has called into question the importance of team cognitive diversity. To address this, we investigate when and how team cognitive diversity fosters individual creativity. Drawing on the categorization-elaboration model (CEM) and literature on Chaxu climate, we develop a multilevel mediated moderation model in which the team Chaxu climate is treated as the moderator and team knowledge sharing is treated as the mediator. Using two-wave paired data collected from 46 teams and 368 members, we find that Chaxu climate mitigates the positive effect of team cognitive diversity on team knowledge sharing. In turn, team knowledge sharing mediates the interaction effect between team cognitive diversity and Chaxu climate on individual creativity. Our study facilitates a shift from an automatic-oriented lens to a contingent-oriented lens by identifying a new contingent factor and advances research on the underlying mechanisms by identifying a new process factor. Ultimately, this study enriches our knowledge on the function of cognitive diversity in the field of business strategy.

1. Introduction

As the workforce becomes increasingly heterogeneous in terms of age, gender, race/ethnicity, education, values, cognition, and culture [1,2], organizations seek ways to effectively manage workforce diversity and unleash its strategic value. Diversity management has become a stream of business management research and received considerable attention from scholars in the fields of strategy management, international business, and psychology. Considering that the nature of diversity as a two-edged sword has been identified [3–5], understanding how to capitalize on the resources inherent in and gain value from the increasing diversity of the workplace

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has become important [6]. Among the various dimensions of diversity, cognitive diversity—defined as the degree to which team members differ in terms of their expertise, experience, knowledge, skills, thinking styles, values, and beliefs [7,8]—is assumed to have favorable effects on firms' strategic orientation, high-quality decisions, and creativity [5,9–14]. However, the benefits of cognitive diversity have not yet been consistently supported by empirical evidence. For example, some studies have found that cognitive diversity has a positive effect on employee creativity, whereas others have concluded that it depends on certain conditions [15–19].

To reconcile these ambiguous results, this study examines the conditions and processes underlying the effects of cognitive diversity on beneficial outcomes based on the categorization-elaboration model (CEM). CEM integrates the perspectives of information/decision-making and social categorization processes to illustrate when and how diversity generates positive outcomes. It proposes that the elaboration of task-relevant information is the primary process underlying the positive effects of diversity on performance (i.e., creativity and decision quality); however, such a mechanism is subject to social categorization [5]. The intergroup biases flowing from social categorization may disrupt the elaboration process of task-relevant information, including "the exchange of information and perspectives, individual-level processing of the information and perspectives, the process of feeding back the results of this individual-level processing into the group, and discussion and integration of its implications" [5]. This can subsequently impede the positive effects of diversity on outcomes [5]. This theoretical perspective implies that cognitive diversity within a team does not necessarily facilitate the information elaboration process, which is also restricted by a repertoire of contextual factors (e.g., social categorization) [5], highlighting the prerequisites of the mechanisms that link cognitive diversity to beneficial outcomes.

Consistent with the CEM, we consider contingencies that may influence the mechanisms underlying the effects of cognitive diversity on outcomes. Although the CEM provides a sound rationale for interpreting the processes and conditions underlying the relationship between diversity and outcome variables, most previous research has overwhelmingly focused on potential processes, such as information elaboration [13,20]; while less emphasis has been placed on possible prerequisites, leading to ambiguity in previous findings [21]. Some studies have empirically supported the claim that the positive effect of cognitive diversity does not occur automatically but instead occurs under certain conditions, such as when transformational leadership is high [18,19] or when the team's need for cognition is high [16]. Accordingly, it is reasonable to prioritize considering possible contingent factors when investigating the effects of cognitive diversity, instead of merely examining the underlying mechanisms. Considering that organizational climate has been identified as one of the most influential conditional factors because of its symbolic meaning [22–24], it could be insightful to investigate whether organizational climates could promote or hinder the benefits of cognitive diversity.

Chaxu climate, a pervasive organizational phenomenon in China, refers to employees' shared perceptions of the differential relationships between resource allocators and petitioners, and the resultant differential treatments in an organization or group [25]. Chaxu climate captures a circular-layer relationship pattern built more on personal preferences and ties in non-work-related settings than on personal contributions and competence in a work-related setting, and reflects the substantial distribution of resources and powers within a team [25]. This phenomenon can not be fully captured through well-established constructs, such as leader-member exchange differentiation, team fairness/justice climate, and insider/outsider status in the context of employment; nevertheless, it is easily recognized and widely perceived among Chinese employees. A team with high levels of Chaxu climate signals to members that there exist favored and unfavored groups, which may result in inter-subgroup biases. According to the CEM, intergroup conflicts arising from social categorization in an environment with a Chaxu climate may disrupt the task-relevant information elaboration process, interrupting the mechanism through which cognitive diversity is translated into favorable outcomes. Therefore, we incorporate the Chaxu climate as a boundary condition and examine its role in determining the effect of cognitive diversity on outcomes.

Moreover, we focus on the collective knowledge-sharing process to articulate the mechanisms underlying the effects of cognitive diversity on outcomes. Team knowledge sharing follows a process through which team members share task-relevant ideas, information, and suggestions with each other [26–28]. This is an indispensable component of the task-relevant information elaboration process. By exchanging knowledge with others, team members can fulfill other parts of the information elaboration process, such as absorbing, assimilating, and internalizing the available knowledge, information, ideas, and skills. Team knowledge sharing has been found empirically to be conducive to individual creativity by enlarging individual members' knowledge pools, activating their divergent thinking, and inspiring novel insights and alternatives [29]. The knowledge-sharing process has been found to be fostered by team members' diverse knowledge, education, and experience [30]. Following the mediating logic of the task-relevant information elaboration process proposed in the CEM, team knowledge sharing can be viewed as a proxy mechanism underlying the effect of cognitive diversity on its outcomes. Thus, we consider team knowledge sharing a bridge and test its mediating role in the effect of cognitive diversity on outcomes.

Additionally, individual creativity involves the production of novel ideas by an employee [31–33], which relies on an individual's skill and knowledge [29]; this process is proximal to diversity. Such creativity has long been regarded as one of the most favorable outcomes of diversity [5,11,18,34,35]. Thus, we specifically focus on the relationship between team cognitive diversity and individual creativity. On one hand, we concentrate on team-level cognitive diversity because organizations are increasingly relying on cross-functional teams to cope with the constantly changing situations, and understanding how teams function in volatile environments is imperative [6]. On the other hand, we focus on individual-level creativity instead of the frequently studied team-level creativity; this is because, in contrast to team-level creativity, individual creativity can be achieved by individuals leveraging heterogeneous resources and information with no need for team convergence processes; moreover, this mechanism is understudied and requires clarification [18,30].

Overall, we develop a multilevel mediated moderation model in which Chaxu climate moderates the effect of team cognitive diversity on knowledge sharing, which subsequently influences individual creativity (see Fig. 1). This study contributes to the literature in several ways. First, we address the inconclusive results in the literature regarding the effects of cognitive diversity by shifting from an automatic-oriented lens to a contingent-oriented lens, thereby highlighting the contingency of its functionality. By identifying the

notion of the Chaxu climate, a prominent characteristic in Chinese society, as a new contextual condition, our study answers the call for researchers to probe the boundary conditions pivotal to the effect of cognitive diversity [36]. Second, we extend the CEM by uncovering an alternative mechanism underlying the contingent effects of cognitive diversity on individual creativity. We include team knowledge sharing as a proxy process for task information elaboration, providing a novel mechanism to explain how cognitive diversity relates to creativity and responds to the call for considering additional mechanisms underlying the function of diversity [36–39]. Finally, because cross-national generalizability is a primary concern in the field of diversity and creativity [18,36,40], our research offers new insights into the culturally contextual effects of cognitive diversity by considering a non-Western culture (i.e., the Chinese context) that is characterized as a differential society [41]. In this process, we capture the moderating role of an indigenous team-level context (i.e., Chaxu climate), which is subsequently conducive to demonstrating how the strategic value of diversity can be taken advantage of in a specific context.

2. Theory and hypotheses

2.1. The moderating role of Chaxu climate

Team cognitive diversity refers to the degree to which team members differ in terms of their expertise, experience, knowledge, skills, thinking styles, values, and beliefs [7,8]. Diverse cognition in a team implies that a repertoire of complementary and nonredundant ideas, perspectives, knowledge, and values is accessible to each member. Team knowledge sharing, a team process through which team members share task-relevant ideas, information, and suggestions with each other [26–28], is expected to be fostered by team members' diverse knowledge, education, and experience [30].

Although this type of diversity is conceptually conducive to team knowledge sharing, the CEM explicitly asserts that its effects are subject to the social categorization process. If social categorization produces intergroup biases that disrupt group functioning to the extent that the identity implied by the categorization is subjectively threatened or challenged [42], the task information elaboration process is impeditive, even within a diverse group [5]. This claim implies that team cognitive diversity does not necessarily trigger knowledge sharing among team members. and that this link is constrained by disruptive intergroup biases resulting from the social categorization process.

The notion of Chaxu climate originates from the indigenous Chinese concept of Chaxu patterns in society; this term was coined by Fei Xiaotong [43]. Traditional Chinese society is characterized by a differential pattern in which individuals are located at the center, and their interpersonal relationships extend outward layer-by-layer in "ripple circles." As these ripple circles expand, the intimacy of their interpersonal relationships gradually weakens, causing individuals at the center of the circle to interact differentially with others [41,44].

Drawing on the Chaxu patterns of society, the notion of Chaxu climate was developed to capture the same phenomenon in organizations [45]. Such a climate has been conceptualized in terms of individuals' shared perceptions of the differential relationships between resource allocators (e.g., leaders) and petitioners (e.g., team members) within a team [25]. Chaxu climate captures a circular layered relationship pattern that is built more on personal preferences and ties in non-work-related settings than on personal contributions and competence in work-related settings. It also reflects the substantial distribution of resources and powers in a team [25].

In a team with a strong Chaxu climate, allocators assign the resources they possess to each petitioner based on the proximity of their dyadic relationships [46,47]. Members in a layer closer to the core leader (e.g., the resource allocator) tend to be privileged and given more resources. In such a climate, social categorization into subgroups with unequal status, such as superior versus subordinate groups, favored versus unfavored groups, or core versus marginalized groups, invisibly emerges. Problematic social categorizations that entail uneven opportunities to gain key resources challenge members' positive perceptions of their group identity and may provoke inter-subgroup biases or conflicts. According to the CEM, considering these barriers, knowledge sharers may have a lower tendency to engage in knowledge exchange activities even when they are exposed to a broad range of information, knowledge, and skills. Consequently, the level of team members' knowledge sharing is expected to be low.

In summary, because of inherent social categorization, Chaxu climate creates several barriers that prevent team members from leveraging the potential of cognitive diversity within a team. Accordingly, we propose the following hypothesis:

H1. Chaxu climate mitigates the positive relationship between team cognitive diversity and knowledge sharing such that the relationship is less positive at a high (instead of low) level of Chaxu climate.

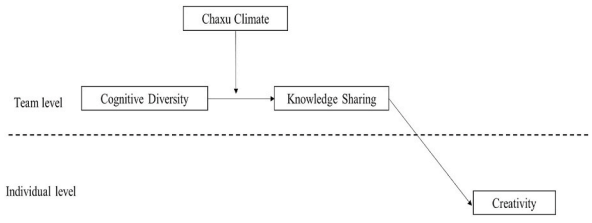

Fig. 1. Conceptual model.

2.2. Knowledge sharing and individual creativity

Individual creativity involves employees producing novel and useful ideas about products, services, processes, and procedures [31–33]. It is generated by divergent thinking, considering things from different perspectives, and combining previously unrelated processes, products, or materials into something new and better [32].

According to the CEM, information integration, utilization, and elaboration facilitates creativity [5]. Thus, team knowledge sharing, as a proxy for the task-information elaboration process, is posited to foster individual creativity. More knowledge-based resources generated are within teams with a higher degree of knowledge-sharing. Individual members in such teams can access, absorb, integrate, and capitalize on more available knowledge at work and are consequently more likely to generate novel ideas, activate divergent thinking, and inspire new insights and alternatives [29]. Therefore, individual creativity is expected to be fostered.

Accordingly, we postulate that team knowledge sharing is conducive to individual creativity and propose the following hypothesis:

H2. Team knowledge sharing is positively related to individual creativity.

2.3. The mediating role of knowledge sharing

Combining the CEM and previous two hypothesized relationships, we posit that knowledge sharing mediates the interaction effect between team cognitive diversity and Chaxu climate on individual creativity.

When Chaxu climate within a team is high, team members tend to perceive the existence of core and marginalized groups with status differences and may suffer from inter-subgroup biases and/or unjust treatment [46]. In such cases, team members may negatively view the differences in cognition within their teams and become less motivated to engage in knowledge sharing because of their fears of an unexpected or hostile "return" [48]. Embracing and openly discussing distinct ideas or perspectives among members is less likely to occur, which is detrimental to individual creativity. Therefore, although a team with diverse cognition features a variety of information, knowledge, and skills, a high-level Chaxu climate creates barriers that prevent team members from sharing and utilizing these varied cognitive resources; thus, individual creativity is less likely to be fostered in Chaxu climate.

Conversely, a low-level Chaxu climate implies a low degree of disparate treatment within the team, representing an environment of justice, transparency, and low levels of social categorization with narrow status differences within the team. In such teams, all members tend to perceive themselves as included and valued, and feel free and safe to transfer knowledge; thus, they are more active in cooperating with and learning from each other. Considering their high willingness to share, absorb, and integrate others' different but complementary knowledge, information, and perspectives, these members are more likely to behave creatively by combining different ideas, building upon others' ideas, and experimenting with ideas offered by those with different perspectives [5,18,49]. Thus, individual creativity is facilitated via the process of team knowledge sharing.

Accordingly, Chaxu climate determines the effect of cognitive diversity on knowledge sharing; subsequently, this moderating effect influences individual creativity. Thus, we posit the following hypothesis:

H3. Team knowledge sharing mediates the interaction effect between team cognitive diversity and Chaxu climate on individual creativity.

3. Methods

3.1. Participants and procedures

Our sample comprised 46 teams from six high-tech organizations in northern and southern China. These organizations were private and medium-sized and engaged in the following different industrial sectors: software development (14 teams), biological engineering (10 teams), pharmaceuticals (8 teams), manufacturing (6 teams), telecommunications (5 teams), and energy (3 teams). These teams primarily focused on fulfilling knowledge-based tasks, including developing new technologies and improving existing technologies, products, and services. We selected the sample teams according to the following criteria: (1) teams forming a basic functional unit within the organization, (2) teams reporting directly to the same supervisor, (3) teams with members belonging to only one team, (4) teams working together permanently, and (5) teams interacting several times per week and closely collaborating to meet team objectives.

This project was reviewed and supported by the academic committee in our university and the National Natural Science Foundation of China (Nos. 71972139), as we did not have an ethics committee. After obtaining their approval, we contacted team leaders and invited their team members to participate in our study with the support of the HR managers in each organization. After receiving agreements from 63 teams, we collected data from multiple sources at two time points. At time 1, the team members were required to report their demographic information and complete measures of cognitive diversity, Chaxu climate, and knowledge sharing. Around eight weeks later, at time 2, we asked the leader of each team to rate the individual creativity of their members. We chose eight weeks as the time-lag interval to capture the substantial effect of cognitive diversity on creativity because cognitive resources usually require time to exert an effect.

Questionnaires were used to collect the data. The surveys were conducted during working hours by two trained research assistants (a professor and a PhD student). Participation was voluntary and the respondents were assured of the anonymity of their responses. All participants were assigned pre-coded questionnaires to facilitate matching. A gift of six dollars was given to each participant after completing the questionnaire, and each leader was offered a reward of thirty dollars for their cooperation.

We obtained responses from 63 teams between June 1, 2018, and August 1, 2018. We excluded 11 of these teams due to a large amount of missing data and an additional six teams because of high turnover during the survey period. Our final sample comprised 368 members across 46 teams, ranging in size from 4 to 12 members (mean = 8, SD = 2.28). Among the participating team members, 76.6 % were male, 85.3 % were aged between 25 and 35 years, 72.8 % held a master's degree or a higher educational qualification, and 89.1 % had majors in science or engineering. Among the 46 participating team leaders, most were male (91.2 %), between the ages of 31 and 35 years (82.4 %), and all held master's degrees or higher educational qualifications.

3.2. Measures

The scales used to measure cognitive diversity, knowledge sharing, and individual creativity were initially written in English and translated into Chinese following the standard translation-back-translation procedure [50]. The six-point Likert-type scales were used to avoid the central tendency derived from the potential influence of Zhong Yong's thinking on Chinese people [51] while completing the scales.

Team Cognitive Diversity. We measured team cognitive diversity using the four-item scale validated by Van der Vegt and Janssen [52]. The respondents were asked to indicate the extent to which the members of their team differed in their ways of thinking, knowledge, and skills, how they viewed the world, and their beliefs about right and wrong (1 "similar to a very large extent"; 6 "similar to a very small extent"). A sample item was "The members in our team agree with the best way to maximize the team's long-term benefits." The Cronbach's alpha for this scale was 0.93. We conceptualized team cognitive diversity using a direct consensus model [53]. Before aggregation, we examined the inter-rater agreement (rwg) and intraclass coefficients (ICCs) of the raters. Next, we averaged the ratings of multiple peers to establish a score for team cognitive diversity, given a mean rwg of 0.85, which indicated that the team members rated these items similarly. An ICC (1) of 0.35 suggested that sufficient between-group variance existed among the teams, while an ICC (2) of 0.78 revealed that the reliability of the average team perceptions was sufficient. Based on these acceptable inter-rater agreement scores and intra-class coefficients, we computed the mean to indicate the level of team cognitive diversity.

Chaxu Climate. The eleven items developed by Liu [45], grounded in the Chinese context, were used to measure Chaxu climate. This construct is a localization concept that refers to a unique phenomenon in the Chinese context, operationalized as members' perception of a leader's differential treatment toward subordinates; it includes the following three dimensions: reciprocal attachment, favoritism, and having cronies [45]. A sample item was "There are differences in the treatment of each of us by the team leader." Using the aforementioned six-point scale (1 = "strongly disagree" to 6 "strongly agree"), participants rated the degree of their individual perceptions. Cronbach's alpha for this scale was 0.87. We also justified averaging the individual data to create a team-level variable representing the Chaxu climate based on a mean rwg of 0.72, ICC (1) of 0.32, and ICC (2) of 0.79.

Knowledge sharing. We used the three-item scale developed by Choi et al. [54] to measure team knowledge sharing. This measurement was modified based on the knowledge sharing intention scale reported by Bock et al. [55]. It targets the measurement of individuals' perceptions of the degree to which their team members share different forms of knowledge. This scale fits our definition well, and can be appropriately aggregated at the team level. It was completed by each team member. A sample item was "Our team members provide their manuals and methodologies for other team members". The Cronbach's alpha for this scale was 0.72. The feasibility of aggregating this scale was further supported by a mean rwg of 0.74, ICC (1) of 0.46, and ICC (2) of 0.87.

Creativity. We used Shin et al.'s [18] validated Chinese version of the creativity scale, which was originally developed by Zhou and George [56], to measure individual creativity. The team leaders were asked to evaluate how much they agreed or disagreed that the rated members in their team exhibited the 13 creative activities demonstrated on that scale (1 "strongly disagree"; 6 "strongly agree"). A sample item was "Comes up with creative solutions to problems." The Cronbach's alpha for this scale was .83.

Control Variables. To avoid spurious relationships, we included several control variables identified in previous studies to be associated with these relationships. First, we controlled for the degree of education at level 1, because this variable has been found to be related to creativity [18,32]. We also controlled for other demographic variables at level 1, such as age, gender, major, and region, which have usually been treated as control variables in diversity and creativity research [31,57–59]. Furthermore, following Kearney et al. [16] and Shin et al. [18], surface-level diversity, such as age and gender diversity, was controlled for at the team level. This is because such diversity is believed to interfere with the effects of cognitive diversity, which represents a form of deep-level diversity. Given that education and major diversity have sometimes been regarded as proxy variables of functional background diversity to indicate cognitive diversity [60,61], we also controlled for these variables at level 2. Additionally, a study from Korea, which is culturally similar to China, found that the region of employees has a significant effect on their sense of inclusion in the workplace [62]. Therefore, we added regional diversity as another team-level control variable. All control variables at level 2 were measured using Blau's index ($1\text{-}\Sigma P_i^2$), where p is the proportion of team members in the kth category [49,63].

4. Analytical strategy

Our theoretical model was a 2–2–1 multilevel mediated moderation model with the moderator variable at level 2. Given that our data were hierarchical, we conducted a multilevel modeling analysis to test all hypotheses using Mplus 7.4 [64].

Specifically, we used multilevel structural equation modeling [65–67] with manifest variables to test our hypotheses. Regarding the first-stage moderation (Hypothesis 1), we conducted a multilevel simple slope analysis to estimate the simple slopes at the high (1 *SD* above the mean) and low (1 *SD* below the mean) levels of the moderator variable. To examine the mediated moderating effect (Hypothesis 3), we followed the principles of conditional indirect effect testing proposed by Bauer et al. [68] and Hayes [69]. Accordingly, we calculated the indirect effects at the high and low moderator levels and their effect differences. The Monte Carlo

method recommended by Preacher et al. [65] was used to estimate the confidence intervals (CI) (95 %) of the hypothesized multilevel moderating and mediating relationships. When producing the interacting term, the predictor (cognitive diversity) and moderator variables (Chaxu climate) at level 2 were grand-mean-centered to control for multicollinearity [70].

5. Results

5.1. Preliminary analysis

5.1.1. Confirmatory factor analysis

Prior to testing our hypotheses, we conducted confirmatory factor analysis (CFA) to assess the quality of our survey measures, including cognitive diversity, Chaxu climate, knowledge sharing, and creativity. The expected four-factor model fit the data the best ($\chi2(146) = 254.88$, CFI = 0.98, TLI = 0.96, RMSEA = 0.05, SRMR = 0.04) and was superior to alternative models. The results indicate that the hypothesized model yielded a better fit to the data than the three-factor model (combining creativity and knowledge sharing: $\chi2(149) = 822.414$, CFI = 0.86, TLI = 0.80, RMSEA = 0.12, SRMR = 0.09), two-factor model (combining cognitive diversity, creativity and knowledge sharing: $\chi2(151) = 1194.05$, CFI = 0.80, TLI = 0.74, RMSEA = 0.15, SRMR = 0.13), and single-factor model (all items were loaded on the same factor: $\chi2(152) = 1388.18$, CFI = 0.78, TLI = 0.67, RMSEA = 0.18, SRMR = 0.19). The factor loadings of all four variables were significantly greater than 0.50. All AVE values were greater than 0.50 ($AVE_{\text{cognitive diversity}} = 0.78$, $AVE_{\text{knowledge sharing}} = 0.70$, and $AVE_{\text{creativity}} = 0.67$), except for that of the Chaxu climate ($AVE_{\text{Chaxu climate}} = 0.49$), which was slightly below 0.50. The composite reliability of the four factors also met the acceptance standards; they were 0.93 for cognitive diversity, 0.88 for Chaxu climate, 0.86 for knowledge sharing, and 0.85 for creativity. Next, we computed the shared variance (SV; the squared correlation across factors) following the methodological recommendations [71]. The SV values were 0.11 for cognitive diversity and creativity, 0.10 for cognitive diversity and Chaxu climate, 0.51 for cognitive diversity and knowledge sharing, 0.01 for Chaxu climate and knowledge sharing, 0.01 for Chaxu climate and creativity, and 0.19 for knowledge sharing and creativity. All the values were lower than the corresponding AVE values for each variable, providing further evidence of discriminant validity. With sufficient convergent and discriminant validity, these variables were examined as distinct constructs.

Although our data were collected from different sources at different time points and the team members rated more than one variable, common method variance may have impacted our study. To examine common method bias, we developed a bifactor model and conducted a CFA [72,73]; in this context, the method factor was treated as a general factor. We used an M − 1 model (removing one method) to ensure model specification [74]. The results showed that the AVE value of the method factor (AVE = 0.18) was less than 0.50, which was not sufficient to be judged as a latent factor [75]. Thus, the common method bias was considered not a serious issue in this study.

Subsequently, considering that each team leader rated multiple members, we examined leader ratings for non-independence. A one-way random analysis of variance (ANOVA) of the dependent variable indicated significant between-group variance, $F(45, 322) = 10.84$, $p < .001$. The ICC(1) was 0.55, suggesting that 55 % of the variance was from between-team creativity. This result warranted the use of multilevel modeling to analyze the data.

5.2. Descriptive statistics

Table 1 presents the means, standard deviations, and bivariate correlations of the focal variables. Cognitive diversity was significantly and negatively related to Chaxu climate ($r = -0.310$, $p < .001$ and significantly and positively related to knowledge sharing ($r = 0.711$, $p < .001$)[1] and creativity ($r = 0.337$, $p < .001$). Chaxu climate was negatively correlated with knowledge sharing ($r = -0.065$, *n.s*) and creativity ($r = -0.086$, *n.s*), but this correlation was not significant. Knowledge sharing was significantly and positively linked to creativity ($r = 0.435$, $p < .001$).

5.3. Hypothesis testing

Given the nested nature of our data and cross-level relationships included in our model, we used multilevel structural equation modeling (MSEM) [65–67] with Mplus 7.4 software to test our hypotheses. All path coefficients were unstandardized because our multilevel analysis was built using a random slope model.

Hypothesis 1. proposed that Chaxu climate can mitigate the positive relationship between team cognitive diversity and knowledge sharing. The results of Model 1, as shown in Table 2, supported Hypothesis 1. The interaction term between cognitive diversity and Chaxu climate was significantly and negatively related to knowledge sharing ($\gamma = -.657$, S.E. = .122, $p < .001$) after controlling for the effects of gender, age, education, major, and regional diversities at the team level. Following Aiken et al. [76], we calculated simple slopes and plotted the moderating effect (see Fig. 2). The simple slope of the impact of team cognitive diversity on knowledge sharing in a high level Chaxu climate (+1 SD) (estimate $_{\text{high}} = 2.474$, S.E. = .358, $p < .001$) was significant. The simple slope in a low level

[1] Although the correlation between cognitive diversity and knowledge sharing was high ($r = 0.711$, $p < .001$), it remained less than the 0.75 standard for multicollinearity (Tsui et al. [100]). Additionally, the SV values of the two variables were lower than the AVE value of both variables, indicating their distinctiveness.

Table 1
Descriptive statistics, reliabilities, correlations, and aggregation.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Level 1														
1. Gender[a]														
2. Age[b]	−.039													
3. Education[c]	−.123*	−.148**												
4. Major[d]	.499***	.010	−.081											
5. Origin[e]	.397***	.070	.002	.228***										
6. Creativity	.014	−.022	−.029	.027	−.175**	(.83)								
Level 2														
7.Gender diversity	.506***	−.050	−.302***	.200***	.264***	.173**								
8.Age diversity	.058	.149**	−.269***	.049	.096	−.039	.208***							
9.Education diversity	.183***	.157**	−.257***	.203***	.170**	.024	.090	.496***						
10.Major diversity	.467***	.047	.042	.588***	.374***	.016	.382***	.212***	.257***					
11.Region diversity	.060	−.026	−.286***	−.036	.027	−.246***	.302***	.343***	.323***	.144**				
12.Cognitive diversity	.164**	.005	.266***	.179**	.092	.337***	.140**	.277***	.008	.244***	−.337***	(.93)		
13.Chaxu climate	−.059	.290***	−.068	−.177**	−.055	−.086	.108*	−.133*	−.218***	.032	.288***	−.310***	(.87)	
14.Knowledge sharing	.325***	.259***	−.004	.254***	.200***	.435***	.385***	.342***	.256***	.447***	−.161**	.711***	−.065	(.72)
Mean	1.23	2.64	2.92	1.39	2.14	4.07	.18	.28	.30	.09	.28	4.43	3.48	4.39
SD	.42	.93	.86	1.26	.53	.55	.21	.24	.23	.19	.23	.72	.93	.67
Mean Rwg												.86	.72	.74
ICC (1)						.55						.52	.32	.46
ICC (2)												.90	.79	.87

*p < 0.05.
**p < 0.01.
***p < 0.001 (two-tailed tests).
Note: $N_{within\text{-}level} = 368$, $N_{between\text{-}level} = 46$; Cronbach's alpha is shown in the parentheses along the diagonal.
[a] 1 = male, 2 = female.
[b] 1 = less than 25, 2 = 25–30, 3 = 31–35, 4 = 36–40, 5 = 41–45, 6 = more than 45.
[c] 1 = below a bachelor's degree, 2 = bachelor's degree, 3 = master's degree, 4 = doctoral degree.
[d] 1 = science and engineering, 2 = liberal arts, 3 = business, 4 = politics, 5 = sports, 6 = others.
[e] 1 = developed region, 2 = moderately developed region, 3 = undeveloped region.

Table 2
Results of the multilevel analysis.

Variable	Model 1	Model 2	Model 3		Model 4	
	X*W → M	M → Y	X*W → M→ Y		X → M*W → Y	
	Knowledge sharing	Creativity	Knowledge sharing	Creativity	Knowledge sharing	Creativity
Intercept	14.275***(1.856)	1.834*(.726)	14.275***(1.856)	1.736*(1.104)	4.130***(.111)	1.849(1.249)
Level 1						
Gender		−.240*(.116)		−.240*(.116)		−.239*(.115)
Age		−.208** (.078)		−.213** (.078)		−.214** (.080)
Education		−.030(.137)		−.026(.145)		−.027(.146)
Major		.083**(.024)		.086**(.026)		.085**(.026)
Region		−.056(.039)		−.056(.039)		−.056(.039)
Level 2						
Gender-div	.887***(.237)	.550(.430)	.887***(.227)	.540(.422)	.765**(.274)	.584(.395)
Age-div	.243(.282)	−.564(.329)	.243(.282)	−.505(.365)	.125(.297)	−.472(.378)
Edu-div	.181(.292)	.358(.363)	.181(.292)	.377(.358)	.754*(.325)	.379(.352)
Major-div	.443*(.195)	−.937(.647)	.443*(.195)	−.961(.670)	.470(.246)	−.901(.717)
Region-div	−.508(.305)	−.546(.383)	−.508(.305)	−.646(.413)	−.549(.311)	−.693(.444)
Knowledge sharing		.781***(.137)		.804***(.181)		1.015(.682)
Cognitive diversity	2.835***(.423)		2.835***(.423)	−.042(.199)	.600***(.118)	−.037(.202)
Chaxu climate	3.484***(.579)		3.484***(.579)	.053(.173)	.326**(.109)	.423(1.209)
Cognitive diversity × Chaxu climate	−.657***(.122)		−.657***(.122)			
Chaxu climate × Knowledge sharing						−.068(.217)

Note: $N_{within\text{-}level} = 368$, $N_{between\text{-}level} = 46$; *p < 0.05, **p < 0.01, ***p < 0.001 (two-tailed tests).

Chaxu climate (−1 SD) was also significant (estimate $_{low} = 3.197$, S.E. = .489, p < .001); their effect difference was significant (estimate $_{diff} = -.720$, S.E. = .130, p < .001). These results showed that the slope of the impact of the team's cognitive diversity on knowledge sharing in a high level Chaxu climate was significantly less steep than the slope in a low level Chaxu climate. This provided strong evidence to support Hypothesis 1.

Hypothesis 2. proposed that team knowledge sharing promotes individual creativity. As shown in Table 2, Model 2 revealed that knowledge sharing has a significantly positive cross-level effect on individual creativity ($\gamma = .781$, $p < .001$) after controlling for the effects of gender, age, education, major, and regional diversities at the individual level and effects of the corresponding team-level control variables. Thus, Hypothesis 2 was supported.

Based on evidence supporting the moderating and cross-level direct effects, we tested the cross-level mediated moderating effect proposed in Hypothesis 3. We examined the conditional indirect effect following the procedures described by Hayes [69] and Bauer et al. [68]. Considering the cross-level nature of the relationship suggested in Hypothesis 3, we applied a parametric bootstrap procedure [65] using R 3.6.1, based on the results of Model 3 in Table 2. With 20,000 Monte Carlo replications, the results suggested that after controlling for the effects of all control variables, the cross-level indirect effect of team cognitive diversity on individual creativity via knowledge sharing in a high level Chaxu climate was significantly positive (effect $_{high} = 1.988$, S.E. = 0.020, $CI_{95\ \%} = [0.987, 3.201]$, excluding zero). The indirect effect in a low level Chaxu climate was also significantly positive (effect $_{low} = 2.570$, S.E. = 0.795, $CI_{95\ \%} = [1.349, 3.979]$, excluding zero); the magnitude of the two indirect effects significantly differed (effect $_{diff} = -0.581$, S.E. = 0.192, $CI_{95\ \%} = [-0.983, -0.455]$, excluding zero). Consistent with Hypothesis 3, these results showed that when Chaxu climate is high instead of low, the positive relationship between team cognitive diversity and knowledge sharing is alleviated. This subsequently reduces individual creativity, thereby demonstrating the cross-level mediated moderation effect. Thus, Hypothesis 3 was supported.

5.4. Supplementary analysis

To rule out alternative explanations, we further examined whether Chaxu climate moderated the second-stage indirect effect of cognitive diversity → knowledge sharing → individual creativity. We used procedures similar to those used for Model 3. The results are shown in Model 4 in Tables 2 and 3 and they suggest that the indirect effect when the Chaxu climate was high (*effect* $_{high} = 0.586$, S.E. = 0.385, $CI_{95\ \%} = [-0.229, 1.521]$, including *zero*) or low (*effect* $_{low} = 0.631$, S.E. = 0.519, $CI_{95\ \%} = [-0.180, 1.579]$, including *zero*) was not significant, nor was the difference between the two indirect effects (*effect* $_{diff} = -0.045$, S.E. = 0.145, $CI_{95\ \%} = [-0.342, 0.244]$, including *zero*). Accordingly, the postulation that Chaxu climate moderates the second-stage indirect effect was not supported, further supporting our theory.

6. Discussion

Driven by dramatic changes in economy, society, and culture, the workforce is becoming increasingly heterogeneous in terms of age, gender, race/ethnicity, education, values, cognition, and culture. The task of wisely managing diversity to capitalize on its potential value has been a tremendous challenge for both researchers and practitioners for decades [77]. Our study addressed this issue by focusing on a typical type of deep-level diversity (i.e., cognitive diversity) that has received less attention from researchers

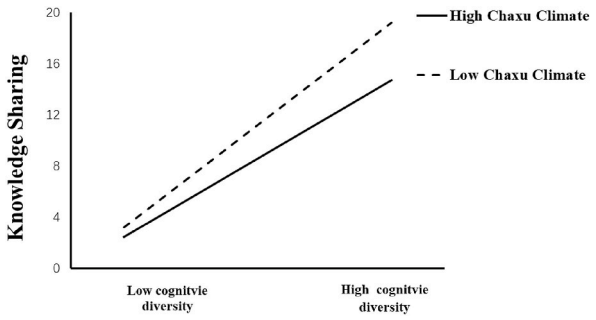

Fig. 2. Effect of team cognitive diversity on knowledge sharing.

Table 3
Results of the multilevel analysis.

Model	Moderator: Chaxu climate	Stage		Effect	
		First P_{MX}	Second P_{YM}	Indirect P_{MX} * P_{YM}	95 % CI of indirect effect
Model 1	Low (-1SD)	3.197***(.489)			
X*W → M	High (+1SD)	2.474***(.358)			
	Diff	−.720***(.130)			
Model 3	Low (-1SD)	3.197***(.489)	.804***(.181)	2.570(.795)	[1.349, 3.979]
X*W → M → Y	High (+1SD)	2.474***(.358)	.804***(.181)	1.988(.020)	[.987, 3.201]
	Diff			−.581(.192)	[-.983, −.455]
Model 4	Low (-1SD)	.600*** (.118)	1.052(.798)	.631(.519)	[-.180, 1.579]
X → M*W → Y	High (+1SD)	.600*** (.118)	.977(.568)	.586(.385)	[-.229, 1.521]
	Diff			−.045(.145)	[-.342, .244]

Note: $N_{within\text{-}level} = 368$, $N_{between\text{-}level} = 46$; *p < 0.05, **p < 0.01, ***p < 0.001 (two-tailed tests).

compared to surface-level diversity, such as diversity in terms of age, gender, or race/ethnicity [78]. We also identified the underlying mechanism and boundary conditions associated with the transformation of cognitive diversity into creativity.

Based on time-lagged and paired data collected from 46 teams in six Chinese organizations, we developed a multilevel mediated moderation model and found that Chaxu climate attenuates the positive relationship between team cognitive diversity and knowledge sharing. Moreover, knowledge sharing was found to mediate the joint effect of team cognitive diversity and Chaxu climate on individual creativity. Our findings have significant theoretical and practical implications for future studies.

6.1. Theoretical contributions

This study makes several theoretical contributions to the existing literature. First, we confirmed the contingency of the benefits of team cognitive diversity by showing that its positive effects are subject to Chaxu climate. When the Chaxu climate is high, team members with diverse cognition are less motivated to engage in knowledge-sharing activities, which results in a lower level of knowledge sharing in that team; subsequently, such team members' individual creativity is less likely to increase. The results show that the beneficial outcomes of cognitive diversity are not necessarily achieved; this relationship also depends on contextual conditions. Unlike the typical moderated mediation model (e.g., Refs. [13,20,37,78]), which assumes an inevitably positive effect, our mediated moderation model demonstrates a lens with a contingency orientation instead of an automation orientation, which is helpful in reconciling the inconsistencies in previous research. Supporting the CEM [5], our study provides a more reasonable perspective on the mechanisms underlying the effects of cognitive diversity on beneficial outcomes.

Second, our research is among the first to empirically corroborate the interplay between social categorization and cognitive diversity. It is acknowledged that social categorization explains why surface-level diversity, such as gender, age, and ethnicity, results in intergroup conflicts and exclusion. Conversely, information-processing elucidates why deep-level diversity, such as cognitive diversity, generates benefits [5,9,11,12,17,79]. Nevertheless, as suggested by the CEM, our results indicate that social categorization with status differences in an environment with Chaxu climate leads to disruptive intergroup bias and subsequently interrupts knowledge sharing among members. This subsequently prevents value translation from cognitive diversity to creativity. This finding indicates that social categorization can explain the effect of surface-level diversity and shape the effect of deep-level diversity, thereby advancing our understanding of when cognitive diversity fosters creativity. Moreover, this empirical result implies that surface-level diversity, which can easily lead to social categorization, may act as a buffer against the benefits of deep-level diversity. This can provide a new avenue for further exploration.

Third, we extend the CEM by validating the mediating role of knowledge sharing in the interaction effect between cognitive diversity and Chaxu climate on individual creativity. The CEM proposes that the task-information elaboration process is a key mechanism linking diversity to its outcomes that has been commonly examined in the literature as an underlying process [13,16,20,38].

However, this study found that knowledge exchange among members also plays an important role in linking cognitive diversity and creativity, thereby identifying an alternative mediator for the interpretation of the underlying mechanism. By identifying a specific mechanism in addition to a common general mechanism (i.e., the task-information elaboration process), our research responds to the call for investigating additional mechanisms underlying the relationship between diversity and outcomes [36,37,39].

Finally, this study provides insight into the cultural boundaries associated with the effects of cognitive diversity. Considering that most studies in this field have been conducted in Western cultures, multicultural research grounded in non-Western societies is necessary [18,36,40]. Our research was conducted in the Chinese context, which is characterized by a "differential pattern of interpersonal relationships" [41] and high levels of collectivism [80] and conformity [81]. Thus, our context dramatically differs from the Western context. By capturing the notion of Chaxu climate, an indigenous concept originating from the unique characteristics of Chinese society, and verifying its role in the effects of cognitive diversity, our research revealed a new cultural boundary that could facilitate cross-cultural studies concerning cognitive diversity.

6.2. Practical implications

This study has insightful implications for business management. By showing the contingent effect of cognitive diversity, which depends on Chaxu climate, and the mediating role of knowledge sharing in linking diversity and outcomes, our findings could help managers leading or preparing to organize cognitively diverse teams in managing such teams more effectively and strategically.

First, cognitive diversity does not automatically translate into benefits, and this linkage is subject to contextual factors; thus, cultivating an environment that takes advantage of cognitive diversity is necessary for realizing its strategic potential. For example, managers are encouraged to work in staff teams with members who have diverse knowledge, cultures, and professions, signifying that cognitive diversity is welcomed. They can also provide diversity training programs and create an inclusive climate to convey the philosophy of appreciating and dealing with diversity to their members. Importantly, top managers play a pivotal role in setting good examples for line managers [82–84] and exert significant influence on their implementation [85–87]. Therefore, the intended initiatives launched by top managers for valuing cognitive diversity are expected to be implemented well and cultivate a beneficial environment for capitalizing on cognitive diversity.

Second, Chaxu climate tends to engender disruptive social categorizations with status differences, attenuating the positive effects of cognitive diversity. Considering its widespread in Chinese organizations and easily recognized by employees [25,88], managers should pay close attention to initiatives that can decrease members' shared perceptions of differential treatment. It is paramount to be transparent, objective, and fair when making human resource management (HRM) decisions. However, if they must implement differential HR practices in certain situations, it is critical to try to legitimize these uneven measures [89]. By so doing, managers can unlock the full potential of the strategic value embedded in a cognitively diverse team.

Finally, knowledge sharing serves as a pivotal mechanism underlying the positive effect of cognitive diversity, and managers could benefit from executing measures that encourage members to freely, openly, and actively transfer, communicate and exchange their acquired knowledge [90–94]. For example, it is worth creating more opportunities for members with diverse cognitions to interact, discuss, and communicate. This can strengthen their mutual trust and interdependency and encourage them to share, integrate, and utilize each other's knowledge. It can also reward those willing to formally or informally share their own knowledge.

6.3. Limitations and directions for future research

We acknowledge a few limitations in our study. First, although we collected data from multiple sources (i.e., team members and their corresponding leaders) at two time points, we could not confirm causality with respect to the relationships of interest. Future research should employ longitudinal designs using more representative samples with more demographic information or experimental designs to uncover such causal effects.

Second, we measured cognitive diversity subjectively, which may not have accurately captured the attributes and reflected the effects of cognitive diversity. Future research could develop more proper diversity indices [95] or profiles [96] to increase the psychometric quality of cognitive diversity.

Third, we did not control for the effects of other similar constructs that are well-established and more culturally generalizable, such as leader-member exchange differentiation, team fairness/justice climate, and insider/outsider status in employment. Thus, we could not provide strong evidence for the unique effect of Chaxu climate. Although the notion of Chaxu climate as an indigenous construct is theoretically expected to be distinct from these constructs, future research that simultaneously considers these overlapping constructs and examines the net effect of the Chaxu climate can consolidate the unique influences of Chaxu climate and generate more robust conclusions.

Notably, we measured the perceived diversity in various cognitive attributes instead of the actual cognitive diversity among members of any specific attribute. Although this subjective measurement has been validated in previous research [18,19,37,78], some studies have adopted objective measurements, such as educational diversity [16], as proxies. Thus, future research could benefit from a comparison between the validity of subjective and objective measurements. This could help identify the type of cognitive diversity measurement (actual versus perceived) with a stronger predictive power.

Another limitation is that our sample included only Chinese employees. Although our study is culture-specific and all our hypotheses are based on theories and supported, the question of whether the results are generalizable to other cultures remains open. We do not know if this relationship is culturally bounded. Therefore, in the future, more cross-cultural and comparative studies should be encouraged.

Additionally, we only included knowledge sharing as an underlying mechanism, ignoring other potential mediators. As indicated by the CEM, diversity, including both surface- and deep-level diversity, can have either negative (e.g., group conflict) or positive (e.g., information elaboration) effects on outcomes [5]. Future research that simultaneously incorporates these two countervailing mechanisms may clarify the fine-grained relationship between cognitive diversity and creativity.

Furthermore, we considered only the linear relationship hypotheses and neglected the possibility of curvilinearity. Previous studies have proposed or verified the curvilinear effects of diversity [5–7,97], showing that a moderate level of cognitive diversity is the most beneficial, while too much or too little cognitive diversity is less favorable. Therefore, it could be promising to investigate whether the influence of cognitive diversity leads to a "the more the better" effect or a "too much of a good thing" effect.

Finally, we presumed that the disruption of social categorization with status differences results from a Chaxu climate, ignoring the possibility that the influence of status differences may vary according to hierarchy and legitimacy. On one hand, as reported by Zhang et al. [89], pay-grade dissimilarity is more beneficial for individuals with lower pay grades than for those with higher pay grade. This is because the influence of diversity may vary with the hierarchy of status. Therefore, the attitudinal and behavioral reactions of groups favored by resource allocators may not be the same as those that are not favored. On the other hand, status differences may not necessarily be viewed negatively or contested and instead be accepted if they can be legitimated [89]. A status hierarchy can be considered reasonable when the allocation of status is perceived as appropriate or is determined by employing a fair, depersonalized procedure [98,99]. If this is true, the status difference caused by Chaxu climate may not necessarily be disruptive; instead, this difference could be appreciated if leaders allocate resources according to objective criteria, such as skill, competence, and performance. Thus, whether the effect of Chaxu climate is positive or negative depends on whether it is perceived as legitimate. Therefore, future research involving these two factors could provide a clearer picture of the influence of Chaxu climate on diversity.

Ethics approval

The studies involving human participants were reviewed and approved by University of Academic Committee. Written informed consent was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Consent to participate

The studies involving human participants were reviewed and approved by Academic Committee of University. The participants provided oral informed consent to participate in this study.

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Data availability statement

Data will be made available on request.

CRediT authorship contribution statement

Jiaojiao Qu: Writing – original draft, Funding acquisition, Data curation. **Shuming Zhao:** Writing – review & editing. **Man Cao:** Writing – original draft. **Jintao Lu:** Supervision. **Yuan Zhang:** Writing – review & editing. **Yanhong Chen:** Writing – review & editing. **Rongmin Zhu:** Methodology.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:Jiaojiao Qu reports financial support was provided by National Natural Science Foundation of China. Shuming Zhao reports financial support was provided by National Natural Science Foundation of China. Man Cao reports financial support was provided by National Natural Science Foundation of China. Man Cao reports financial support was provided by Jiangsu Planned Projects for Postdoctoral Research Funds. Jiaojiao Qu reports financial support was provided by Fundamental Research Funds for the Central Universities. Man Cao reports financial support was provided by Nanjing Science and Technology Innovation Project for Overseas Returnees. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e23970.

Gender-div: gender diversity; Age-div: age diversity; Edu-div: education diversity; Major-div: major diversity; Region-div: region diversity; Standardized errors (S.E.) are shown in the parentheses.

P_{MX} refers to the path from cognitive diversity to knowledge sharing; P_{YM} refers to the path from knowledge sharing to creativity; PM_X * P_{YM} refers to the multi-level indirect effect; Diff refers to the main effect difference for Model 1, and the multi-level mediated moderation effect difference between Chaxu climate with high level and low level for Model 3 and 4; CI refers to confidence interval calculated using the Monte Carlo method; Standardized errors (SE) are shown in the parentheses.

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