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The role of network position, tie strength and knowledge diversity in tourism and hospitality scholars' creativity

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ABSTRACT

This study proposes a model of a structural hole, with knowledge diversity as a moderator that influences the quality and quantity of creativity outputs. The proposed models used a sample of 2316 international academic publications listed in social science citation indexes by 1661 tourism and hospitality scholars over a 32-year period across different regions of China (e.g., Mainland China, Hong Kong, Taiwan, and Macao). The results showed a curvilinear pattern of the relationships between the position of structural holes with the quantity and quality of creativity output. In addition, we found that knowledge diversity may positively influence creativity, as it performs the negative role of moderating the relationships between network positions and the quality and quantity of creativity outputs.

1. Introduction

Recently, practitioners and academics have identified creativity as the foundation of organization innovation. At the organizational level, employee creativity is a foundational attribute associated with an increase in the innovative capability for organization and competitiveness and is one of the most important factors for individual career success (Liu, Gong, Zhou, & Huang, 2017; Perry-Smith & Mannucci, 2017). In the academic field, scholars' creativity can often be measured by their academic publications, which not only highly correlate to individual academic reputation but also significantly influence their promotion and research funding applications (Garcês, Pocinho, & Jesus, 2017; Li & Liu, 2016; McFadyen & Cannella, 2004). Indeed, the academic literature on creativity describes the need for knowledge exchange through individual networks that share information and develop knowledge inputs through interaction with others to develop creativity (Hahn, Lee, & Lee, 2015). In measuring the relative contributions of creativity and social network theory, researchers have begun to explore how social ties and heterogeneous knowledge may provide significant evidence supporting the importance of creativity (Huang & Liu, 2015). Notwithstanding the significant contributions that have been made by previous studies, in the tourism and hospitality literature, most studies on creativity focused on employees (Tsai, Horng, Liu, & Hu, 2015), tourist attractions (Leiper, 1990), destinations (Prentice & Andersen, 2003) and organizations (Dredge, 2006). Little is known about how creativity is developed by knowledge researchers or workers in the fields of tourism and hospitality studies. Therefore, this study aims to fill the gaps and extend the of understanding of how the mechanisms that underlie earlier theoretical and empirical work in the existing tourism and hospitality literature have failed to show a relationship between network structure, tie strength, knowledge diversity and creativity in general.

This study combines the social network, knowledge management and creativity literary streams, and suggests that individual academic network structures may be able to influence the development of their internal capabilities to enhance creativity. Although interpersonal relationships affect the quality of an idea, the appropriate feedback can improve the idea's chances for adoption (Kijkuit & Van Den Ende, 2007). Interpersonal relationships also involve the potential costs of incompatible behaviors and attitudes, which can result in deleterious consequences to creativity (Bizzi, 2013). As Liao and Phan (2015) note, interpersonal relationships that span structural holes are better situated to control information flows and to exploit novel opportunities because they often lead to the combination of existing concepts. More importantly for this study, we assert that a shared common language, experience, and diverse information may help individuals toward powerful positions from which they can negotiate the costs and connections that lead to value-creation.

This study addresses a number of important aspects that have been overlooked by the existing literature. Firstly, knowledge workers or researchers can help an organization to identify new market opportunities (McFadyen & Cannella, 2004), increase the rate of new product

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introduction (Smith, Collins, & Clark, 2005) and increase knowledge transfer and management in tourism organizations (Shaw & Williams, 2009). Therefore, understanding the activities of knowledge workers or researchers is not only beneficial for organizations but also for advancing the core knowledge of individual successful careers in higher education. Although previous literature has demonstrated the creativity process and highlighted the importance of creativity in individual success (Zhu, Gardner, & Chen, 2018), using the social network perspective in explanations of individual creativity and demonstrating how different network positions may influence individual creativity have not been fully covered in the existing literature (Liu & Gan, 2018). Moreover, knowledge workers, such as scholars or scientists, discuss the quality and depth of the creation process, which not only provides significant evidence to fill the previous gaps in the social network literature (McFadyen & Cannella, 2004) but also reveals the success in fully considering the implications of professional relationships (Phelps, Heidl, & Wadhwa, 2012). Furthermore, as Seibert, Kacmar, Kraimer, Downes, and Noble (2017) note, interpersonal networks and critical network position are required for knowledge workers to share a language, produce strong norms and shared experiences to generate creative ideas among network members, and then integrate the information gained from the relationships, thus limiting openness to new information and diverse views. Therefore, this study uses the social network and knowledge management perspective, sampling tourism and hospitality scholars with a longitudinal period to address researcher–coworker role-relationships in explaining creativity. Secondly, we advance creativity theory in general, and the literature on knowledge network in particular, by providing insights into the previously neglected issue of individual professional network mechanisms. In explaining how individuals obtain network positions, tie strength, and knowledge diversity and how they contribute to creativity performance, the existing research has focused on how organizations support creativity performance and what individuals can do (Tsai et al., 2015). However, to fully understand individual creativity and the influences of network structure, it is necessary to further discover scholars' cooperation strategies and co-authorship relations (Leydesdorff, Park, & Wagner, 2014). This study addresses these issues and offers empirical evidence and additional explanations for scholars' creativity measurement and suggestions for how colleagues or coauthors can contribute and have an impact on creativity. Thirdly and finally, the role of tie strength and knowledge diversity that is provided by colleagues and coauthors may have a different effect on the quantity and quality of creativity. Therefore, the present study adopts the concept that diverse knowledge and tie strength will have direct and different moderating effects on the link between the position of structural holes and creativity. For example, we contribute to knowledge management theories of identification by shedding light on the potential impacts that may arise if knowledge diversity does not fit an individual's absorptive capability. This opens up a new perspective on the benefits of heterogeneous knowledge and identity conflicts and helps us to understand how to observe obtrusive attributes that may influence transitions and unobtrusive behavior in others.

Therefore, to investigate tourism and hospitality scholars' creativity generation process in different regions across China, this study relies on the perspective of social network theory, knowledge management, and network ties in relation to researchers' depth and quality of creativity with longitudinal period observations. Until now, the connection between heterogeneous knowledge and structural holes' advantages and disadvantages mediated by the positive influences of tie strength and average tie strength in an individual network structure has been an article of faith. As mentioned above, although tie strength is recognized for its obvious benefits in accessing critical resources and although heterogeneous knowledge will influence creativity independently and jointly, few rigorous empirical investigations have been conducted on the micro-social processes that exploit network structure or on how individual exposure to diverse knowledge and network ties recombines to produce a wellspring of creativity and innovation (Rodan & Galunic, 2004). The following section presents a comprehensive literature overview of social networks, network ties and knowledge management to develop the theoretical argument and main hypotheses. Next, the method section describes sample selection, variable definitions and research methods for regression usage. The results section presents the empirical results of our hypotheses tests in separate regions of China to determine the robustness of the findings. The final section concludes with a discussion of the implications of our empirical findings as well as limitations and suggested directions for future research.

1.1. Literature review and hypothesis development

1.1.1. The concepts of creativity in the field of academia

There has been a considerable increase in interest in the role of creativity in improving one's capacity to survive in the highly competitive academic environment. Since the 2000s, Chinese academics have begun to internationalize and aggressively increase their cooperation activities, attending academic conferences and maintaining and building their personal networks. Additionally, academic publication growth became more rapid after 2010 (Chen & Liu, 2012; Li & Liu, 2016), as seen in the trends shown in Fig. 1. Such trends indicate the increasing importance of this issue for Chinese sociality and the needs of knowledge workers. Discussing different regions in tourism and hospitality research provides an appropriate setting to fill the literature gap and to provide and identify new tourism-related research trends, which can in turn provide new insights that extend beyond those of the previous studies.

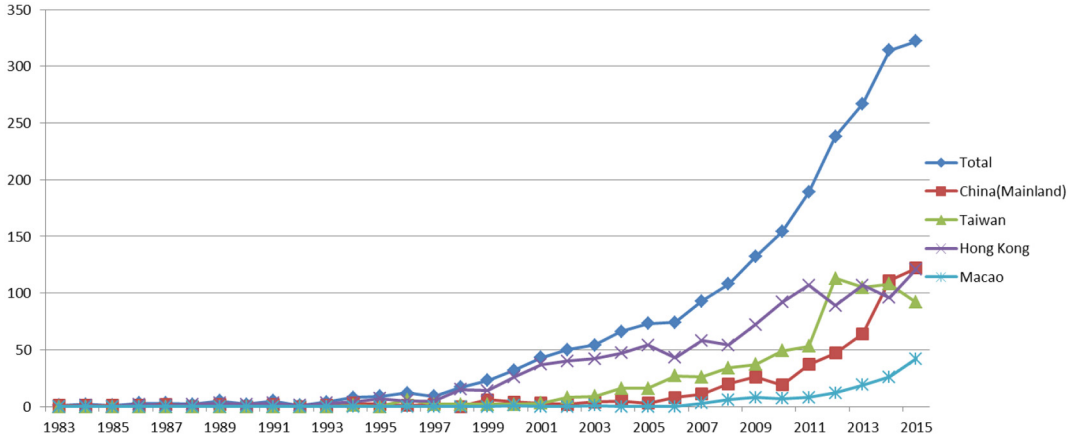


Fig. 1. Tourism and hospitality publication trends between 1983 and 2015.

This study addresses three important questions about the relationship between professional networks, tie strength and heterogeneous knowledge among researchers. First, prior studies have suggested that the structure of individual networks influences creativity (Kijkuit & Van Den Ende, 2007; Perry-Smith & Mannucci, 2017); however, critical network position always provides an opportunity to develop creativity (McFadyen & Cannella, 2004). The present study asks whether the degree of disconnectedness between partners and the sources of non-redundant information have a curvilinear effect on individual creativity, and it provides empirical evidence about tourism and hospitality scholar networks to support this assumption. Second, creativity is a highly complex undertaking that requires the strength of relationships to provide "codifiable information" to inspire (Perry-Smith & Shalley, 2014). However, does the effort that is required to create, build, and maintain direct ties always interfere with individual creativity? Third, the effectiveness of knowledge-sourcing strategies relies not only on the potential benefit of the knowledge flow sources that are generated but also on the individual's ability to integrate and digest the received flows (Hu, Horng, & Sun, 2009). Therefore, the present study seeks to investigate the effectiveness of knowledge-sourcing strategies, such as exploring diversity knowledge, and how effectiveness influences the relationships between individual network position and creativity outputs.

1.1.2. Structural hole position and creativity

The structural hole position, which functions as a "brokerage" of connections across groups, provides the advantage of homogeneous vision within and between groups that can be translated into social capital (Burt, 2004). 'Structural holes' are based on the concept of a 'broker,' or a person who with dense connections that are linked by occasional bridge relationships between clusters (Aarstad, 2012). Compared with other positions, an individual who is positioned in a structural hole is more likely to connect with persons who are dissimilar to him or her, and the best ideas come from exchanges with others who are outside of one's discipline (Hahl & Davis, 2016). These individual brokers derive the significant benefits of faster promotions, greater opportunity of access to a larger portion of information, and higher potential for creativity (Kim, Shin, Shin, & Miller, 2016).

Parallel to such contrasting conceptual views, Burt (2000) argued that network bridge advantages depends on context, and Zhimin, Qiaoxi, and Zhijun (2015) used a contingency view to explain that too many ties may be problematic because more diverse information and more opportunities to which an individual is exposed may become distracting, thus resulting in negative impacts on individual performance. In addition, Liu (2015) recently proposed that although the structural hole position provides the potential network structural advantage of arbitraging resources, contacts, and knowledge that can improve the efficiency of information flows, individual positioning in structural holes is also highly unevenly distributed among network members. Thus, without control of the appropriate contacts, an individual cannot significantly benefit from brokerage opportunities. Applying the same logic to individual-level creativity performance, we propose that:

Hypothesis 1. A structural hole position will produce the highest creativity at a moderated level of work; beyond the moderated level, greater structural holes will constrain creativity.

1.1.3. The moderating role of knowledge diversity

Given the importance of strategic cooperation for creativity and considering its relationship with knowledge diversity among individuals (Perry-Smith & Shalley, 2003a, 2003b), a social network theory that includes network attributes and structure and parses out individual knowledge flows seems to be appropriate. The above-referenced studies suggest that there is a curvilinear relationship between the structural hole position and individual creativity. However, the slope the relationship between network structure advantages can vary in magnitude with the addition of knowledge diversity (Rodan & Galunic, 2004). Knowledge diversity contributes to individual creativity and refers to significant gathered expertise across domains to achieve 'creative leaps' and supports a flexible approach to building previously unconnected pieces of existing knowledge and generating substantial creativity (Frey, Lüthje, & Haag, 2011). Although exposure to heterogeneous knowledge is expected to improve both individual creative potential and as well skill that can be applied to ideas, enabling an individual to perform complex tasks in general, structural holes positioning may result in the potential disadvantage of too much redundant information and knowledge (Chen & Liu, 2012). As Li and Liu (2016) note, too much redundant knowledge wastes individual time, causes difficulties in the effective utilization of fundamental ideas, and has potentially disastrous effects on creativity generation. Li and Liu (2016) also argue that broader exploration of knowledge diversity in network structure may result in costs from the integration of the new knowledge that is obtained with only marginal returns on creativity. Hitherto, this contingency relationship of the potential cost of knowledge diversity and structural hole position for creativity has not been tested, possibly because of the empirical difficulty in assessing the diversity of knowledge that a network affords. Therefore, the following hypothesis can be formed:

Hypothesis 2. Knowledge diversity will have negative moderating effects on structural hole position and creativity.

1.1.4. The moderating role of tie strength

Granovetter's (1973) definition of tie strength is the frequency, duration, and closeness of a contact, which ensures that the contact and the supporting effects last for a long time. Individuals are more creative if they are able to make valuable connections with various actors who can provide unique information and have access to different knowledge pools (Li & Liu, 2016). As a result, individuals who receive more valuable information distributed across network ties should be more open to processing it (Wang, Fang, Qureshi, & Janssen, 2015), and thus they need to expend effort and attention to fully integrate and apply the obtained information in the performance of tasks (Perry-Smith & Shalley, 2003a, 2003b). Under such conditions, novel ideas and information that have been combined and transformed are more likely to arise, given the greater interaction with actors and the development of personal relationships to more quickly transform original ideas and existing thoughts into creativity in the mind by solidifying cognitive pathways (Kim et al., 2016). Thus, individuals can yield positive outcomes depending on the proper management of the logic of collaboration that governs the exchange between partners and a cognitive balance between the strength of network ties and content to enhance the possibility of cognitive flexibility and increased creativity (Bizzi, 2013). To summarize, we expect the effect of individual creativity to depend on the strength of ties through the brokerage of opportunities and the connection of disconnected members. We expect strong interpersonal connections to exacerbate the difference between valuable information and framing due to the effect of shared communities and social imbalances that can contribute to the full utilization and integration of information to produce creativity outputs.

Hypothesis 3. Tie strength will have positive moderating effects on structural hole position and creativity.

2. Methods

2.1. Sampling

We hand-collected and downloaded research papers to obtain all of the researchers' background information from the social science citation index database and tracked their academic publications and co-

authorships over a 32-year period (1983–2015). Previous studies have suggested that the use of academic publications fairly represents the quality and quantity of creativity performance and that it also captures professional networks; thus, such a sample is appropriate for investigating knowledge worker interaction phenomena (Li & Liu, 2016; McFadyen, Semadeni, & Cannella, 2009; Wang, 2016). The reasons for using academic publications to measure creativity performance and the detail of data collected are as follows. (1) publications listed in the Social Sciences Citation Index (SSCI) provide good indexes for measuring researchers' academic achievement, which also demonstrate the network structure for further co-authorship relations of analysis (Leydesdorff et al., 2014). (2) Liu and Gan (2018) suggested that academics are highly incentivized to publish their research results in famous international journals because publication brings benefits for research funding opportunities, academic promotion, and increased academic reputation. (3) Creativity refers to new approaches or discovering new phenomena by coming up with novel methods or creative ideas that were not known previously (Lin, Law, & Zhou, 2017). Publications listed in SSCI not only mean the discovery of something new in comparison with the existing literature; published impact-factor-weighted articles also demonstrate the unbiased indexes to measure the importance of journals and the quality of researchers' outputs (Mcfadyen & Cannella, 2004). Based on the above reasons and suggestions made in previous studies, we used the impact factor and the number of papers as a proxy for measuring academic scholars' creativity. Furthermore, to effectively collect detailed information, the steps taken were as follows. (1) Three research assistants were hired to search all of the tourism and hospitality publications from the Institute for Scientific Information (ISI), journal websites and the Social Sciences Citation Index (SSCI) database. (2) Samples were hand selected from different regions of China (e.g., Mainland China, Taiwan, Hong Kong and Macao) and were double checked. (3) Finally, we also reviewed the websites of each scholar's university and department to check the accuracy of the data.

The study focused on professional networks from different regions of China (e.g., Mainland China, Taiwan, Hong Kong and Macao) for several reasons. First, following the rapid economic growth in Asia Pacific areas, the tourism and hospitality industry also experienced growth. Second, academic research has contributed to knowledge about the growth of the tourism and hospitality industry and has provided important directions for government and policy makers, such as the allotment of funding for various regions. Third, to gain international academic recognition, scholars invest significant effort to have papers published in established journals to increase their academic reputation and to obtain additional research funding (Liu, 2015). By double-checking and performing comparisons of the information from journal websites and personal information, the study identified 1661 researchers from four different regions and different departments of tourism and hospitality at various universities. The detailed background information and interaction graphic for the tourism and hospitality researchers is shown in Table 1.

2.2. Variables

2.2.1. Quality of creativity

We measure the quality of creativity using the average weighting of impact factors of journal publications. Liu (2015) suggested that impact factors are good indexes for measuring a journal's quality that allows us to objectively evaluate the relative quality of creativity (Li & Liu, 2016; McFadyen et al., 2009). We constructed our measure of creativity quality by adding the weighting of the impact factors of all journal articles that were published by tourism and hospitality researchers in the above-stated observation period.

2.2.2. Quantity of creativity

We measure the quantity of creativity using the raw number of publications, which is an approach that has been used widely in previous studies to measure organizational levels of innovation performance (Ernst, Conley, & Omland, 2016; Löfsten, 2016).

2.2.3. Structural hole

A structural hole is the critical position from which to measure how an individual can effectively access critical resources through individual network connections (Giuliani, 2013). The current research used the software UCINET 6 to compute the position of structural holes. The equation for the constraint index that is applied here is $C_{ij} = (P_{ij} + \Sigma P_{iq}P_{jq})^2,\ q \neq i, j;$ where P_{ij} is the measure of the distance that links scholar i to another scholar j. This index of P_{ij} ranges from 0 to 1, where 0 means the tourism and hospitality scholars' ego networks that are not constrained in their individual network, and 1 means that the scholar's connections are totally constrained. $\Sigma P_{iq}P_{jq}$ indicates the sum of distances between i and j by q.

2.2.4. Knowledge diversity

We measured knowledge diversity using an entropy index (Bartolacci, Castellano, & Cerqueti, 2015). The equation for a diversity index that is applied here is $\Sigma P_r \mathrm{In}(1/P_r)$, where P_r is the proportion of a tourism and hospitality researcher's co-author fields, and ln $(1/P_r)$ is calculated by each co-author's catalogue that relates to the tourism and hospitality fields or to different fields, and it is defined by the natural logarithm of the inverse of the proportion of a co-author's field counts.

2.2.5. Tie strength

This study followed McFadyen and Cannella (2004), and Liu (2015)'s procedure to measure the interaction strength of tourism and hospitality researchers' times published in academic publications with the cooperation of a co-author. Therefore, when more papers are published with same co-author, the strength of ties becomes stronger. We first counted the average number of cooperations for each scholar (e.g., counting one when two authors only have one publication and double counting when a researcher has two publications with same coauthor during the observation period), and then we divided by the total number of co-authors (e.g., to ensure that authors do not overlap, we downloaded all of an author's publications to determine all of the references to the author and coauthors) to measure the tie strength for each tourism and hospitality researcher.

2.2.6. Control variables

Several variables were controlled to avoid potential influences between dependent variables and independent variables. (1) Dummy variables were used to measure gender. (2) Four regions of China (Mainland China, Taiwan, Hong Kong and Macao) were controlled to prevent regional effects. (3) We controlled for the academic position of the scholars, i.e., professor, associate professor, assistant professor, lecturer, postdoctoral fellow, and others. (4) Finally, the countries in which the researchers obtained their highest degree were controlled because Liu (2015) suggested that international journals require expertise in reading, writing, and sentence correction. Therefore, we controlled the highest degree countries, identifying where the researchers received their final degree. The degree countries included Australia, New Zealand, America, Hong Kong, Thailand, Portugal, Macao, Taiwan, Mainland China, the United Kingdom, Korea, Germany, the Netherlands, and Canada.

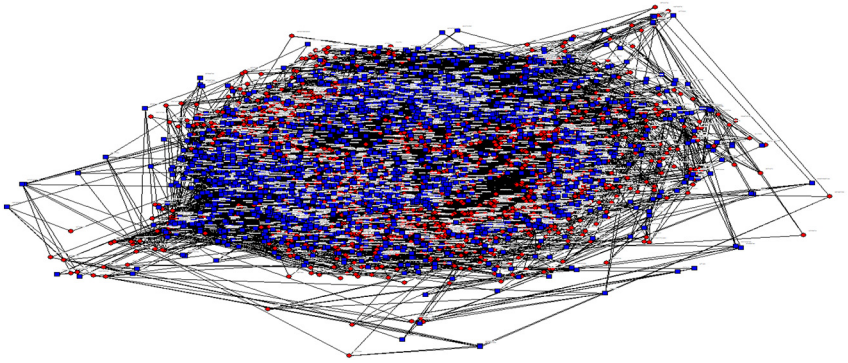
2.3. Statistical methods

Because of the different dependent variables' characteristics in our data, the use of different regressions models was a more reasonable method of testing the hypotheses in this study. First, the quantity of creativity was measured in the raw number of publications that represent the appropriate use of negative binomial regression analysis of creativity performance due to a non-negative count measure to account

Table 1
The demographic information for all samples.

Item	Sample	%	Item	Sample	%
The number of scholars in four regions			The number of institutions in four regions		
Hong Kong	416	25.05%	Hong Kong	27	8.79%
Taiwan	689	41.48%	Taiwan	129	42.02%
Mainland	471	28.36%	Mainland China	144	46.91%
Macao	85	5.12%	Macao	7	2.28%
Total	1661	100.00%	Total	307	100.00%
Gender			Highest Degree Countries		
Male	949	57.13%	Mainland	369	22.19%
Female	712	42.87%	Hong Kong	27	1.60%
Total	1661	100.00%	Taiwan	253	15.24%
Academic position			Macao	13	0.80%
Professor	354	21.31%	America	431	25.94%
Associate Professor	324	19.51%	Britain	195	11.76%
Assistant Professor	279	16.80%	Australia	124	7.49%
Lecture	144	8.67%	Others	249	14.97%
Postdoctoral	203	12.22%	Total	1661	100.00%
Others	357	21.49%			
Total	1661	100.00%			

The interaction graphic among all samples



for the autocorrelation and to control for individual heterogeneity (Wu & Shanley, 2009). Second, the quality of creativity was measured by the average weighting of impact factors of the publications. These dependent variable characteristics represent the appropriate use of ordinary least squares (OLS) due to the estimation of unknown parameters, disturbance terms across different cross-sectional units (researchers) and correlated residual error terms (McFadyen & Cannella, 2004). Therefore, we used different models of negative binomial regression and OLS regression methodology to account for academic data serial correlation and heteroscedasticity across various regions of China to specifically address the proposed over-dispersion of the dependent variable distribution.

3. Results

Table 2 presents the basic descriptive statistics and correlations of the measured constructs of this study. We note that some of the constructs of this study appear to be highly correlated. For example, the independent variables of structural hole, tie strength and knowledge diversity show a high correlation above 0.7 with the dependent variables of quality and quantity of creativity, which required the calculation of a variance inflation factor (VIF). Liu (2015) suggested that values of VIF below 10 means that there is no serious problem with collinearity. After calculating the VIF, the high values of 7.31 shows no collinearity consideration in this study. Before the hypothesis moderating test, we also followed Cronbach (1987) and calculated the means of the key explanatory variables of structural hole before entering the interaction terms of tie strength and knowledge diversity. This step may have reduced the correlation between the power terms of the first order and the second order of the measured terms, as well as the significance of the separate and interactive effects.

Table 3 summarizes the relevant coefficients of the moderating effects of knowledge diversity in the curvilinear relationship between network position and creativity for different regression models. Model 1 and Model 5 are only base models and include control variables. In Model 2 and Model 6, there was a significant positive coefficient for structural hole (e.g., Model 2 $\beta = 0.100$ $p < .001$ and Model 6 $\beta = 0.837$ $p < .001$) and a significant negative coefficient square term of structural hole in Model 3 ($\beta = -0.001$ $p < .001$) and Model 7 ($\beta = -0.008$ $p < .001$), which demonstrates a curvilinear relationship between structural hole and creativity, thus supporting Hypothesis 1.

In Model 4 and Model 8, the addition of an interaction term between structural hole and knowledge diversity shows a negative significant coefficient (e.g., Model 4 $\beta = -0.069$ $p < .001$ and Model 8 $\beta = -0.137$ $p < .05$), which suggests that consideration of knowledge diversity will have negative effects on creativity.

The proposed inverse U-shaped relationship between structural hole and knowledge diversity across different levels of knowledge diversity is apparent in Fig. 2. As shown in Fig. 2(a), for individuals who occupy and maintain a low or a high level of network connections, the coefficient for the regression of structural hole on creativity quantity is comparatively lower, and it is comparatively higher for the regression of knowledge diversity. Fig. 2(b) shows inverse U-shaped relationships for the regression of structural hole on creativity quality at high levels of knowledge diversity, for which the association was strongly negative and significant, which provides empirical support, with the significant quadratic and negative interaction terms, for Hypotheses 1 and 2.

Table 4 summarizes the regression results of the moderating effect of tie strength between structural hole position and creativity. Model 9 and Model 13 only include controls, and Model 10 and Model 14 add the direct effects of structural hole and the square term in Model 11 and Model 15. The positive significant coefficient (e.g., Model 10 $\beta = 0.061$

Table 2
Descriptive information for variables: Standard Deviation, Mean and Correlations.

Variables	Mean	S.D.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	VIF
1.Creativity(Quantity)	2.526	7.787	1.000																6.70
2.Creativity(Quality)	1.355	3.949	0.759	1.000															4.91
3.Structural Hole	2.195	3.865	0.825	0.787	1.000														7.31
4.Tie Strength	4.754	8.462	0.916	0.856	0.925	1.000													6.42
5.Knowledge Diversity	0.314	0.326	0.289	0.286	0.436	0.399	1.000												1.34
6.Gender	0.407	0.491	−0.035	−0.037	−0.058	−0.038	−0.057	1.000											
Academic Position																			
7.Professor	0.175	0.380	0.021	0.046	0.015	0.009	0.043	0.011	1.000										
8.Associate Professor	0.205	0.404	0.011	0.017	0.002	0.004	−0.009	−0.009	−0.234	1.000									
9.Assistant Professor	0.093	0.291	−0.037	−0.040	0.055	−0.046	−0.089	0.064	0.148	−0.163	1.000								
10. Lecture	0.184	0.387	−0.072	−0.102	0.086	−0.072	−0.111	0.086	−0.219	−0.242	−0.153	1.000							
11. Postdoctoral	0.129	0.335	−0.040	−0.054	0.039	−0.028	0.046	0.076	−0.177	−0.196	−0.124	−0.183	1.000						
12.Others	0.211	0.408	0.098	0.109	0.137	0.112	0.100	0.001	−0.238	−0.263	−0.166	−0.246	−0.199	1.000					
Regions																			
13. Mainland China	0.283	0.450	−0.067	−0.077	−0.031	−0.038	0.094	−0.192	−0.212	0.039	0.150	0.024	−0.007	0.034	1.000				
14. Taiwan	0.415	0.492	0.135	0.119	0.175	−0.139	−0.051	0.025	−0.017	−0.094	0.000	0.123	0.050	−0.050	−0.363	1.000			
15. Hong Kong	0.249	0.433	−0.012	0.012	−0.031	−0.029	−0.057	0.000	0.158	−0.016	0.009	−0.039	−0.065	−0.046	−0.146	−0.134	1.000		
16. Macao	0.051	0.220	−0.051	−0.039	−0.111	−0.074	−0.015	0.041	0.138	0.054	−0.141	−0.113	−0.008	0.033	−0.530	−0.486	−0.195	1.000	
Highest Degree Countries					YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES		

N = 1661, All coefficients above 0.481 are significant at 5% level.

p < .001 and Model 14 $\beta = 0.202$ p < .001) and negative coefficient (e.g., Model 11 $\beta = -0.002$ p < .001 and Model 15 $\beta = -0.007$ p < .001) confirm a curvilinear relationship between structural hole position and creativity, thus supporting Hypothesis 1. Further, Model 12 and Model 16 additionally include the linear interaction terms of tie strength and structural hole position. The coefficient of the interaction term shows that tourism and hospitality researchers have a greater quantity and quality of creativity when tie strength and structural hole is higher (e.g., Model 12 $\beta = 0.001$ p < .001 and Model 16 $\beta = -0.009$ $p < .001$). As such, Hypotheses 1 and 3 are supported.

Figs. 3 provides interaction graphs of the quadratic associations between structural hole position and tie strength to quantity and quality of creativity. As shown in Fig. 3(c), our negative binomial methodology involved a nonlinear transformation of structural hole and tie strength to quantity of creativity. The relationship between structural hole position and quantity creativity is highly positively significant at the high level of tie strength. Fig. 3(d) used the coefficient of OLS regression and shows inverse U-shaped relationships for structural hole and quality of creativity, and relationships become more positive at a high level of tie strength. Therefore, the 3D interaction graphic provides strong support for Hypothesis 3 for the overall conditional moderating effects model.

3.1. Robustness tests

The study conducted several tests of separate regions for Mainland China, Hong Kong, Taiwan, and Macao to confirm the robustness of the results. We tested our hypothesis model specifications using two alternative designs for the dependent variable: 1) separate the creativity performance into quantity and quality defined as a tourism and hospitality researcher's creative performance and his or her network cooperation activity at an observation time divided by the region of China; and 2) a measure for how linear (or nonlinear) an individual's creativity process is relative to the their learning process and access to knowledge and mutual trust. The results with these independent variables and dependent variables are consistent with the results reported here.

3.1.1. Hong Kong

Table 5 presents the basic personal information of the participants such as gender, academic position, highest degree and highest degree countries, for example, Hong Kong. A total of 416 researchers' information was completely collected (58.17% and 41.83% gender rate for the researcher participants).

Table 6 presents the statistics tests for the sample, Model 18, Model 21, Model 24 and Model 27, in support of Hypothesis 1, and there is an inverted-U relationship between the structural hole position and the quantity ($\beta = 0.162$ $p < .001$ single term and $\beta = -0.001$ $p < .001$ square term in Model 18; $\beta = 0.090$ $p < .001$ single term and $\beta = -0.002$ $p < .001$ square term in Model 21) or quality ($\beta = 0.358$ $p < .001$ single term and $\beta = -0.008$ $p < .001$ square term in Model 24; $\beta = 0.026$ $p < .05$ single term and $\beta = -0.003$ $p < .01$ square term in Model 27) of creativity.

As shown in Model 19 and Model 25, consistent with the prediction of Hypothesis 2, the interaction between knowledge diversity and structural hole position was negatively significantly predicted quantity ($\beta = -0.091$ $p < .001$ in Model 19) and quality ($\beta = -0.522$ $p < .001$ in Model 25) of creativity. Finally, in support of Hypothesis 3, for tourism and hospitality researchers with high levels of tie strength, the critical network position of the structural hole was more strongly related to creativity ($\beta = 0.001$ $p < .001$ in Model 22; $\beta = 0.008$ $p < .001$ in Model 28).

3.1.2. Mainland China

Table 7 summarizes the characteristics of Mainland China. The data collection included several steps and checking systems with hand

Table 3
Moderating effect of knowledge diversity on network position and creativity.

	Creativity (Quantity)				Creativity (Quality)			
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	0.163**	0.103	0.074	−0.019	1.194**	−0.332	0.326	0.161
	(0.061)	(0.056)	(0.054)	(0.056)	(0.357)	(0.234)	(0.213)	(0.225)
Independent variable								
Structural Hole		0.100***	0.158***	0.210***		0.837***	0.362***	0.472***
		(0.006)	(0.007)	(0.012)		(0.017)	(0.029)	(0.056)
(Structural Hole)^2			−0.001***	−0.001***			−0.008***	−0.009***
			(0.000)	(0.000)			(0.000)	(0.000)
Interaction effects								
Diversity*Hole				−0.069***				−0.137*
				(0.013)				(0.060)
Control variables								
Knowledge Diversity	1.766***	0.970***	0.745***	0.965***	3.469***	−0.843***	0.566**	0.792***
	(0.061)	(0.069)	(0.068)	(0.079)	(0.285)	(0.206)	(0.199)	(0.222)
Gender	0.019	0.034	0.034	0.033	0.031	0.087	0.097	0.096
	(0.045)	(0.042)	(0.040)	(0.040)	(0.190)	(0.123)	(0.111)	(0.111)
Regions								
Mainland China	−0.178**	−0.213***	−0.239***	−0.262***	−1.684***	−0.113	−0.470**	−0.461**
	(0.058)	(0.053)	(0.052)	(0.051)	(0.255)	(0.169)	(0.153)	(0.153)
Taiwan	0.660***	0.211***	0.117*	0.093	−0.647	0.653	0.316	0.339
	(0.052)	(0.052)	(0.051)	(0.050)	(0.449)	(0.293)	(0.265)	(0.264)
Hong Kong	0.194	0.096	0.081	0.083	−1.277***	0.367*	−0.057	−0.030
	(0.105)	(0.095)	(0.092)	(0.091)	(0.234)	(0.119)	(0.142)	(0.143)
Academic position								
Professor	−0.177**	0.056	0.054	0.030	0.277	0.090	0.265	0.251
	(0.067)	(0.062)	(0.060)	(0.059)	(0.383)	(0.083)	(0.224)	(0.224)
Associate Pro.	−0.101	0.037	0.030	0.018	0.380	0.019	0.178	0.171
	(0.064)	(0.060)	(0.058)	(0.057)	(0.364)	(0.081)	(0.213)	(0.213)
Assistant Pro.	−0.294***	−0.048	−0.013	−0.012	−0.616	−0.153	−0.429*	−0.428*
	(0.092)	(0.085)	(0.082)	(0.082)	(0.367)	(0.117)	(0.215)	(0.215)
Lecture	−0.596***	−0.294***	−0.250***	−0.248***	−0.652***	−0.740***	−0.332	−0.344
	(0.076)	(0.072)	(0.070)	(0.069)	(0.396)	(0.108)	(0.232)	(0.232)
Others	−0.556***	−0.222**	−0.175*	−0.196**	0.799*	−0.408***	0.108	0.109
	(0.079)	(0.075)	(0.072)	(0.072)	(0.367)	(0.106)	(0.215)	(0.215)
Degree Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model fit								
LR χ^2	1186.80***	1679.33***	1831.89***	1858.55***				
Log likelihood	−2880.42	−2634.15	−2557.87	−2544.54				
Pseudo R^2	0.170	0.241	0.263	0.267				
R^2					0.123	0.629	0.699	0.700
R^2_{adj}					0.117	0.627	0.697	0.698
F_{-Value}					23.14***	254.79***	319.26***	295.86***
Observations	1661	1661	1661	1661	1661	1661	1661	1661

* $p < .05$.
** $p < .01$.
*** $p < .001$.

collection. First, we downloaded all of the publications from Google Scholar and the journal websites. Second, we checked the individual information from the personal university websites to ensure that we had obtained accurate information. Third, we also checked the journal's annual impact data to measure the quality of creativity.

We conducted hierarchical analyses and used different regression analyses to assess the form and magnitude of the relationship between network position and individual creativity. In Table 8, we also used several system analysis processes to examination the main hypothesis. In the first step, the control variables were entered in Model 29, Model 32, Model 35 and Model 38. We observed that knowledge diversity ($\beta = 1.385$ $p < .001$ in Model 29; $\beta = 1.137$ $p < .001$ in Model 35) and tie strength ($\beta = 0.068$ $p < .001$ in Model 32; $\beta = 0.167$ $p < .001$ in Model 38) positively influenced creativity. We entered the linear and nonlinear structural hole of the network position term on the second step and the interaction term of knowledge diversity and tie strength on the third step.

As shown in Model 30, Model 33, Model 36, and Model 29, the linear network position term ($\beta = 0.281$ $p < .001$ in Model 30; $\beta = 0.181$ $p < .001$ in Model 33; $\beta = 0.356$ $p < .001$ in Model 36; $\beta = 0.052$ $p < .05$ in Model 39) was significantly and positively related to creativity, and the squared term ($\beta = -0.008$ $p < .001$ in Model 30; $\beta = -0.008$ $p < .001$ in Model 33; $\beta = -0.005$ $p < .05$ in Model 36; $\beta = -0.003$ $p < .01$ in Model 39) was found to be negatively and significantly related to creativity. This result provided support for Hypothesis 1.

Following the similar procedure of the previous examination, the interaction term of knowledge diversity was added in Model 31 and Model 37, and we found that this interaction term was negatively and significantly related to creativity ($\beta = -0.041$ $p < .05$ in Model 31; $\beta = -0.517$ $p < .001$ in Model 37), thus supporting Hypothesis 2. Finally, the interaction term of tie strength was added in Model 34 and Model 40, and we found that this interaction term was positively and significantly related to the quantity ($\beta = 0.003$ $p < .001$ in Model 34) and quality ($\beta = 0.004$ $p < .05$ in Model 40) of creativity. This result confirmed Hypothesis 3, finding that tie strength is beneficial to individual creativity.

3.1.3. Taiwan

The descriptive statistics and information for all of the researchers are reported in Table 9. We computed several additional variables that were collected from the researchers, including gender, academic

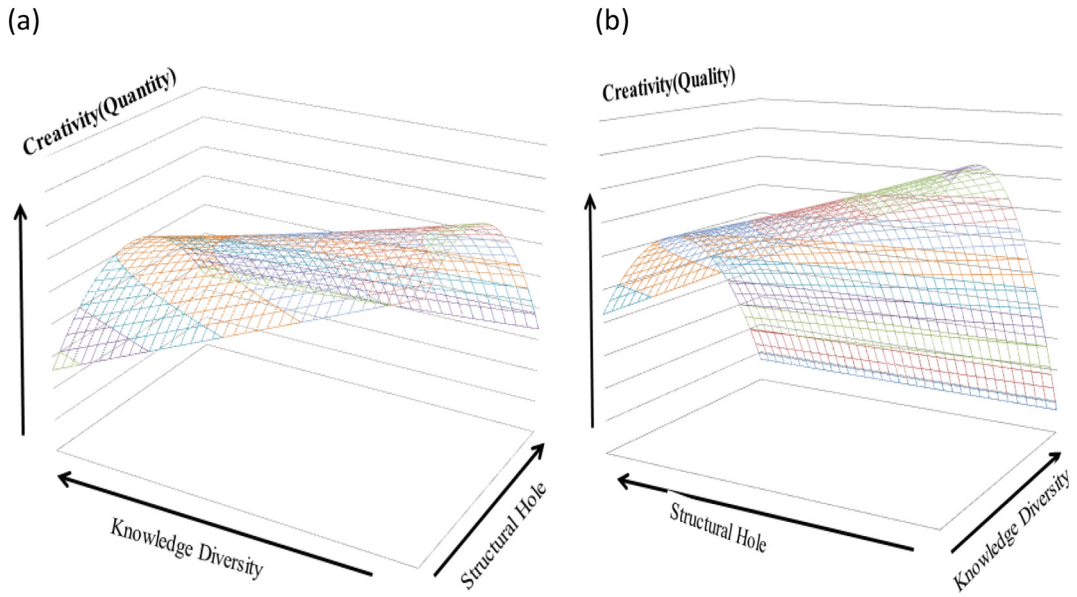


Fig. 2. The relationship between *Structural Hole* and *Creativity* as a moderator of *Knowledge Diversity*. (a) Creativity quantity. (b) Creativity quality.

position, highest degree, and highest degree countries.

The negative binomial regression and OLS regression results testing the hypotheses are reported in Table 10. There was support for Hypothesis 1. The coefficient for the linear term of network position was positive and significant ($ß = 0.329$ $p < .001$ in Model 42; $ß = 0.343$ $p < .001$ in Model 45; $ß = 0.580$ $p < .001$ in Model 48; $ß = 0.192$ $p < .05$ in Model 51), and the quadratic relationship represents when the rate of structural hole position exceeds the moderated level ($ß = -0.010$ $p < .001$ in Model 42; $ß = -0.017$ $p < .001$ in Model 45; $ß = -0.015$ $p < .05$ in Model 48; $ß = -0.006$ $p < .05$ in Model 51). The results confirm that there will be an inverted U-shaped relationship between the critical position of structural hole and the quantity and quality of creativity performance.

Hypotheses 2 predicted that the relationship between structural hole and quality and quality of creativity would be weaker under different levels of knowledge diversity. As shown in Model 43, there was a significant negative interaction between structural hole position and knowledge diversity, which influences the quantity of creativity ($ß = -0.118$ $p < .01$). Next, in Model 49, the interaction between structural hole position and knowledge diversity had significant and negative impacts on the quality of creativity ($ß = -1.075$ $p < .001$). Thus, the results show substantial support for Hypotheses 2. Finally, Hypothesis 3 predicted that the relationship between structural hole position and creativity would be stronger under the degree of tie strength. In Model 46, the interaction of structural hole and tie strength was significantly positively related to quantity of creativity ($ß = 0.004$ $p < .001$). Finally, as shown in Model 52, we found strong evidence that structural hole position and tie strength are significantly positively related to quality of creativity ($ß = 0.003$ $p < .05$).

3.1.4. Macao

Table 11 presents the individual descriptive statistics of the participants from Macao. As shown in previous tables presenting the regional individual background information of the researchers, we observed that only 85 participants were from Macao. This significant difference in numbers may have caused different findings and may not have supported the discriminant validity and predictions of the variables.

Table 12 reports the negative binomial regression and OLS regression results for creativity performance. Model 53, Model 56, Model 59 and Model 62 include all of the control variables and two critical examining moderating variables of knowledge diversity and tie strength. The coefficients of knowledge diversity are positive and significant, which indicates that individual contacts and access to heterogeneous knowledge are more likely to generate innovations. On the other hand, an increase in individual contacts and interaction frequency with cooperative partners has a significant effect on the creation of new ideas. It is notable that both knowledge diversity and tie strength have positive and statistically significant coefficients for creativity performance, which suggests that a network that maintains a heterogeneous knowledge base is beneficial for individual new idea generation.

Models 54 and 57 were used to test the inverted U-shaped relationship of structural holes with quantity of creativity. The results show a direct effect of structural hole position ($ß = 0.130$ $p < .05$ in Model 54; $ß = 1.599$ $p < .05$ in Model 57) but with significant inverted U effects on quantity of creativity ($ß = -0.012$ *n.s.* in Model 54; $ß = -1.086$ *n.s.* in Model 57). Further, in examining quality of creativity, Model 60($ß = 1.273$ $p < .01$) and Model 63($ß = 1.220$ $p < .05$) indicate that the coefficient of structural hole position is positive and statistically significant. The coefficients of the quadratic term of structural hole in Model 60 ($ß = -0.307$ $p < .001$) and Model 63 ($ß = 0.301$ $p < .01$) confirm the impact of the network position of structural hole on quality of creativity is curvilinear and provides partial support for Hypothesis 1. Model 55 and Model 61 introduce the interaction term between structural hole and knowledge diversity and test Hypothesis 2. The coefficient of the interaction term is negative and significant ($ß = -0.029$ $p < .05$ in Model 55; $ß = -0.864$ $p < .05$ in Model 61), which provides support for Hypothesis 2. Model 58 and Model 64 were used to test Hypothesis 3, and we found that the interaction of tie strength and structural hole positively influences creativity. The addition of the interaction term in Model 58($ß = 0.025$ $p < .05$) shows the existence of a moderating effect between tie strength and structural hole on quantity of creativity. The coefficient of the interaction term in Model 64 ($ß = 0.114$ *n.s.*) does not support the expectation. The coefficient and results of the interaction term provide partial support for Hypothesis 3.

4. Discussion

To answer critical but unsolved questions about how knowledge workers create new ideas through individual network connections and heterogeneous knowledge, this study examines the effects of the critical network position of structural holes and the quality and quantity creativity performance. Hand collection and longitudinal observation

Table 4
Moderating effect of tie strength on network position and creativity.

	Creativity (Quantity)				Creativity (Quality)			
Variables	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
Constant	0.445***	0.401***	0.285***	0.203***	−0.177	−0.181	0.272	−0.343*
	(0.053)	(0.054)	(0.049)	(0.049)	(0.170)	(0.161)	(0.151)	(0.141)
Independent variable								
Structural Hole		0.061***	0.088***	0.200***		0.202***	0.168***	0.524***
		(0.012)	(0.008)	(0.014)		(0.031)	(0.029)	(0.045)
(Structural Hole)^2			−0.002***	−0.007***			−0.007***	−0.029***
			(0.000)	(0.000)			(0.000)	(0.002)
Interaction effects								
Tie*Hole				0.001***				0.009***
				(0.000)				(0.000)
Control variables								
Tie Strength	0.059***	0.038***	0.056***	0.029***	0.270***	0.340***	0.211**	0.061***
	(0.002)	(0.004)	(0.003)	(0.004)	(0.004)	(0.009)	(0.011)	(0.013)
Gender	−0.022	−0.008	−0.024	−0.021	0.019	−0.044	−0.014	−0.010
	(0.044)	(0.044)	(0.040)	(0.039)	(0.103)	(0.095)	(0.088)	(0.080)
Regions								
Mainland China	−0.120*	−0.149**	−0.155**	−0.181***	−0.313*	−0.404**	−0.493***	−0.445***
	(0.055)	(0.056)	(0.051)	(0.050)	(0.139)	(0.128)	(0.119)	(0.108)
Taiwan	0.125*	0.081	0.030	0.006	0.495*	0.203	0.005	0.077
	(0.054)	(0.054)	(0.049)	(0.048)	(0.245)	(0.226)	(0.209)	(0.190)
Hong Kong	0.078	0.059	0.084	0.078	0.028	−0.093	−0.220*	−0.110
	(0.099)	(0.098)	(0.089)	(0.087)	(0.129)	(0.120)	(0.111)	(0.101)
Academic position								
Professor	0.060	0.065	0.056	0.019	0.521**	0.410*	0.519	0.396**
	(0.066)	(0.065)	(0.058)	(0.057)	(0.185)	(0.171)	(0.158)	(0.144)
Associate Pro.	−0.060	−0.044	−0.050	−0.055	0.423*	0.402*	0.467**	0.457***
	(0.064)	(0.064)	(0.057)	(0.055)	(0.177)	(0.164)	(0.151)	(0.137)
Assistant Pro.	−0.151	−0.123	−0.073	−0.065	0.355	0.404*	0.318	0.330*
	(0.088)	(0.088)	(0.080)	(0.079)	(0.214)	(0.198)	(0.182)	(0.165)
Lecture	−0.372***	−0.341***	−0.290***	−0.279***	−0.034	0.134	0.031	0.050
	(0.074)	(0.074)	(0.068)	(0.067)	(0.180)	(0.166)	(0.153)	(0.139)
Others	−0.208**	−0.181*	−0.152*	−0.146*	0.422*	0.333*	0.380*	0.355**
	(0.078)	(0.077)	(0.071)	(0.069)	(0.178)	(0.165)	(0.152)	(0.138)
Degree Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model fit								
LR χ^2	1555.36***	1580.86***	1979.59***	2053.52***				
Log likelihood	−2693.02	−2680.26	−2480.90	−2443.93				
Pseudo R^2	0.224	0.227	0.285	0.295				
R^2					0.740	0.785	0.817	0.850
R^2_{adj}					0.738	0.784	0.816	0.848
F-$_{Value}$					469.45***	548.30***	613.92***	716.71***
Observations	1661	1661	1661	1661	1661	1661	1661	1661

* $p < .05$.
** $p < .01$.
*** $p < .001$.

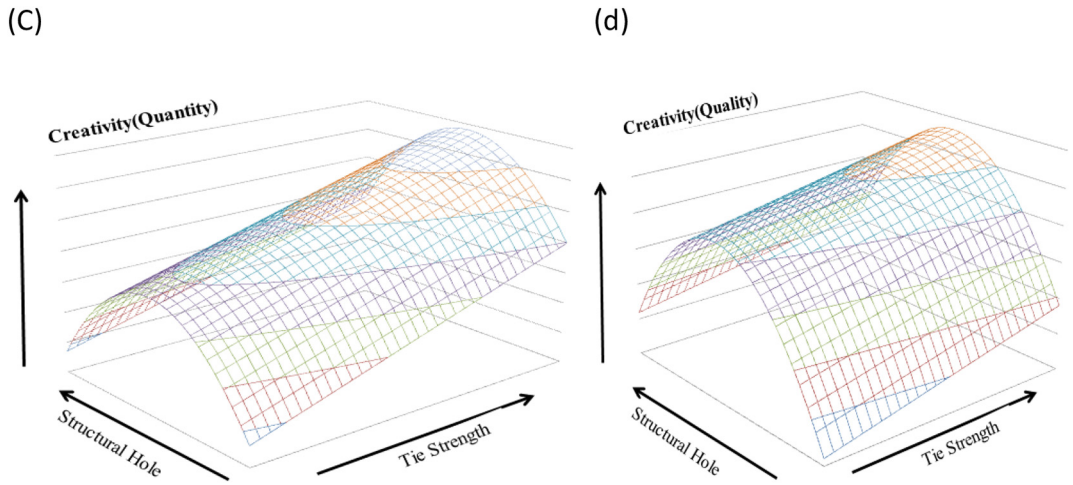


Fig. 3. The relationship between *Structural Hole* and *Creativity* as a moderator of *Tie Strength*. (c) Creativity quantity. (d) Creativity quality.

Table 5
The demographic information for Hong Kong.

Item	Sample	%	Item	Sample	%
Gender			Highest Degree		
Male	242	58.17%	Master	164	39.42%
Female	174	41.83%	Doctor	388	93.27%
Total	416	100.00%	Others	29	6.97%
Academic position			Total	416	100.00%
Professor	78	18.75%	Highest Degree Countries		
Associate Professor	52	12.50%	Mainland China	2	0.48%
Assistant Professor	66	15.87%	Hong Kong	198	47.59%
Lecture	42	10.10%	America	71	17.07%
Postdoctoral	64	15.38%	Britain	51	12.26%
Others	114	27.40%	Australia	27	6.49%
Total	416	100.00%	Others	67	16.11%
			Total	416	100.00%

The interaction graphic among Hong Kong scholars

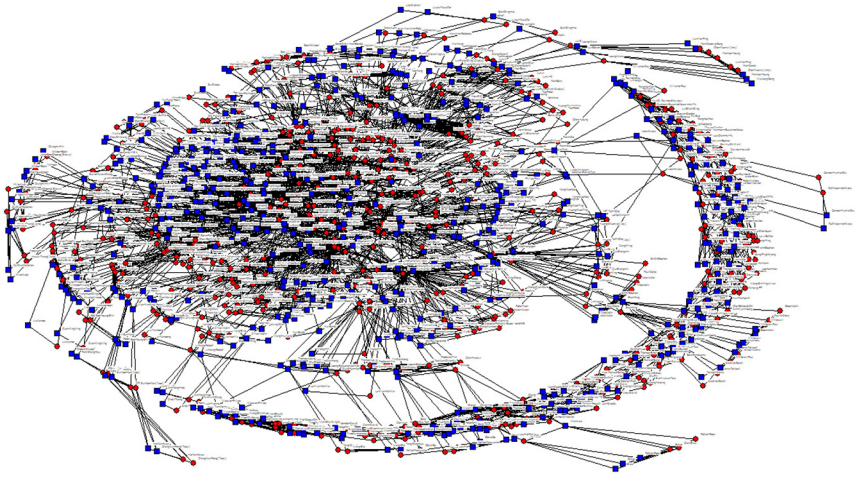


Table 6
Moderating effect of knowledge diversity and tie strength on network position and creativity-Hong Kong.

	Creativity (Quantity)						Creativity (Quality)					
Variables	Model 17	Model 18	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24	Model 25	Model 26	Model 27	Model 28
Independent variable												
Structural Hole		0.162***	0.220***		0.090***	0.215***		0.358***	0.745***		0.026*	0.759***
(Structural Hole)^2		−0.001***	−0.001***		−0.002***	−0.007***		−0.008***	−0.011***		−0.003**	−0.031***
Interaction effects												
Diversity * Hole			−0.091***						−0.522***			
Tie*Hole						0.001***						0.008***
Control variables												
Knowledge Diversity	2.200***	0.585***	0.934***				7.132***	1.617*	1.978**			
Tie Strength				0.047***	0.048***	0.020**				0.275***	0.223***	0.094*
Gender	0.033	0.021	0.032	−0.083	−0.087	−0.062	0.168	0.244	0.246	0.060	0.088	0.167
Academic position												
Professor	0.085	0.476***	0.386**	0.565***	0.422***	0.264*	−0.553	0.328	0.239	0.586	0.553	0.190
Associate Pro.	0.200	0.354**	0.309*	0.259	0.109	0.033	−0.858	−0.645	−0.538	0.162	−0.211	−0.165
Assistant Pro.	−0.295	0.169	0.157	−0.026	0.076	0.025	−1.032	−0.973	−0.809	−0.291	−0.647	−0.515
Lecture	−0.385*	0.056	0.058	−0.169	−0.071	−0.107	−1.940	−0.993	−0.996	−0.435	−0.707	−0.681
Others	−0.567**	0.078	0.010	−0.071	−0.015	−0.050	0.825	−0.891	−0.727	−0.117	−0.387	−0.195
Degree Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model fit												
LR χ^2	360.02***	632.29***	652.75***	508.45***	694.64***	730.98***						
Log likelihood	−875.93	−739.79	−729.57	−801.71	−708.62	−690.45						
R^2							0.155	0.792	0.803	0.809	0.815	0.838
F_{-Value}							10.67***	171.47***	164.27***	247.06***	197.73***	208.90***

$N = 416$.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 7
The demographic information for Mainland China.

Item	Sample	%	Item	Sample	%
Gender			Highest Degree		
Male	248	52.65%	Master	135	28.66%
Female	223	47.35%	Doctor	291	61.78%
Total	471	100.00%	Others	45	9.55%
Academic position			Total	471	100.00%
Professor	112	23.78%	Highest Degree Countries		
Associate Professor	103	21.87%	Mainland China	320	67.94%
Assistant Professor	21	4.46%	Hong Kong	19	4.03%
Lecture	65	13.80%	Taiwan	1	0.21%
Postdoctoral	54	11.46%	America	25	5.31%
Others	116	24.62%	Britain	10	2.12%
Total	471	100.00%	Australia	13	2.76%
			Others	83	17.62%
			Total	471	100.00%

The interaction graphic among Mainland China scholars

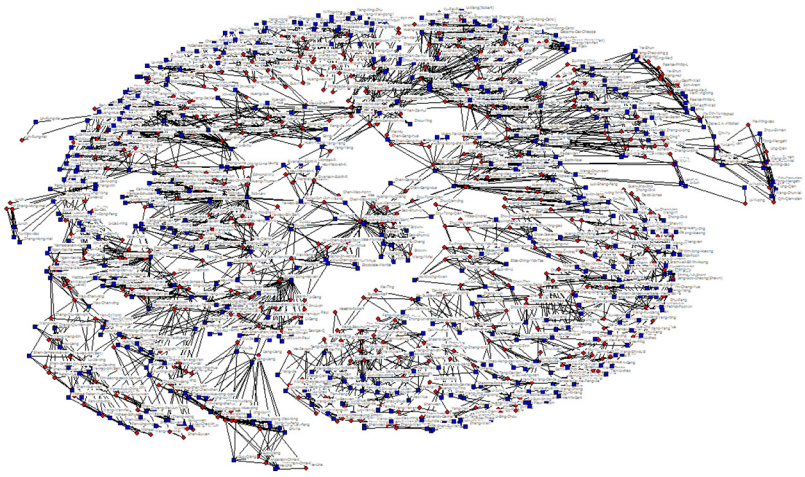


Table 8
Moderating effect of knowledge diversity and tie strength on network position and creativity- Mainland China.

	Creativity (Quantity)						Creativity (Quality)					
Variables	Model 29	Model 30	Model 31	Model 32	Model 33	Model 34	Model 35	Model 36	Model 37	Model 38	Model 39	Model 40
Independent variable												
Structural Hole		0.281***	0.266***		0.181***	0.091*		0.356***	0.121*		0.052*	0.069*
(Structural Hole)^2		−0.008***	−0.009***		−0.008***	−0.001*		−0.005*	−0.018***		- 0.003**	−0.005*
Interaction effects												
Diversity * Hole			−0.041*						−0.517***			
Tie*Hole						0.003***						0.004*
Control variables												
Knowledge Diversity	1.385***	0.383**	0.222*				1.137***	0.112*	0.927***			
Tie Strength				0.068***	0.063***	0.106***				0.167***	0.179***	0.128***
Gender	0.064	0.114	0.112	0.133	0.083	0.063	0.096	0.137	0.103	0.095	0.092	0.095
Academic position												
Professor	−0.347	−0.183	−0.180	−0.011	−0.037	0.003	0.516	0.451	0.455	0.551*	0.561*	0.521*
Associate Pro.	−0.258*	−0.146	−0.159	−0.060	−0.074	−0.074	0.476*	0.365*	0.323*	0.370*	0.370*	0.345*
Assistant Pro.	−0.143	0.001	−0.009	−0.024	0.022	0.020	0.483*	0.379*	0.345*	0.360*	0.353*	0.334*
Lecture	−0.550***	−0.285*	−0.285*	−0.239*	−0.189	−0.174	−0.101	−0.076	−0.089	−0.066	−0.071	−0.093
Others	−0.526***	−0.303*	−0.292*	−0.155	−0.142	−0.158	0.610	0.360*	0.335*	0.313	0.316	0.286
Degree Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model fit												
LR χ^2	148.80***	274.29***	277.04***	296.69***	338.09***	348.94***						
Log likelihood	−686.09	−623.35	−621.97	−612.15	−591.45	−586.02						
R^2							0.122	0.314	0.391	0.474	0.475	0.482
F_{-Value}							9.21***	23.41***	29.50***	59.50***	46.29***	42.74***

N = 471.
* p < .05.
** p < .01.
*** p < .001.

Table 9
The demographic information for Taiwan.

Item	Sample	%	Item	Sample	%
Gender			Highest Degree		
Male	417	60.52%	Master	180	26.12%
Female	272	39.48%	Doctor	480	69.67%
Total	689	100.00%	Others	29	4.21%
Academic position			Total	689	100.00%
Professor	153	22.21%	Highest Degree Countries		
Associate Professor	154	22.35%	Mainland	3	0.44%
Assistant Professor	155	22.50%	Hong Kong	7	1.02%
Lecture	29	4.21%	Taiwan	411	59.65%
Postdoctoral	82	11.90%	America	167	24.24%
Others	116	16.84%	Britain	29	4.21%
Total	689	100.00%	Australia	12	1.74%
			Others	60	8.71%
			Total	689	100.00%

The interaction graphic among Taiwan scholars

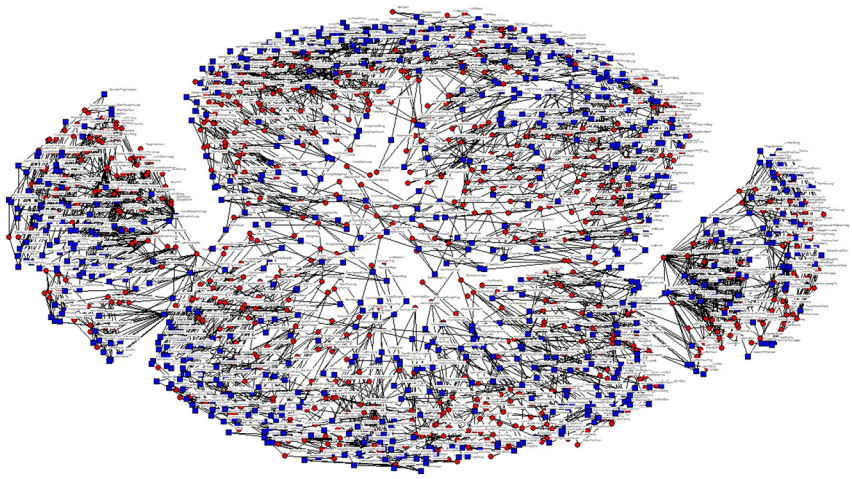


Table 10
Moderating effect of knowledge diversity and tie strength on network position and creativity- Taiwan.

	Creativity (Quantity)						Creativity (Quality)					
Variables	Model 41	Model 42	Model 43	Model 44	Model 45	Model 46	Model 47	Model 48	Model 49	Model 50	Model 51	Model 52
Independent variable												
Structural Hole		0.329***	0.267***		0.343***	0.171***		0.580***	0.036		0.192*	0.284*
(Structural Hole)^2		−0.010***	−0.014***		−0.017***	−0.000		−0.015*	−0.026**		−0.006*	−0.018
Interaction effects												
Diversity * Hole			−0.118**						−1.075***			
Tie*Hole						0.004***						0.003*
Control variables												
Knowledge Diversity	1.656***	0.623***	0.340*				2.318***	0.225	1.382***			
Tie Strength				0.076***	0.042***	0.090***				0.263***	0.232***	0.204***
Gender	0.028	0.002	0.009	−0.009	−0.041	0.020	0.032	−0.024	0.004	−0.023	−0.025	−0.034
Academic position												
Professor	−0.326***	−0.108	−0.136	−0.170	−0.161*	−0.194*	0.364	0.216	0.183	0.256	0.242	0.231
Associate Pro.	−0.249**	−0.033	−0.053	−0.089	−0.060	−0.088	0.447	0.283	0.252	0.336	0.325	0.317
Assistant Pro.	−0.530**	−0.331*	−0.350*	−0.342*	−0.320*	−0.338*	−0.004	−0.137	−0.162	−0.020	0.353*	−0.040
Lecture	−0.685***	−0.406***	−0.446***	−0.548***	−0.459***	−0.510***	−0.239	−0.284	−0.298	−0.223	−0.032	−0.231
Others	−0.462***	−0.176	−0.192	−0.207	−0.162	−0.185	1.057***	0.454	0.495*	0.578*	0.537*	0.534*
Degree Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model fit												
LR χ^2	398.28***	595.67***	604.06***	499.30***	626.65***	650.97***						
Log likelihood	−1079.14	−980.44	−976.25	−1025.86	−962.19	−950.03						
R^2							0.156	0.382	0.416	0.450	0.453	0.454
F_{-Value}							18.01***	46.76***	48.36***	79.60***	62.53***	56.32***

$N = 689$.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 11
The demographic information for Macao.

Item	Sample	%	Item	Sample	%
Gender			Highest Degree		
Male	43	50.59%	Master	13	15.29%
Female	42	49.41%	Doctor	68	80.00%
Total	85	100.00%	Others	4	4.71%
Academic status			Total	85	100.00%
Professor	11	12.94%	Highest Degree Countries		
Associate Professor	15	17.65%	Mainland China	7	8.24%
Assistant Professor	37	43.53%	Hong Kong	14	16.47%
Lecture	8	9.41%	Taiwan	2	2.35%
Postdoctoral	3	3.53%	Macao	13	15.29%
Others	11	12.94%	America	8	9.41%
Total	85	100.00%	Britain	11	12.94%
			Australia	8	9.41%
			Others	22	25.88%
			Total	85	100.00%

The interaction graphic among Macao scholars

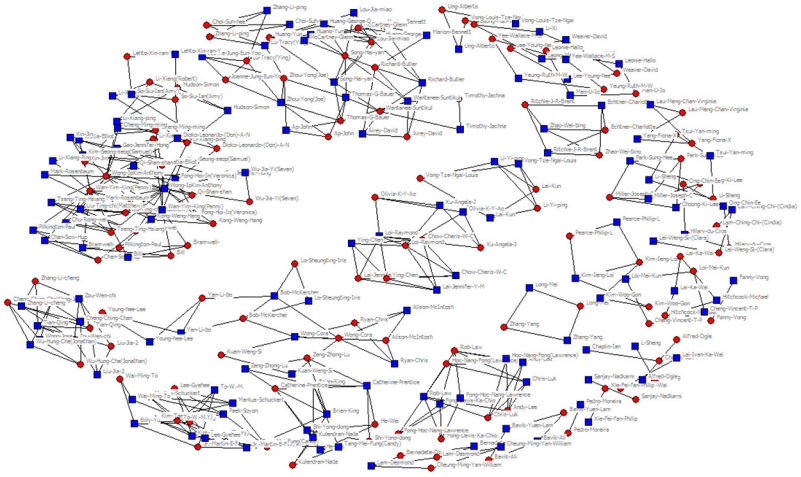


Table 12
Moderating effect of knowledge diversity and tie strength on network position and creativity- Macao.

	Creativity (Quantity)						Creativity (Quality)					
Variables	Model 53	Model 54	Model 55	Model 56	Model 57	Model 58	Model 59	Model 60	Model 61	Model 62	Model 63	Model 64
Independent variable												
Structural Hole		0.130*	0.131		1.599*	1.142		1.273**	1.257**		1.220*	1.788**
(Structural Hole)^2		- 0.012	0.015		−1.086	−0.861		−0.307***	−0.384***		−0.301***	-.0.560**
Interaction effects												
Diversity * Hole			−0.029*						−0.864*			
Tie*Hole						0.025*						0.114
Control variables												
Knowledge Diversity	1.707***	0.568*	0.624*				3.037**	0.270	1.719			
Tie Strength				0.134***	0.104***	0.099**				0.437***	0.010	0.238
Gender	−0.015	−0.008	−0.007	−0.010	−0.063	−0.062	−0.017	0.127	0.069	−0.023	0.126	0.089
Academic position												
Professor	0.015	−0.144	−0.135	0.002	−0.008	−0.027	0.621	0.299	0.345	0.222	0.308	0.354
Associate Pro.	0.077	0.071	0.076	0.256	0.225	0.207	0.793	0.986	0.954	0.742	0.980	0.980
Assistant Pro.	0.002	0.005	0.010	0.121	0.111	0.086	−0.044	−0.241	−0.214	−0.125	−0.258	−0.215
Lecture	−0.162	−0.257	−0.250	−0.135	−0.142	−0.175	−0.814	−0.318	−0.393	−0.388	−0.269	−0.294
Others	−0.562	−0.299	−0.298	−0.115	−0.105	−0.134	0.658	0.717	0.598	0.340	0.720	0.737
Degree Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model fit												
LR χ^2	44.95***	75.83***	75.84***	75.78***	77.66***	77.83***						
Log likelihood	−130.84	−115.40	−115.39	−115.42	−114.48	−114.40						
R^2							0.178	0.727	0.733	0.454	0.727	0.733
F-Value							2.39*	22.28***	20.38***	9.15***	22.22***	20.41***

$N = 85$.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

were used to collect data from 2316 publications by 1661 researchers in the fields of tourism and hospitality who had built individual academic cooperative relationships between 1989 and 2015. McFadyen et al. (2009) suggested that creativity is one of the most important success factors for knowledge workers in gaining a competitive advantage and surviving in the highly competitive academic world. Therefore, it is critical to examine ego network structures, knowledge diversity and tie strength not only concurrently but also interactively because one affects the other's relationship to creativity.

To investigate the important role of network structure in individual creativity performance, this study examines the role of the academic network structure, specifically the position of structural holes. The findings suggested that for focal scholars or knowledge workers, the occupation of a critical network position, the maintenance of durable network ties and access to diverse knowledge are important to explain the quantity and quality of researcher creativity. Equally important, it is found that, while knowledge diversity, tie strength and structural hole position directly influence researchers' creativity, a superior network position may have a negative effect if such a position goes beyond the moderated level. Further, tie strength and structural hole position are interdependent with creativity: increases in levels of interaction and tie strength enhance mutual trust and cooperative partners are more willing to share useful information, which helps researchers' internal learning capabilities and enhances creativity. Furthermore, although access to diversified knowledge may increase an individual's new thinking, heterogeneity may also cause conflict and inconsistency, which may reduce the effects of critical position and creativity because of absorptive capability. The findings provide new insights for the existing literature to explain current knowledge workers' creativity and cooperative strategies in different Chinese regional contexts.

4.1. Theoretical implications

The findings answer the research questions and make several contributions to tourism and hospitality research in terms of social positioning and logic. First, the results extend the findings of organization innovation and can be applied to individual creativity performance, showing that critical network positioning plays an important role in accessing valuable resources and new information to enhance individual new idea generation (Li & Liu, 2016; Liu, 2015). The interesting result here is that in an inverse-U relationship between structural hole position and creativity, the structural hole position has a brokerage role, mediating and controlling the flow of information between two unconnected actors, and may contribute to an individual's generation of new ideas due to the advantage of information and resources that can be obtained in that position (Farr-Wharton, Brown, Keast, & Shymko, 2015; Shi, Markoczy, & Dess, 2009), which further enhances creativity. However, occupying a critical position and the control of too many resources may result in conflict created by the overabundance of information (Kratzer, Lettl, Franke, & Gloor, 2016), cut into an individual's time and lead an individual's focus away from integrating data into useful information (Liu, 2015), thus making it more difficult to explore useful ideas (McFadyen et al., 2009) and reducing the speed and absorptive capability of the actor to create new ideas.

Second, previous studies have found that knowledge diversification may induce more information and ideas to inspire new individual thinking (Rodan & Galunic, 2004; Shin, Kim, Lee, & Bian, 2012). In this study, we found that the condition of diversifying knowledge influencing creativity is not a linear relationship but rather a negative curved one because knowledge diversification may also produce inconsistences and conflict with the existing knowledge of an individual. Therefore, when knowledge workers are positioned in a structural hole and have access to heterogeneous knowledge, it may reduce the quantity and quality of creativity. The relative magnitude of this phenomenon is particularly worth noting, especially in Chinese academic fields. Recently, despite the different regions and political structure of China's government, academic scholars have invested a great deal of effort in seeking out international academic cooperation opportunities. It is notable that access to too much diverse knowledge may also require an individual to have plenty of time to acquire, integrate, and understand the heterogeneous knowledge. Therefore, to increase individual creativity, knowledge selection is more important than knowledge diversity (Huang & Liu, 2015).

Third, it is confirmed that average tie strength is an important moderator in the relationship between structural hole position and creativity. Levin and Cross (2004) found that with an increase in interactions among knowledge exchangers, individuals may receive more useful knowledge when mutual trust and competence are controlled. Furthermore, by occupying a critical position and with mutual trust among knowledge exchangers, the speed of useful transfer accelerates, which improves individual creativity performance (Perry-Smith & Shalley, 2014). This evidence implies that individuals should increase communication and interaction with cooperative partners and increase information transfer, mutual trust, and new knowledge sharing. This approach will eventually facilitate the quality and quantity of creativity and idea generation.

4.2. Management practice implications

The implications of these results for knowledge workers and managers are that knowledge workers must know the potential and different functions of the two governing attributes that underlie their choice to build an individual network structure and to access a variety of knowledge or increase interaction frequency among a network's actors. A structural hole position in a network is beneficial to creativity because connected contacts serve as information bridges that can control the information flow (Burt, 1992), which both increases the brokerage opportunities of the connection between separate actors in a social network and provides entrepreneurial brokering activity through the recognition of market opportunities, thus improving creativity performance (Gargiulo & Benassi, 2000). However, previous studies have seldom paid attention to the limitation of network contacts, and knowledge diversity is not always beneficial for individual or organizational development. Especially in developing countries, an increase in heterogeneous knowledge and contacts requires time to incorporate, maintain and transfer into an individual's capabilities. Therefore, knowledge workers or managers should carefully select their cooperation partners and should carefully measure the appropriate middle level of network connections to harness those governing forces to achieve better creativity and increase opportunity.

Another recommendation for management practice is that managers and human resource executives should design an appropriate motivation mechanism to encourage employees to access distinct areas of competence, learn other skills during their leisure activities and encourage other team members to more carefully consider alternative solutions and to avoid becoming ‘disconnected’ people; this will ultimately cause employees to become more creative (Chen & Liu, 2012). Addressing these issues of creativity enhancement, job rotation, cross department cooperation activities, and the encouragement of employees to participate in other fields of training will not only lead to their spending time learning different functional knowledge, but it will also allow individuals to extend their personal ties to others (Perry-Smith & Shalley, 2014). Perry-Smith and Mannucci (2017) suggested that employee creativity is a foundational attribute for organizational innovation. Thus, managers should encourage employees to broaden their knowledge and skills and to continue to update their existing capabilities to increase creativity and overall organizational innovation. The present study also implies that tie strength facilitates creativity only when structural hole positions are occupied. This implication supports the idea that knowledge workers or managers who are interested in being more creative should consider increasing their interactions with others. This effort will enhance mutual trust in sharing useful

knowledge, expertise, and experiences and will increase the speed of creativity generation. Overall, the insights about network position, knowledge diversity and network ties in this paper suggest that individuals should be aware of the importance of appropriate connections because the exploration of too much information, knowledge, and resources may constrain creativity.

4.3. Limitations and suggestions for future research

As with other studies, although the current study provides important contributions, several limitations must be addressed further. First, hand-collected data allowed the exploration of phenomena that other studies have not detected. However, future studies may use alternative methods or solutions to extend the results of this study: for example, (1) the use of an experimental design and the controlled isolation of causality to focus on specific topics such as creativity (Sawyer, 2017); (2) the use of methods of interviews of managers and knowledge workers to reflect the complexity of organizations (Henriksen et al., 2018); and (3) the use of interviews with employers in different knowledge areas to understand approaches to problem solving from different perspectives and to identify how they learn from internal and external individual networks(Chen, Chang, & Chang, 2015). Second, we examined the tourism and hospitality academic network in a Chinese context. It is not clear that our findings can be generalized to other fields of knowledge workers or to academic networks in Western countries(McFadyen & Cannella, 2004). However, many constructs related to the network structure of academic environments are common to creativity issues more generally, including complexity, high competition, contested findings, and seemingly unlimited opportunities for cross-country cooperation in academic research. Therefore, future research is suggested to extend the findings of this study to different types of creative environment issues or to compare with the differences in Eastern and Western situations (Tan, 2016).

5. Conclusions

The findings reveal the significant effect of the structural hole position, knowledge diversity and tie strength on creativity in different regions of China. Structural hole position strongly influences creativity, but it has nonlinear relationships, and the “bridge advantage” increases capability and new idea generation through individual network connection management. Tie strength can effectively promote network position advantage through mutual trust with knowledge exchangers, which can offer an important signal for knowledge workers or creators when managing their network structure. It is notable that the potential impacts of knowledge diversity in social networks on individual creativity are less frequently mentioned in previous tourism and hospitality studies. Tie strength and knowledge diversity attributes have not only a direct effect on individuals' network structures and advantage extension but also an indirect effect as moderators of quantity and quality of creativity. In summary, the enhancement of individual knowledge acquisition and the building of personal relations in Chinese social networks can not only promote an individual to a more advantageous network position but can also strengthen individual learning capability and thereby enhance creativity performance.

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