Can employee's boundary-spanning behavior exactly promote innovation performance? The roles of creative ideas generation and team task interdependence

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Abstract

Purpose – The complex and changeable working environment makes individual cross-boundary activities inevitable. Yet, how employee's boundary-spanning behavior (BSB) stimulates innovation performance remains to be further explored. This study aims to analyze the intermediary mechanism and boundary conditions between employee's BSB and innovation performance based on knowledge integration theory.

Design/methodology/approach – The authors collected data in two waves (July and August 2017) and from two hierarchical levels (from the final sample of 286 employees and their 29 direct supervisors) within ten manufacturing firms located in Nanjing and Anhui, China.

Findings – The results indicate that creative ideas generation mediates the relationship between employee's BSB and innovation performance. Moreover, employees with higher levels of team task interdependence (TTI) lead to a stronger relationship between ideas generation and innovation performance compared to lower levels of TTI (positively moderates the second stage of mediation).

Practical implications – By verifying the key effects of ideas generation and TTI between employee's BSB and innovation performance, the findings of this study provide practical guidance for enterprises to improve the efficiency of employee's BSB.

Originality/value – First, the authors use knowledge integration theory (Grant, 1996a) to deduce the formation process of the mechanism between employee's BSB and his/her innovation results, which clearly shows the driving forces and integral power of the formation process within an individual knowledge integrating system. The authors' second contribution is further exploring the conditions under which engaging innovative ideas generated by the integration of employee's BSB is more likely to lead to ideas for implementation by examining TTI as a team-level moderator.

Keywords Boundary-spanning behavior, Ideas generation, Innovation performance, Team task interdependence

Paper type Research paper

Introduction

We are living in the "VUCA era," which has the characteristics of volatility, uncertainty, complexity and ambiguity (Bennett and Lemoine, 2014). Human activities are increasingly networked and complicated, and cross-boundary activities have become inevitable (Du and Chen, 2018). Especially in uncertain environments or emergencies (e.g. public health events and social security incidents), to improve flexibility and adaptability, organizations and teams put forward higher demands for employee's proactive boundary-spanning behavior (BSB) to get heterogeneous information and to enhance their innovation ability. Thus, an employee's BSB is the key to innovation. The widespread use of social tools at work has blurred the boundaries of teams or organizations and employees who cross boundaries to exchange information need to pay lower additional costs than they did before (Dahlander

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et al., 2016). Most scholars have proposed that cross-boundary activities are helpful for new ideas or innovation (Tortoriello and Krackhardt, 2010). Yet, they did not fully realize that the transition from BSB to innovation involves an unpredictable process of ideas implementation (Baer, 2012), which requires the team's strong support. Thus, we focus on how employee's BSB stimulates ideas generation and under what conditions the creative ideas can be smoothly transformed into innovation performance.

Essentially, individuals who cross boundaries to exchange information and cultivate creative ideas can improve their innovation performance only when the ideas are converted into actual innovations (Baer, 2012). The two-stage innovation arguments divide the process of individual's innovation into two important stages (specifically, *ideas generation*, formally defined as the generation of novel and useful ideas, and *implementation*, described as the process of converting these ideas into new and improved products, services or ways of doing things) (Somech and Drach-Zahavy, 2013). While considerable evidence has confirmed the influence of BSB on different levels of ideas generation (including firm, team and individual) (Ancona and Bresman, 2007) and innovation (Shalley *et al.*, 2004), only a few research studies on innovation have accounted for creative ideas generation as the necessary first stage of the influence mechanism of BSB, which ultimately affects innovation outcomes. As a consequence, our research exactly examines these two questions: first, how does an individual's BSB affect their innovation outcomes through the mediation effect of creative ideas generation? And second, how does team members' resource supporting influence the efficacy of ideas generation on implementation (second stage of innovation)?

At the team level, substantial efforts have been devoted by researchers, who have generally discovered that work teams can interact with outsiders to improve team effectiveness and satisfaction through the team's BSB (Ancona and Caldwell, 1992). These investigations have largely focused on issues of boundary management (Ancona, 1990) and how these boundary-spanning activities improve team learning and effectiveness (Edmondson and Harvey, 2018). However, Marrone (2010) noted that team boundary-spanning actions originate from the behaviors and activities of its members and thus encourages more research attention on individuals' BSB. As individuals are nested within teams, they need to rely on the allocation of resources within the team (Gruber *et al.*, 2013) to externalize the ideas that were internalized from the external search into innovative outcomes. It has been noted that individuals' cross-boundary searching and learning are not well understood (Maggitti *et al.*, 2013); thus, the major purpose of the present study is to develop and test a cross-level theory regarding the influences of individual-level BSB and the team task support context on individual creative idea generation and ultimate innovation performance. The main research contributions are as follows.

First, we use knowledge integration theory (Grant, 1996a) to deduce the formation process of the mechanism between an employee's BSB and his/her innovation results, which clearly shows the driving forces and internal impetus of the formation within an individual knowledge integrating system. By distinguishing creative ideas generation and implementation, we thus construct the EIE logical chain of employee's BSB, that is, – external search–internalization–externalization (See Figure 1 and Figure 4 for details). We

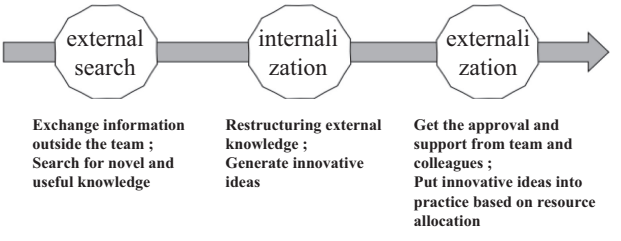

Figure 1.
The mechanism and pathway of the employee's boundary-spanning behavior on innovation performance at the individual level

then empirically test whether idea generation serves in a mediating role between employee's BSB and their innovation performance, which is perhaps a response to appeals by Marrone (2010). Through a review of previous research conclusions, we found that it is not a new notion that individuals exposed to external networks will inherit greater knowledge and facility by both accumulating and taking advantage of new ideas (Marrone *et al.*, 2007). However, it is difficult for individuals to effectively implement external new knowledge to improve innovation (Baer, 2012), without time and resources trade-offs to refine creative ideas. According to the resource allocation framework, the amounts of time, energy and resources are limited not only within a particular work setting but also in life in general. Individuals at work are bound to face trade-offs between ideas generation and implementation, which are distinct activities (Škerlavaj *et al.*, 2014) related to different behaviors. Generating creative ideas via BSB and external searches are just the first step in the innovation process, and while it is essential to implement these ideas and improve innovation, performance depends on integrating team resources. Thus, we believe that the current research study, to some degree, could compensate for the gap in the influence path of employee's BSB in innovation outcomes research and further promote the refinement of innovation theory.

Our second contribution is to explore how team task interdependence (TTI) as a team-level boundary condition plays a moderating role between the employee's ideas generation and implementation. As revealed by social dependency theory (Johnson and Johnson, 1989), an individual's behavior in the workplace is strongly influenced by task interrelationship and the TTI has been proven to be one of the most significant factors (Bertucci *et al.*, 2011). Specifically, team members will invest in developing smooth interpersonal interactions, engage in mutual helping and experience enhanced interpersonal liking and harmony when they must work together on a group task (Johnson and Johnson, 1989). Hence, the second central mission of this study is seeking to extend this line of work by proposing that TTI influences the relations between idea generation and implementation. In practice, our research may help organizations understand and facilitate the use of the untapped potential of such ideas.

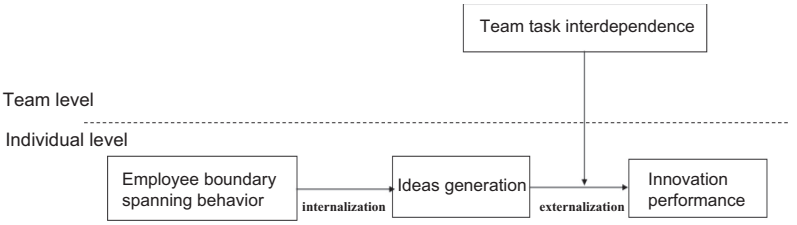

Figure 2.
The theoretical model

Theory and hypotheses

The pathway of employee's boundary-spanning behavior to improve their innovation performance

Based on the theory of knowledge integration (Grant, 1996a), we argue that with the enhancement of employee's BSB, an increasing number of creative ideas can be produced. Prior research has demonstrated the requirement to flexibly integrate different types of specialized knowledge and create new functions under the hypercompetitive conditions in the marketplace (Grant, 1996a). According to knowledge integration theory, individuals who share information across boundaries through external trading can access know-how and information from the outside and then recombine with existing knowledge within the team to

generate new ideas (Teigland and Wasko, 2003). In particular, individuals in other teams/organizational units are more likely than co-located coworkers to have important knowledge that is nonredundant, thus generating access to sources of new ideas and innovations located across intrateam boundaries (Edmondson and Harvey, 2018). By interacting with external sources, boundary workers gain information and expertise not available locally and can interact informally, free from the constraints of hierarchy and local rules. Consequently, boundary workers facilitate integrative flexibility of knowledge trading for information, which is acquired from the outside through BSB. Individuals can not only obtain useful internal and external resources but also enhance their alertness to novelty in this complex process (Teigland and Wasko, 2003). Thus, the integration of external and local information reserves could help individuals to cultivate and generate creative ideas.

In addition, to fully understand the relationship between employee's BSB and ideas generation, we can also refer to the analysis of Marrone (2010). That is, the relationship between boundary spanners and other key subjects, such as customers, executives and external experts, can help them to gain key network positions within the interface between their work team and the outside, such as "structural holes" or "structural bridge." According to Burt (1992), the actors in these key positions can connect two areas (i.e. internal and external networks) with a dense relationship, bringing new information or other resources to these interconnected units. External information and resources flow through the border into the team (Leiponen and Helfat, 2011) and are then shared with colleagues. These sharing and helping activities contribute to the generation of creative ideas by strengthening the integration and interaction of new knowledge. Additionally, individuals who help others are entitled to reciprocity, thereby gaining access to advice and new ideas when needed. In summary, we expect the employee's BSB to have a positive impact on creative ideas generation.

H1. Employee's BSB is positively related to his or her ideas generation.

Furthermore, although the two-stage innovation arguments have confirmed that ideas generation is the premise of implementation (innovation) (Somech and Drach-Zahavy, 2013), they do not give a specific answer to how the relationship between the two occurs. Indeed, implementing ideas is risky (i.e. whether to obtain the recognition and support of leaders at all levels or colleagues), which will inevitably lead to opposition and difficulty in achieving (Baer, 2012). Thus, a transition from ideas generation to innovation (externalization) still involves a complex internal transaction and a reciprocal process. Drawing on a resource allocation framework (Becker, 1965), some studies have suggested that ideas implementation is inherently embedded within the social context and that employees should exchange, integrate and disseminate their ideas within the team to implement them. We focus on the possible basis for a positive relationship between ideas generation and implementation from the perspective of internal knowledge trading. Specifically, knowledge integration theory holds that in addition to external integrative flexibility, individuals also need to integrate new ideas into the internal environment to improve their innovation outcomes. When engaging in internal information trading, individuals can not only send and receive task-specific knowledge but they can also achieve reciprocity by spending time solving each other's work problems. Helping others may improve an individual's technical skills and provide the necessary support for his/her ideas implementation. Additionally, previous research on BSB has shown that employees do not offer help and advice to their colleagues for free but trade knowledge within the team with reciprocal expectations (Kogut and Zander, 1992). In other words, trading and expectations of reciprocity are key cooperation mechanisms underlying cross-boundary knowledge exchange, which may reduce the risk of uncertainty in idea implementation. Similarly, individuals who help others are entitled to reciprocity, thereby gaining access to advice, support and encouragement when

needed. Thus, we believe that there is a positive relationship between employee's creative ideas generation and innovation performance.

Combining with the above analysis, we are more concerned that employee's BSB is likely to promote innovation performance (implementation) via the creative ideas generation. Due to the lack of a direct empirical test, the previous research study on the relationship between employee's BSB and their innovation performance is still controversial, this paper attempts to explain the mechanism of individual's BSB on innovation performance from the perspective of external and internal information trading. Specifically, it includes three processes: (1) *external search*: employees search for information and knowledge across the boundaries of the organizations or teams through BSB, which involves external transactions and interactions with the external environment; (2) *knowledge internalization*: employees who cross boundaries update their knowledge base to form creative ideas by internalizing knowledge acquired from outside; (3) *knowledge externalization*: to obtain the support of colleagues and leaders to implement creative ideas, these employees need to "sell" ideas in the work team (i.e. to show their ideas and the expected benefits of implementation to others) through internal knowledge transactions. Consequently, the process of employee's BSB to improve their innovation performance goes through the logical chain of "external search–internalization - externalization" and the creative ideas generation is an important transmission mechanism between BSB and innovation. The specific relationship is shown in Figure 2. Through the above analysis, we propose that an employee's BSB will ultimately positively affect innovation performance (that is, ideas implementation) and the ideas generation plays an important mediating role. Combining the reasoning above, we hypothesize as follows:

H2. Ideas generation mediates the relationship between employee's BSB and innovation performance.

The moderating role of team task interdependence

The literature on individual ideas generation and innovation performance has generally paid little attention to understanding when, why and how idea generation has a positive effect on idea implementation (Škerlavaj *et al.*, 2014). Grant's knowledge integration theory also misses a key point that people will be willing to actively share knowledge if reciprocal workflows and structures can be provided (Teigland and Wasko, 2003). Moreover, previous research on cross-boundary communication has shown that reciprocity is one of the guiding principles for knowledge exchange as people expect an increased chance of getting feedback after they give information (Kogut and Zander, 1992). Thus, the goal of this research is to investigate the positive effect of reciprocity on the relationship between idea generation and implementation based on the team's common interests.

Following the resource allocation framework (Becker, 1965) mentioned above, we can still reach the same interpretation, that is, organizations and individuals must make trade-off decisions on the allocation of limited resources, which can explain the effect of TTI as a boundary condition between ideas generation and implementation. Because the process of ideas implementation, even at the individual level, is open to social-political maneuvers among employees (Baer, 2012), it is necessary to cooperate and "sell" ideas within the organization to other colleagues or groups to obtain support and resources (Axtell *et al.*, 2000). To navigate these political processes, individuals must convince their coworkers that ideas should be implemented and hence influence their coworkers' decisions (Green *et al.*, 2003). Consequently, whether creative ideas obtained through boundary-spanning activities can be successfully implemented within the group also depends on the support of internal resources and the expectation of reciprocity.

According to social interdependence theory (Johnson and Johnson, 1989), TTI is defined as the extent to which the behavior of one team member influences the performance of others. In

other words, TTI is the extent to which team members must work together to accomplish tasks (Saavedra *et al.*, 1993). Based on this definition, TTI is a construct that corresponds to interdependence at the team level and can be measured by averaging the task interdependence of all team members. In this regard, we hold that the implementation of creative ideas depends to a large extent on the attitudes of and recognition by other colleagues within the team to provide the necessary support (Klein and Mulvey, 1995). Generally, when the degree of interdependence is high, team members should work interactively to accomplish a task; conversely, they must work independently when the degree of interdependence is low. The moderating effect of task interdependence would appear to be as follows:

In teams predominated by lower levels of TTI, team members tend to rely on their resources and formal channels to promote the implementation of creative ideas. Influenced by the allocation of resources, the independent implementation of creative ideas is hindered by limits on time, energy and resources and inevitably draws opposition. The risky nature and uncertainty of creative ideas will frustrate the enthusiasm of border employees and make it difficult to implement these innovative ideas because they are likely to be met with more skepticism and hesitation (Baer, 2012).

In contrast, higher levels of TTI mean that there is a high degree of interaction between team members who can help each other by providing the resources necessary for idea implementation. Simultaneously, as Grant (1996) pointed out, employees who successfully cross the boundary still need to meet the expectations of reciprocity rather than freedom to implement their creative ideas within the team. As a consequence, trading and integrating ideas in a team with a higher level of TTI will make it easier to obtain support and shared resources without paying too much "transaction costs" because once the idea is successfully implemented, it is beneficial to everyone in the team.

Based on the above reasoning, our prediction is as follows:

H3. TTI moderates the relationship between employee's ideas generation and innovation performance, such higher levels of TTI lead to a stronger relationship between ideas generation and innovation performance compared to employees with lower levels of TTI.

The research method

The sample and data collection

To test our hypotheses, we have chosen the method of on-the-spot questionnaire recovery, which can reduce the awkward problem of low response rates to some extent. In addition, to ensure the reliability and validity of the measurement, we use mature scales that have been employed in the domestic and foreign literature reviews, and the translation-back-translation procedure was used to translate the items (that we adopted from previous papers) from English into Chinese and back into English to reduce language errors. First, the English questionnaire was translated into Chinese by a professional researcher; the Chinese version was translated into English and the differences were compared and modified accordingly. Second, another researcher from the same field conducted the same process. Finally, differences were verified with another researcher and corresponding corrections were made and then finalized to complete the translation of the questionnaire.

We collected data in two waves (July and August 2017) and from two hierarchical levels (from the final sample of 286 employees and their 29 direct supervisors) within ten manufacturing firms located in Nanjing and Anhui, China. To enhance and extend the significance of this research, we have selected teams from different departments, such as research and development, sales, production and functional management. Meanwhile, as these organizations and teams have completed the network transformation, they have the characteristics of networked working patterns and laid the foundation of individual BSB. At

time 1 (T1), we sent invitations to the 35 team leaders and their 392 subordinates to measure employees' BSB, ideas generation and TTI. After a six-week interval (T2), we invited these leaders to evaluate the implementation of their subordinates' creative ideas. After eliminating the missing and invalid questionnaires, we ultimately obtained valid data from the 29 team leaders and their 286 subordinates, with an effective response rate of 72.95%.

Measures

Boundary-spanning behavior (BSB)

Following the existing research study, we used the three-item scale of the information collection dimension developed by Ancona and Caldwell (1992) to measure employee's BSBs. A sample item was "Collect technical information/ideas from individuals outside of the team." In this study, Cronbach's alpha for the scale was 0.826.

Ideas generation

We used a three-item scale to measure employee's creative ideas generation, which was developed by Subramaniam and Youndt (2005). Each team member evaluated himself/herself on three items: "Developed breakthrough ideas, not minor changes to existing products/services"; "Developed ideas that make existing knowledge about current products/services obsolete"; "Developed ideas that imply substantial departures from existing product and service lines." Cronbach's alpha was 0.778.

Innovation performance

A three-item scale developed by Baer (2012) was adopted in this study to measure employee's ideas implementation (innovation performance). The supervisors rated the frequency with which an employee's ideas had reached certain stages of implementation: the employee's ideas (1) have been approved for further development, (2) have been transformed into useable products, processes or procedures and (3) have been successfully brought to market or have been successfully implemented in the organization. Cronbach's alpha for the scale was 0.774.

Team task interdependence (TTI)

We used a three-item scale compiled by Liden *et al.* (1997) to measure employee's TTI. A sample item was "To accomplish our task, we need each member's contribution." According to the common practice of relevant research on holistic team task analysis ratings (e.g. Butler and Harvey, 1988), we used the mean value of self-evaluation to represent TTI. Cronbach's alpha for this scale was 0.858.

Control variables

Following previous research (Marrone *et al.*, 2007; Yang *et al.*, 2012; Zhang and Begley, 2011; Zhang *et al.*, 2012), we controlled age, gender, education, monthly income, department and tenure at the individual level. And we also controlled team size at the team level (Marrone *et al.*, 2007), which was measured by the number of team members. In addition, considering that the differences in team age may affect the stability of the teamwork atmosphere, we also controlled the average age of the team.

Results

Preliminary analyses

Since TTI is aggregated at the team level from the individual responses, it is important to verify the homogeneity and intergroup differences in the group. The results revealed

significant between-group variance for TTI (mean $R_{wg} = 0.86$, ICC (1) = 0.24, ICC (2) = 0.75), thus supporting the aggregation in our study (James *et al.*, 1984), which can be used for the team-level analysis.

Then, we conducted a confirmatory factor analysis (CFA) on the variables involved in the model. The results indicated that the four-factor model (employee's BSB, ideas generation, innovation performance, task interdependence) is well fitted ($\chi^2 = 48.28$, df = 48, RMSEA = 0.005, CFI = 1.000, NFI = 0.966) and superior to three- (e.g. employee's BSB, ideas generation + innovation performance and TTI, $\chi^2 = 294.78$, df = 51, RMSEA = 0.130, CFI = 0.820, NFI = 0.792), two- (e.g. employee's BSB + TTI, ideas generation + innovation performance, $\chi^2 = 621.90$, df = 53, RMSEA = 0.194, CFI = 0.579, NFI = 0.561) and single-factor models ($\chi^2 = 832.497$, df = 54, RMSEA = 0.225, CFI = 0.424, NFI = 0.413). The analysis showed that the variables have good discriminant validity.

In addition, we used the factor analysis method to test the convergent validity of each variable. The results were presented in the Appendix. The composite reliability (CR) of each variable was greater than 0.7, and the average variance extracted (AVE) was greater than 0.5. Meanwhile, all of the loadings were significantly greater than 0.6.

Descriptive statistics

The means, standard deviations and correlation coefficients of all the key variables at the individual and team levels are shown in Table 1 and Table 2, respectively. The results indicated that there is a significant positive correlation between employee's BSB and ideas generation ($\gamma = 0.25$, $p < 0.05$). Meanwhile, ideas generation and implementation are also positively related ($\gamma = 0.35$, $p < 0.05$) and the similar correlation between employee's BSB and implementation was also reported ($\gamma = 0.32$, $p < 0.05$). These results are preliminarily consistent with our hypotheses. To further test the relationship between these variables, this study adopts hierarchical linear modeling (HLM), which is a suitable analytic approach when cross-level data are involved because it maintains the independence of the predictors.

The mediation effect of ideas generation

The hypotheses were tested using the hierarchical regression analysis, and the results in Table 3 indicate that when we controlled for age, gender, education, tenure, department, income and team age and team size, employee's BSB had a positive effect on ideas generation ($\beta = 0.20$, $p < 0.01$, model 2 and model 3). Hence, an employee exhibiting more BSBs was more likely to generate creative ideas. Therefore, H1 was supported. Furthermore, combined with the results of models 5 and 6 in Table 3, these results indicate that employee's BSB has a positive effect on idea implementation ($\beta = 0.23$, $p < 0.01$) and that ideas generation also positively relates to implementation ($\beta = 0.34$, $p < 0.01$). In addition, after entering the mediating and independent variables at the same time, model 7 showed a decrease in the regression coefficient between employee's BSB and implementation (from the $\beta = 0.23$ to $\beta = 0.17$), but the significance has not disappeared, which satisfies the conditions of partial mediation. These results provide support for H2. Hence, we confirmed that employee's BSB can promote the implementation of ideas and this process is mediated by the ideas generation. Finally, we also used the *bootstrap repeated sampling method* (Preacher and Hayes, 2008) to further examine the mediating role of ideas generation. The results indicate that the mediation effect is significant within the 95% confidence interval, with a value of 0.06 (CI = [0.03, 0.10]). Thus, H2 is fully verified.

The moderating effect of team task interdependence

Furthermore, after entering the interaction of ideas generation and TTI, model 8 showed that the interaction has a significant impact on ideas implementation ($\beta = 0.18$, $p < 0.05$). Hence,

Table 1.
Means, standard deviations and correlations at the individual level[a,b]

	Mean	SD	1	2	3	4	5	6	7	8	9
(1) Gender	1.43	0.49									
(2) Age	2.46	0.82	0.05								
(3) Education	3.99	1.01	−0.15*	−0.20**							
(4) Tenure	2.01	1.23	0.05	0.19**	−0.19**						
(5) Department	3.23	1.93	0.04	0.15**	−0.08	−0.07					
(6) Income	2.30	0.95	−0.21**	0.06	0.39**	−0.67	0.13*				
(7) BSB	4.98	1.08	−0.04	−0.06	0.00	0.04	0.01	−0.05			
(8) Ideas generation	4.51	0.99	0.02	0.09	0.01	−0.03	−0.01	0.01	0.25**		
(9) Implementation	5.39	0.80	−0.10	−0.03	0.12	0.03	−0.01	0.06	0.32**	0.35**	
(10) Task interdependence	4.86	0.87	−0.08	0.06	0.08	0.09	−0.05	0.06	0.18**	−0.18**	0.43**

Note(s): [a]$n = 286$; [b]*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

TTI can moderate the link between idea generation and implementation, and the preliminary results support H3. To further examine the significant interactions, the simple slope analyses were conducted using rescale values for TTI, as outlined by Aiken and West (1991). The zero values for the scale were set at one standard deviation above and below the mean for TTI. The moderating effect is graphically plotted in Figure 3 and reveals that the slope is steeper when TTI is high. The results indicated that the positive relationship between idea generation and innovation performance was significant in both conditions but was stronger when TTI was high (simple slope low = 0.09, $p < 0.05$; simple slope high = 0.25, $p < 0.05$). These results further support for H3.

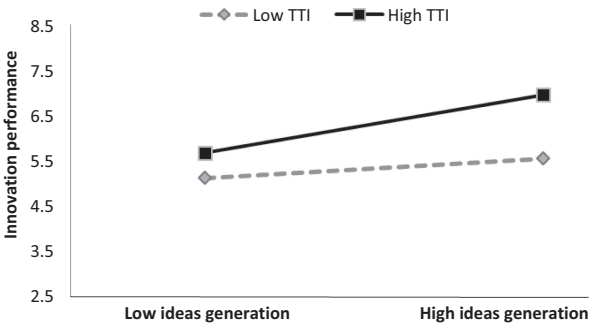

Figure 3.
The moderating effect of team task interdependence on the relationship between ideas generation and innovation performance

Discussion and conclusions

Conclusion

Since the connection between BSB and innovation at the individual level has received scant research attention (Marrone, 2010), we draw on Baer's argument about the innovation process to extend this research line by examining ideas generation as the transmission mechanism between employee's BSB and innovation performance. In addition, based on the reciprocity of knowledge trading and the resource allocation framework, we further explore the boundary conditions between idea generation and implementation in terms of TTI. The findings of our research provide general support for the proposed framework. Consistent with H1 and H2, the results indicated that ideas generation as a direct achievement of employee's BSB may often be a stand-alone concept (Baer, 2012) that has limited individual value without implementation. BSB is a necessary, but far from sufficient, precondition for innovation, which requires implementing innovative ideas (Škerlavaj *et al.*, 2014). Specifically, the difference between the slope representing the direct effect of employee's BSB on innovation performance and the slope for indirect effects indicates that idea generation plays a mediating role in the relationship between employee's BSB and innovation performance.

Further solidifying the general framework proposed here, the results for H3 indicated that, in line with the view of social interdependence and internal information trading, high

Table 2.
Means, standard deviations and correlations at the team level[a,b]

	Mean	SD	1	2
(1) Team average age	33.28	6.97		
(2) Team size	9.86	7.72	−0.03	
(3) Team task interdependence	4.82	0.47	−0.14	0.10

Note(s): [a]$n = 29$; [b]*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table 3.
Regression results[a,b,c]

Variables	Ideas generation Model1	Model 2	Model3	Model4	Innovation performance (ideas implementation) Model 5	Model6	Model7	Model8
Intercept(γ_{00})	3.40***	3.36***	3.34***	4.84***	4.80***	5.08***	5.05***	5.06***
Level 1								
Gender	0.14	0.15	0.13	−0.08	−0.07	−0.11	−0.10	−0.09
Age	0.06	0.08	0.10	−0.04	−0.01	−0.05	−0.02	−0.03
Education	0.08	0.09	0.12*	0.10*	0.10*	0.07*	0.06*	0.06*
Tenure	−0.01	−0.02	−0.03	0.04	0.04	0.04	0.04	0.04
Department	−0.03	−0.03	−0.04	−0.01	−0.01	0.01	0.01	0.01
Income	0.06	0.06	0.05	0.02	0.02	0.01	−0.01	0.01
BSB		0.20***	0.20***		0.23***		0.17***	0.17***
Ideas generation						0.34***	0.29***	0.31***
Level 2								
Team average age	−0,01	−0.01	−0.01	0.01	0.01	0.01	0.01	0.01
Team size	0.02*	0.02*	0.03**	0.01**	0.01**	0.01*	0.01*	0.01**
TTI			−0.74***				0.23***	0.23**
Ideas * TTI								0.18**
σ^2	0.74	0.70	0.70	0.61	0.56	0.53	0.50	0.50
τ_{00}	0.27	0.28	0.15	0.03	0.03	0.04	0.03	0.03
Deviance	796.01	787.95	775.90	717.12	699.25	685.48	673.85	672.39

Note(s): [a]$n = 286$ at the individual level; $n = 29$ at the team level; [b]*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$; [c]All coefficients are values with robust standard errors

TTI combines with idea generation to jointly affect the implementation of innovative ideas. We found that TTI strengthens the positive relationship between innovative idea generation and implementation, making it more significant. Accordingly, high levels of TTI seem to be an internal objective support that influences the reciprocity model and unlocks the potential of highly creative individuals through boundary-spanning activities. The conclusion is consistent with the inference in the introduction. Although with the booming development of information technology, an employee can transcend traditional organizational boundaries to access and cultivate innovative ideas at anytime and anywhere through various forms of social media, the transformation from creative ideas into practical innovation outcomes cannot occur without the team's task support. The result that the moderating effect of TTI (see Figure 3 and Figure 4) supports this view. In addition, we have to mention that our data results only validated TTI's moderating effect on the relationship between ideas generation and innovation but did not verify that it played a moderated mediation between employee's BSB and innovation. Fortunately, this result precisely indicates that in the VUCA era, the different effects of employee's BSB on innovation cannot be simply judged by the TTI level. In fact, the conditions under which employee's BSB influences innovation through the creation of ideas are very multidimensional and complex in the new era, and thus, TTI can only moderate the relationship between ideas generation and implementation (the second stage between BSB and innovation).

In summary, the relationship between employee's BSB and innovation performance covers three steps and two kinds of knowledge trading and integration. First, employees start BSB based on evaluating whether their existing knowledge base can meet the current work requirements (equal to external search). Second, employees trade knowledge outside the team to obtain the nonredundant information and knowledge that is lacking within the team (Teigland and Wasko, 2003) and then integrate with the existing knowledge base to form creative ideas (equal to internalization). Finally, to successfully implement the creative ideas, a second knowledge transaction (equal to externalization) is required within the team, which directly determines whether the innovation performance of span-border employees can be successfully improved. We found that TTI can greatly improve the efficiency of internal knowledge transactions. As a result, we have summarized the knowledge transaction model of employee's BSB on innovation performance as an EIE model (external research–internalization–externalization), as shown in Figure 4.

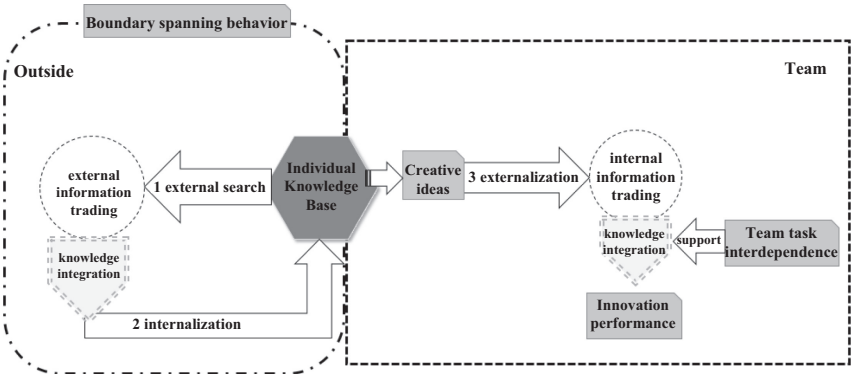

Figure 4.
The external research–internalization–externalization model of the employee's BSB on innovation performance

Theoretical implications

The conclusion of this paper has some theoretical contributions to employee's BSB and innovation literature. First, different from previous studies focusing on cross-border learning and innovation performance at the team level (Ancona, 2007), we answer Marrone's (2010) calls to examine whether individual's BSB as an initial source of enterprise innovation diversity resource demand may affect employee's ability to generate and share creative ideas. Meanwhile, by analyzing the internal and external knowledge trading processes between BSB and innovation performance at the individual level, we further elaborate the internal mechanism of how BSB contributed to the innovation performance and then answer the question of why externally acquired knowledge is difficult to implement in teams (Somech and Drach-Zahavy, 2013).

Second, by distinguishing the process of innovation, we harmonize the previous literature on the two-sided impact of BSB on innovation performance (Dahlander *et al.*, 2016; Edmondson and Harvey, 2018). Our research shows that the pattern of individual boundary-spanning innovation seems to be more complex than previously assumed. Only by implementing innovative ideas within the team, rather than just internalizing external data into useful and novel creative ideas at the ideological level, can we enhance individual innovation performance and improve the existing management pattern of teams or update relatively backward technology. In addition, it is worth highlighting that Nonaka's (1994) SECI model presents a spiral evolution process of knowledge transformation within an organization, including socialization, externalization, combination and internalization. Supporting this general framework, we further extended the logical chain of "external information search–internalization - externalization" for individuals and established an EIE model based on the chain, which provides a new theoretical perspective for interpreting the relationship between individual's BSB and their innovation performance.

Finally, previous studies have emphasized the importance of subjective factors as moderated variables between the two stages of innovation, namely, idea generation and implementation, such as perceived leadership support (Škerlavaj *et al.*, 2014) or knowledge-sharing environment. Differently, we reveal the effect of objective task interdependent relationships between employees and their colleagues, which helps to obtain a comprehensive understanding of how individual creative ideas generation in a team improves their innovation performance. Specifically, TTI can not only reduce the cost of creative idea transactions between individuals but also gain more resource support from their colleagues and leaders, thus increasing the success rate of ideas implementation. The conclusion of this paper extends the discussion on the concept of work atmosphere and networking ties at the team level to the variable of a reciprocal relationship based on the task itself and confirms its academic value and potential.

Practical implications

The conclusions of this paper have some interesting practical significance for the implementation of employee's BSB. First, with the constant updating of social media, the employee's BSB has become an important job requirement (Stone *et al.*, 2015; Dahlander *et al.*, 2016). In addition to encouraging specific individuals, such as border employees or leaders, to actively engage with the outside world, it is more important to promote individual BSB through organizational design. On the one hand, organizations can provide cross-border learning opportunities for employees with different professional backgrounds by building a crossover platform; on the other hand, organizations can also create new border work positions for employees and promote them to adapt and achieve heterogeneous work by stimulating job crafting. Consequently, in the VUCA era, individual BSB is expected to become a new working model that is widely accepted and thus provides resource support and assistance for individual innovation performance.

Second, the popularity of networked working patterns has made the teams' boundaries more and more permeable. "Platform + individual" will gradually replace the traditional

"company + employees" and become the new mainstream in the future (Eisenmann *et al.*, 2011). In this regard, individuals have great opportunities to demonstrate their value and creativity. Yet, we cannot ignore the higher requirements that networked working puts on individual BSB (Teigland, 2003), that is, how to realize the internal integration and transaction of massive information in the shortest time to promote innovation. Especially in the event of an emergency or task, quickly trading and the integration of loose information from crossovers within the team is especially important to solve work problems. Fortunately, our research illustrates how employee's BSB can achieve tangible innovation through creative ideas interactions and transactions within the team. And for organizations, they should also design or redesign work systems based on the relevance of labor division to promote the forming of task interdependence relationships within teams. For example, maintaining the interoperability of team task results or providing a reward mechanism for collective task completion. Together with initiatives aimed at enhancing individuals' implementation instrumentality, such efforts are more likely to improve the odds that even creative ideas are eventually realized.

Limitations and future research

Several limitations of this study provide considerations for further research. First, although we pointed out the key moderating role of TTI between ideas generation and innovation, the team task relationship was confirmed to include other types (Crown and Rosse, 1995), such as the epistemic interdependence (Puranam *et al.*, 2012). Consequently, future research should not only examine the relations posited in the present study but also further divide the influence factors at the team level and explore potential reciprocal relations. Second, substantial research including the current examination assumes a behavior- or subjects-oriented perspective (Teigland, 2003) on boundary spanning in the organization and has obtained considerable empirical and theoretical findings. However, this perspective is limited regarding the further specific impact mechanism of cross-boundary tools. In particular, the increasing popularity of social media is changing the formal and informal communication ways of individuals or even organizations, which will inevitably affect the efficiency of cross-border knowledge acquisition (Stone *et al.*, 2015). Therefore, the introduction of relations and social tools may prove to be a fruitful avenue for future research on innovation pathways.

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Appendix

Variables	Items	Standardized loading	*T*-values	Cronbach's α	CR (>0.7)	AVE (>0.5)
Boundary-spanning behaviour	BSB1	0.833	15.452	0.826	0.829	0.618
	BSB2	0.797	14.635			
	BSB3	0.724	13.012			
Ideas generation	IG1	0.811	14.504	0.778	0.782	0.545
	IG2	0.716	12.504			
	IG3	0.682	11.793			
Innovation performance	IP1	0.740	13.192	0.774	0.773	0.533
	IP2	0.668	11.608			
	IP3	0.777	14.040			
Team task interdependence	TTI1	0.823	15.956	0.858	0.859	0.670
	TTI2	0.793	15.157			
	TTI3	0.839	16.400			

Table A1. The convergence validity test of each variable

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