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A meta-analysis on social exchange relationships and employee innovation in teams

Haoyu Wu [1]✉ & Hongjiang Lv[1]✉

Despite extensive research on the relationship between social exchange and employee innovation in teams, a comprehensive and quantitative synthesis of research findings is necessary to enhance and expand our understanding. A meta-analysis allows for the comparison of different social exchange relationships and their effects on employee innovation, as well as an investigation into the underlying mechanisms of innovation realization. The results showed that compared to Leader-Member Exchange (LMX), Team-Member Exchange (TMX) demonstrated the stronger relationship with employee innovation. Moreover, cognition and motivation mediated the relationship between TMX and innovation, while affect, cognition and motivation mediated the relationship between LMX and innovation. This paper synthesized a body of critical and thriving literature, thereby endeavoring to furnish evidence that can provide information for theoretical advancements, research methodologies, and updated policy recommendations concerning social exchange relationships for individual innovation.

Introduction

Nowadays, social exchange relationships have gradually become a key determinant influencing employee innovation, as team collaboration emerges as a mainstream pattern in the workplace. Social exchange is characterized by long-term and reciprocal obligations (Blau 1964; Liao et al. 2010). Social exchange relationships in work teams for each employee are those with supervisors (i.e. Leader-Member Exchange) and team members (i.e. Team-Member Exchange) (Shore et al. 2006; Liao et al. 2010). It is hypothesized that social exchange relationships assume a pivotal role as precursors of innovation (Carnevale et al. 2017; Lee et al. 2022), as they provide vital information, resources, and emotional sustenance requisite for innovative undertakings (Graen and Uhl-Bien 1995; Seers 1989; Banks et al. 2014). However, it remains unclear whether these two types of social exchange relationships within a team exert comparable influences on employee innovation. More specifically, it is unclear whether the limited time of employees is best utilized in developing leader-member exchange relationships or horizontal relationships among team members (Banks et al. 2014). Therefore, this study endeavors to address this question by reviewing existing literature and employing meta-analysis to clarify some confusion and mitigate sample biases.

To date, meta-analytic investigations into social exchange relationships are predominantly centered on the comprehensive examination of LMX. This scrutiny encompasses the precursors

[1] School of Economics and Management, Southeast University, No.2 Southeast University Road, Nanjing 211189 Jiangning District, China.
✉email: haoyu12344@163.com; Lvhongjiang@seu.edu.cn

and repercussions of LMX (Graen and Uhl-Bien 1995), the correlation between LMX and innovative and creative outcomes (Dulebohn et al. 2012; Carnevale et al. 2017), as well as the contextual factors influencing the efficacy of LMX (Rockstuhl et al. 2012). On one hand, antecedent research has failed to address inquiries into social exchange relationships among colleagues within organizational contexts. Interactions with team members in social exchange relationships assume a pivotal role in the workplace, in addition to interactions with leaders (Liao et al. 2010). Nevertheless, the existing body of research lacks substantiation concerning the nexus between TMX and employee innovation. On the other hand, further investigations are warranted into the mechanisms governing social exchange relationships and their impact on employee innovation. Previous inquiries into the mechanisms of employee innovation have predominantly concentrated on the motivational aspect, inadvertently overlooking other facets such as cognitive and affective factors (Hughes et al. 2018). The dearth of clarity on these issues raises three central inquiries that presently undermine the utility of research in this field: Do different social exchange relationships promote employee innovation? What is the relative significance of distinct social exchange relationships in the context of employee innovation? What are the mechanisms influencing the relationship between a specific social exchange relationship and employee innovation?

Hence, we conducted a meta-analytic study to explore the relationship between various social exchange relationships and employee innovation. That is, through a comprehensive analysis of 231 empirical articles, we bolstered the sample size and statistical power, thereby enhancing the precision and reliability of the results. Meta-analysis allows for the identification of patterns and trends that may not be evident in individual studies, indicating the consistency across different research findings and strengthening the generalizability of study results (Cao and Yu 2023). Furthermore, employing relative weight analysis enabled us to discern the relative importance of different social exchange relationships on employee innovation. Utilizing a meta-analysis structural equation modeling approach, we were able to elucidate the mediating mechanisms between social exchange relationships and employee innovation as observed in prior research. In summary, meta-analysis contributes additional empirical support to the study of social exchange relationships and employee innovation.

Our meta-analytic study makes three main contributions. First, deviating from prior research primarily centered on LMX and employee innovation (Dulebohn et al. 2012; Carnevale et al. 2017), we augmented the meta-analysis by incorporating TMX and examining its correlation with employee innovation. This augmentation furnishes empirical substantiation for the nexus between social exchange relationships and employee innovation. Second, we scrutinized and compared the varying impacts of distinct social exchange relationships on employee innovation, using a relative weight analysis between social exchanges with managers and those with colleagues. Last, we formulated the path mechanism delineating the relationship between social exchange relationships and employee innovation by meta-analysis structural equation modeling, responding to the imperative to investigate the mediating mechanisms that shape employee innovation.

Theory: a framework for understanding social exchange relationships and innovation

Theoretical framework. Social exchange relationships, characterized by long-term and unspecified mutual obligations (Blau 1964), involve the reciprocal exchange of socio-emotional benefits among employees and their respective associates (Shore et al. 2006). In the workplace, the dynamic relationships between employees and their supervisors, known as LMX, and between team members, known as TMX, are two primary forms of social exchange relationships (Liao et al. 2010). LMX is defined as a reciprocal exchange between an employee and their supervisor, based on trust, respect, and obligations (Graen and Uhl-Bien 1995). TMX, on the other hand, refers to the social exchange among team members involving the mutual contribution of ideas, feedback, and assistance (Seers 1989). TMX underscores the horizontal interactions among team members, while LMX focuses on the vertical connection between a leader and each subordinate (Banks et al. 2014). Despite their differing definitions, both LMX and TMX share commonalities as they are deeply rooted in social exchange theory and contribute to favorable organizational outcomes.

Social exchange theory is a representative theory for explaining social exchange relationships. It posits that individuals involved in high-quality social exchange relationships, grounded in the principle of reciprocity, may feel obligated to reciprocate the trust and affection they receive from others. They may work harder, engage in creative activities, and exhibit high levels of creativity in exchange for the support, trust, and other resources provided by leaders or colleagues (Lee et al. 2022). In high-quality social exchange relationships, individuals are more likely to acquire innovative knowledge and skills (Saeed et al. 2019; Zhang et al. 2021), enjoy greater autonomy and decision-making freedom (Graen and Uhl-Bien 1995), possess higher intrinsic motivation (Liao et al. 2010; Rafique et al. 2022), and develop stronger emotional attachments (Montani et al. 2017) — all of which are positively associated with innovation. Three previous reviews on workplace innovation have emphasized the role of motivational, cognitive, and affective mechanisms (Shin 2015; Zhou and Shalley 2011; Hughes et al. 2018). Similarly, we aim to explore the mediating mechanisms that influence the relationship between social exchange relationships and employee innovation through the lenses of cognition, motivation, and affect.

Social exchange relationships and innovation. Given the nature of complexity and dynamism (Mumford and Mcintosh 2017), innovation is often difficult to define and measure. Previous studies have discussed conceptual confusion and the scope of application, which can be broadly divided into two perspectives: outcome-oriented innovation and process-oriented innovation. Outcome-oriented research views innovation as the realization of new ideas (Anderson et al. 2004), while process-oriented research considers innovation as a process (Perry-Smith and Mannucci 2017; Hughes et al. 2018). Some scholars contend that innovation is not exclusively triggered by specific situations. Rather, the generation and implementation of ideas leading to improved organizational outcomes are considered the result of innovation, rather than its defining characteristic. Accordingly, the definition of innovation proposed by Hughes et al. (2018) has gained widespread attention: "Workplace innovation is defined as the processes applied when attempting to implement new ideas" (p. 3). Specifically, innovation includes a combination of problem/opportunity identification, the introduction, adoption, or modification of new ideas related to organizational needs, the promotion of these ideas, and the actual implementation of these ideas (Hughes et al. 2018).

Social exchange relationships play a central role in providing essential sources of inspiration, information, and resources that contribute to the implementation of the innovation process, including the conception, advancement, and realization of innovative ideas (Granovetter 1973; Wang et al. 2015). First,

according to the social exchange theory framework, individuals engaged in high-quality social exchange relationships are motivated to reciprocate their exchange partners, such as leaders and team members (Banks et al. 2014). When employees receive higher levels of social and emotional support from their leaders and team members, they are incentivized to exert greater effort at work as a form of reciprocity, which may include engaging in innovative endeavors (Lee et al. 2022; Graen and Uhl-Bien 1995). Consequently, if innovation is perceived as a valuable outcome for the organization, employees may engage in creative behaviors as a way to reciprocate to their leaders and team members (Lee et al. 2022). Second, social exchange relationships provide additional social support. Employees who report high levels of LMX and TMX may believe that their leaders and team colleagues will offer them the emotional and informational support needed for innovation. This implies that they trust their leaders and colleagues to support them, even if new methods and ideas fail (Lee et al. 2022; Graen and Uhl-Bien 1995). These employees also have greater opportunities to access the resources necessary for engaging in creative processes, such as information exchange, autonomy, and task-related resources and assistance (Khazanchi and Masterson 2011).

H1a. LMX is positively related to innovation.

H1b. TMX is positively related to innovation.

TMX may hold greater promise for fostering innovation compared to LMX. TMX, characterized by collaborative relationships and shared responsibilities among team members (Ancona and Caldwell 1992), establishes a foundation conducive to innovation. High-quality TMX facilitates information exchange and knowledge sharing (Bock et al. 2005), streamlining the flow, improvement, and implementation of new ideas. Inherent trust and cohesion in TMX create an environment supportive of risk-taking and experimentation—crucial elements of innovation efforts (De Dreu and Weingart 2003). Amabile (1997) underscores TMX's role in stimulating intrinsic motivation for innovation by fostering a sense of belonging and individual value. Moreover, TMX's emphasis on flexibility and adaptability aligns with the inherent uncertainties in the innovation process (West and Anderson 1996). In summary, TMX, prioritizing collaboration, information exchange, trust, flexibility and adaptability, emerges as a key contributor to fostering employee innovation, surpassing the potential of LMX in the innovation landscape.

H1c. Compared to LMX, TMX is related to innovation more effectively.

Mediators of the relationship between social exchange relationships and innovation. In the process of social interaction, social exchange relationships influence distal innovation outcomes through closer mediating variables. The innovation process requires employees to exhibit relevant cognitive skills and engage in extensive and effortful cognitive processes. The application and capacity of the memory system, and the flexibility of stored cognitive structures in these processes determine differences in innovation (Hughes et al. 2018). High-quality LMX relationships are typically characterized by greater leader support, making it easier for employees to access useful information, resources, and feedback (Graen and Uhl-Bien 1995). Such support not only stimulates employees to apply creative cognitive processes in their daily work, such as problem-solving, critical thinking, and generating new ideas, but also expands their working memory capacity as they acquire more information and knowledge. Furthermore, high-quality LMX relationships encourage employees to break free from traditional mental models and flexibly adjust their cognitive structures by fostering trust and open communication channels. Subordinates in high-quality LMX associations exhibit a greater inclination to engage in creative cognitive processes (Shin 2015), acquire and apply domain-specific knowledge (Saeed et al. 2019; Zhang et al. 2021), and attain recognition from the organization (Nazir et al. 2018; Zhang et al. 2022). These cognitive processes help them generate new insights and innovative approaches in the workplace.

Cognitive mechanisms play a crucial role in the relationship between TMX and employee innovation as well. TMX is conventionally acknowledged for its role in fostering reciprocal affiliations among team members, involving the exchange of ideas, feedback, and assistance (Seers 1989). This interaction fosters the ability of team members to employ more complex cognitive processes when addressing problems, such as collectively discussing solutions, reinforcing the application of critical thinking and creative thinking. TMX can expand an individual's available cognitive resources and memory system capacity, as individuals can utilize the knowledge of others as external memory resources through team communication (Shih and Wijaya 2017). This knowledge sharing reduces individuals' cognitive load in innovation tasks, allowing them to concentrate more on complex innovative activities. Innovation often requires individuals to flexibly reorganize and apply existing knowledge when encountering new problems or situations (Rahimnia et al. 2022; Lee et al. 2023). Through continuous knowledge exchange, TMX promotes the flexibility of cognitive structures, making it easier for team members to break mental set patterns and flexibly reorganize and utilize their knowledge structures to tackle new challenges. Consequently, interaction among team members enables them to examine problems from different perspectives, thus allowing for greater flexibility in the innovation process.

H2a. Cognition plays a mediating role in LMX and innovation. That is, LMX promotes cognition and then promotes innovation.

H2b. Cognition plays a mediating role in TMX and innovation. That is, TMX promotes cognition and then promotes innovation.

In the context of workplace innovation, motivation is firmly established as a critical catalyst (Scott and Bruce 1994; Hughes et al. 2018). Because innovation often extends beyond conventional job roles, requiring employees to challenge established norms, the significance of intrinsic motivation becomes particularly pronounced (Hughes et al. 2018). According to social exchange theory, when employees perceive trust and support from their leaders, they experience positive psychological feedback and a sense of belonging, which fosters intrinsic motivation for innovation. Intrinsic motivation stems from an individual's internal interest, involvement, contentment, or the positive challenge inherent in task engagement (Ryan and Deci 2000). Thus, psychological empowerment, proactivity, creative self-efficacy, and a willingness to take risks serve as the inherent motivational mechanisms within LMX that influence innovation (Graen and Uhl-Bien 1995; Liao et al. 2010; Rafique et al. 2022). Overall, the generation and reinforcement of motivation are key components of the social exchange process, enabling employees to translate the trust, support, and resources within the LMX relationship into active participation in the innovation process.

High-quality TMX typically encompasses team support, trust, information sharing, and emotional connection (Seers 1989). Both work-related informational support and emotional support from team members are likely to amplify the perceived meaningfulness of their work (Conger and Kanungo 1988), enhancing their ability to make informed and effective decisions in innovative environments (Ghosh et al. 2019). In high-quality TMX relationships, information sharing and feedback among team members can strengthen individuals' self-efficacy and intrinsic motivation (Liden et al. 2000), making them more inclined to engage in innovation. This is

because they feel equipped with sufficient knowledge and competence, and believe that such innovative behavior will be recognized and rewarded by the team (Schermuly and Meyer 2016). When individuals perceive emotional support and trust from their team members, they are more likely to experience a sense of positive work meaning. This motivational mechanism encourages individuals to engage more actively in innovative activities, either as a means of reciprocating the social support or due to a felt sense of obligation to meet the team's expectations. These motivational mechanisms provide employees with the flexibility and confidence required to experiment with innovative ideas, explore fresh opportunities, and implement inventive approaches to task execution (Ohly et al. 2006).

H3a: Motivation plays a mediating role in LMX and innovation. That is, LMX promotes motivation and then promotes innovation.

H3b. Motivation plays a mediating role in TMX and innovation. That is, TMX promotes motivation and then promotes innovation.

The literature has long established affect as a well-recognized precursor to innovation (e.g., Amabile et al. 2005). However, a relatively limited number of studies have delved into the mediating role of positive affect in the relationship between LMX and employee innovation. In contexts characterized by high-quality LMX, employees hold a robust belief in the genuine care and concern of their supervisors for their well-being (Sparrowe and Liden 1997). This perspective leads supervisors to provide necessary support in a timely manner when needed, which in turn helps alleviate employees' work-related stress (Harvey et al. 2003) and fosters a deeper emotional connection with the organization (Montani et al. 2017). Positive affective states trigger flexible cognitive processes that facilitate the generation of novel ideas and the production of creative outcomes (Madrid et al. 2014; Montani et al. 2017). Similarly, employees exposed to enjoyable and challenging job conditions provided by the organization tend to develop a strong sense of commitment to the well-being of the organization, as exemplified by their organizational commitment (Coyle-Shapiro and Conway 2005). Consequently, this enhanced commitment bolsters employees' willingness to engage in behaviors that contribute to the organization, including innovation (Montani et al. 2017).

In the context of high-quality TMX, team members are more likely to develop emotional bonds within relationships (Banks et al. 2014), making them more willing to express themselves, share ideas, and propose innovative solutions within the team. Individuals with high-quality TMX relationships may perceive that they are treated with respect and dignity by peers, fostering a strong sense of affective organizational commitment (Chen and Liu 2022). These perceptions of affective organizational commitment, which make members more goal-oriented and proactive, directly impact their engagement in innovative behaviors (Yang et al. 2020). Current innovation research primarily focuses on the role of positive emotions; however, some scholars suggest that even ambivalent emotions may foster creativity. That is, the unique experience associated with emotional ambivalence signals to individuals that they are in an unusual environment, thus encouraging them to draw upon their creative thinking abilities (Hughes et al. 2018).

H4a. Affect plays a mediating role in LMX and innovation. That is, LMX promotes affect and then promotes innovation.

H4b. Affect plays a mediating role in TMX and innovation. That is, TMX promotes affect and then promotes innovation

Methods

Methodology. Meta-analysis is a quantitative review that re-examines numerous existing empirical results. Due to limitations in sample size and research design, every single empirical study often struggles to verify the true relationship between two variables (e.g. the findings regarding the same variables can be inconsistent in terms of significance, direction and magnitude) (Cao and Yu 2023). By statistically synthesizing these results, this quantitative approach compensates for the limitations of individual studies, providing a more comprehensive and objective perspective (Lee et al. 2019; Dulebohn et al. 2012; Carnevale et al. 2017). This study employs CMA 3.3.07 and R 4.3.2 for technical analysis.

Literature search. To identify pertinent studies for our meta-analysis, an extensive literature search was conducted spanning from January 1990 to May 2023, using Web of Science, EBSCO, Google Scholar and China National Knowledge Internet (CNKI). The key words used were Leader-Member Exchange, LMX, Team-Member Exchange, TMX, Co-worker Exchange, CWX, creativity, creative performance, innovative behavior, innovation, etc. Additionally, various supplementary methods were employed to identify unpublished studies that were relevant to our investigation. As a result of our comprehensive search process, a total of 238 articles were identified as potentially suitable for inclusion in our study. To ensure the quality and relevance of the selected articles, several exclusion criteria were established. First, non-empirical articles were excluded. Second, articles lacking essential information were also excluded. Detailed information regarding the inclusion and exclusion of studies can be found in Fig. 1, which presents a flowchart. In total, our meta-analysis encompassed 231 articles, resulting in a substantial sample size of $N = 78{,}370$ (LMX-innovation), and $N = 11{,}834$ (TMX-innovation).

Coding procedures. The coding procedures of this study were mainly based on the coding guidelines recommended by Lipsey and Wilson (2001). First, to reduce the probability of coding errors, the coder compiled a coding table and coding manual according to the research purpose and research content. Data coding consisted of two parts: research feature description and effect statistics. The former referred to the content related to sample selection and research design. The coding entries involved research information, such as researcher and publication year, literature source, sample size, research design type, variable measurement method, theoretical model, and variable relationship. The latter referred to statistical data obtained by centering on the correlation coefficient between two variables, such as Cronbach's ə, correlation coefficient, p value, t-value, standard error, and the F value of the reliability of the independent variable and the dependent variable. In the process of data coding, the coding of the effect value should be based on an independent study. For the cases where the overall effect value was not explicitly reported in some studies, this article deals with the following: (1) when discussing the relationship between LMX and employee creativity, the coefficient comes from the correlation between LMX of different dimensions in the same sample population and individual innovation, and the simple arithmetic mean was used as the final effect value. (2) For different research sample populations in the same literature, the correlation coefficients obtained can be used as independent effect values and coded separately. To ascertain coding accuracy, a doctoral candidate, proficient in professional meta-analysis, conducted dual independent codings, meticulously documenting effect magnitudes and pertinent focal associations at a three-month temporal interval. Scrutiny revealed a concordance rate surpassing 95% between the two coding instances.

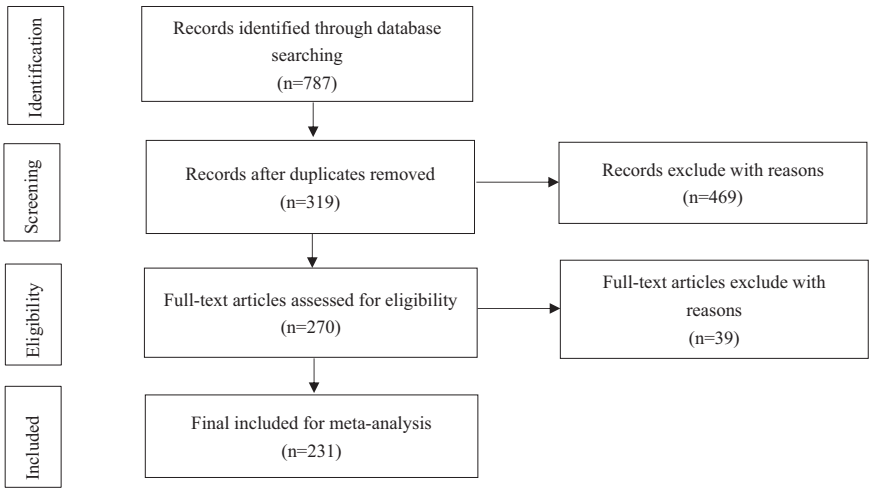

Fig. 1 A flowchart of the literature inclusion procedure. The figure reveals the inclusion-exclusion criteria for studies included in the meta-analysis.

Test for publication bias. Publication bias is a common issue in research, as journals tend to favor publishing positive results while disregarding negative ones. To assess potential publication bias and ensure the reliability of our findings, we used R to perform the funnel plot (Borenstein et al. 2009) and performed classic fail-safe N by CMA (Rosenthal 1979). A funnel plot visually represents the relationship between effect size and its corresponding standard error (SE), helping to identify publication bias. A symmetrical funnel plot suggests the absence of significant publication bias. The classic fail-safe N method is used to estimate the number of missing studies needed to render a meta-analysis non-significant due to publication bias (Rosenthal 1979). If the number of missing studies exceeds the tolerance level of $5k + 10$ (k is the number of studies), the publication bias is considered non-significant.

Meta-analytic procedures. The basic meta-analysis was conducted using the CMA software version 3.3.070, which estimates the overall effect size and its 95% confidence interval based on the correlation coefficient (r) and sample size (n). When using the correlation coefficient as the effect size, a sample size of at least several hundred is typically required to accurately estimate the effect size under the large sample theory. However, by applying the Fisher's z transformation to the correlation coefficients, it is possible to obtain a relatively accurate effect size estimate even with a smaller sample size (e.g., 20). Therefore, in our analysis, we utilized the CMA to process and analyze the effect sizes. Specifically, we transformed each correlation coefficient into its corresponding Fisher's z, computed the weighted average of these Fisher's z values, and then converted this average back into a correlation coefficient to obtain the overall effect size and its 95% confidence interval.

Next, we employed relative weights analysis to compare the effect sizes of LMX and TMX on employee innovation. Relative weights analysis is a method used to quantify the relative contributions or significance of multiple predictor variables in regression analysis, especially when these variables are correlated (Johnson 2000). The principle involves partitioning the total variance explained by the regression model (R^2) into weights that accurately reflect the proportionate impact of each predictor variable. These weights represent the percentage of variance in the outcome variable (innovation) that can be attributed to each individual social exchange relationship (LMX and TMX). Specifically, the relative weights analysis process begins by constructing a correlation matrix among all relevant research variables, followed by the calculation of weights for the influence of LMX and TMX on innovation, according to the guidelines proposed by Tonidandel and Lebreton (2015).

Finally, we examine the mediating role of social exchange relationships and employee innovation through meta-analytic structural equation modeling. The combination of meta-analysis and Structural Equation Modeling (SEM) is known as meta-analytic structural equation modeling. By employing this method, researchers can synthesize information from multiple studies to analyze a single model involving relationships among several variables. Specifically, in Two-Stage Structural Equation Modeling (TSSEM), the effect sizes (i.e., correlations between variables) from each study are first pooled, and in the second step, Weighted Least Squares (WLS) are used to estimate the fit of the structural equation model (c.f. Cheung 2015). We performed the calculations using the "metaSEM" package in R.

Results

Main results. To examine publication bias, R was used to generate funnel plots. The results for LMX and employee innovation revealed an asymmetrical funnel plot (Fig. 2), indicating the presence of publication bias in smaller studies. Consequently, the classic fail-safe N method by CMA was employed to calculate the potential impact of publication bias. According to this method, 7775 additional results would be required to render the overall effect size statistically insignificant. This suggests that the findings are fairly robust against potential publication bias. The calculated number exceeds the tolerance level of 1070 [5*(212) + 10], indicating that publication bias is negligible and meta-analysis is feasible.

Similarly, to assess publication bias in TMX and employee innovation, the same software was used to create a funnel plot (Fig. 3), which showed some asymmetry, indicating publication bias in smaller studies. Using the classic fail-safe N method, an additional 1,815 results would be needed to make the overall effect size statistically insignificant. This demonstrates that the findings are robust against potential publication bias, and the value far exceeds the tolerance threshold of 185 [5*(35) + 10], suggesting that publication bias is negligible and meta-analysis can proceed.

Forest plots were generated to test Hypotheses 1a and 1b. The heterogeneity results presented in Table 1 suggest that random-effects models are appropriate for the meta-analysis. Using the meta-analysis of TMX and innovation as an example, Fig. 4 presents the forest plot results of the random effects model by R.

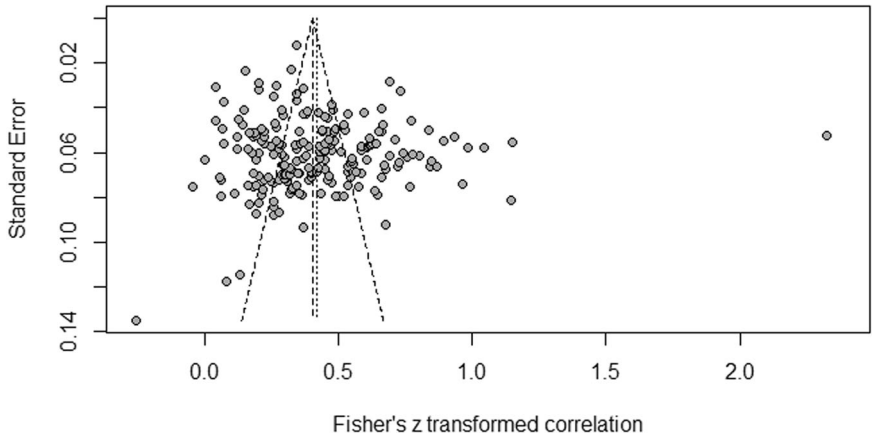

Fig. 2 A funnel plot of LMX and employee innovation. The diagram illustrates the standard error based on effect sizes to evaluate potential publication bias.

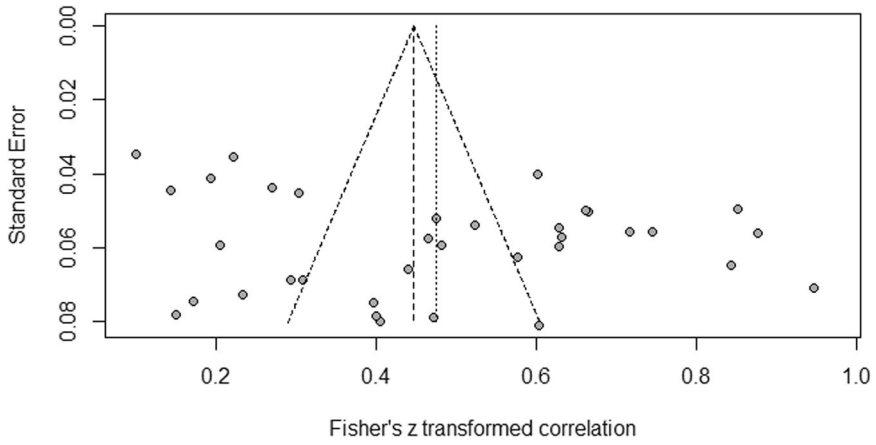

Fig. 3 A funnel plot of TMX and employee innovation. The diagram illustrates the standard error based on effect sizes to evaluate potential publication bias.

Table 1 Meta-analysis results of social exchange relationships and employee innovation.

	ρ	k	N	95%CI	Z	P	Heterogeneity		
							Q	T^2	I^2
LMX-innovation	0.394	212	78370	(0.365, 0.422)	24.007	0.000	4798.901	0.060	95.603%
TMX-innovation	0.442	35	11834	(0.375, 0.505)	11.470	0.000	672.126	0.051	94.941%

Table 2 RWA results of social exchange relationships and employee innovation.

	Raw relative weights	Rescaled relative weights
LMX-innovation	0.110	45.740
TMX-innovation	0.131	54.260

Each individual study is represented by a square in the central column, with the horizontal lines indicating the 95% confidence intervals. Meta-analytic coefficients between the social exchange relationships and individual innovation were displayed in Table 1. LMX was significantly and positively related to innovation ($\rho = 0.394$, 95% CI = [0.364, 0.422], $p < 0.001$), and TMX was significantly and positively related to innovation ($\rho = 0.442$, 95% CI = [0.375, 0.505], $p < 0.001$). Thus, Hypotheses 1a and 1b were supported.

Relative weights analysis. Table 2 presents the results of the relative weight analysis, comparing the relative contributions of LMX and TMX to the total explained variance in the model (Lee et al. 2019). In terms of employee innovation, TMX (54.260%) explained relatively more of the total variance predicted by the model than LMX (45.740%). This suggests that compared to LMX, TMX had the stronger relative effects for employee innovation. Hypotheses 1c was supported.

Mediation results. We employed a meta-analytic structural equation model to assess the mediating roles of cognition, motivation, and affect in the relationships between social exchange relationships and employee innovation. As delineated in Table 3, our observations reveal that the indirect impact of LMX on employee innovation through cognition (i.e., LMX→co→in) is both positive and statistically significant [$\rho = 0.147$, 95% CI = (0.118, 0.181)], providing support for H2a. Similarly, the indirect effect of LMX on employee innovation

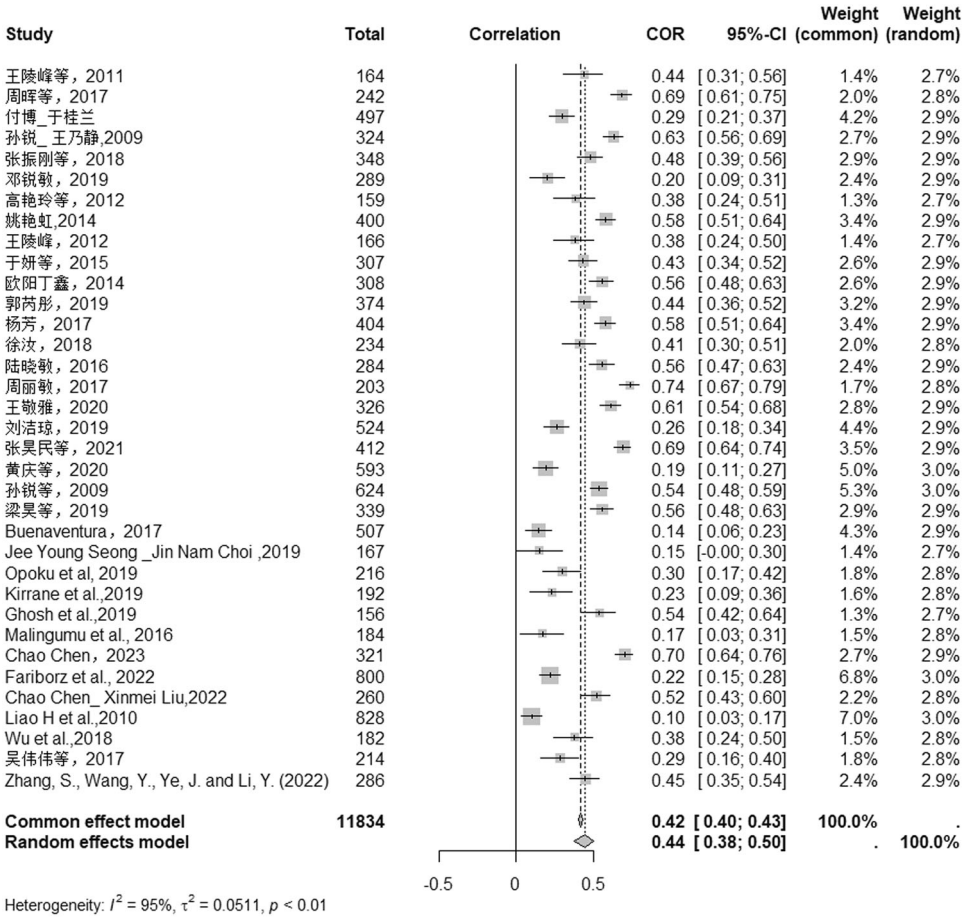

Fig. 4 A forest plot of TMX and employee innovation. The squares represent effect sizes from separate studies, while the diamond signifies the overall effect. Lines extending from both indicate their respective confidence intervals.

Table 3 MASEM results of social exchange relationships and employee innovation.

	k	N	ρ	95%CI
LMX-co-innovation	36	20751	0.147	(0.118, 0.181)
LMX-mo-innovation	37	12913	0.138	(0.112, 0.170)
LMX-aff-innovation	6	1354	0.124	(0.070, 0.207)
TMX-co-innovation	4	1536	0.097	(0.044, 0.178)
TMX-mo-innovation	10	3625	0.137	(0.062, 0.228)
TMX-aff-innovation	1	-	-	-

through motivation (i.e., LMX→mo→in) is positive and significant [ρ = 0.138, 95% CI = (0.112, 0.170)], substantiating H3a. Moreover, the indirect effect of LMX on employee innovation via affect (i.e., LMX→aff→in) is also positive and significant [ρ = 0.124, 95% CI = (0.070, 0.207)], thereby supporting H4a. Subsequently, our analysis unveils that the indirect effect of TMX on employee innovation through cognition (i.e., TMX→co→in) is positive and statistically significant [ρ = 0.097, 95% CI = (0.044, 0.178)], lending support to H2b. Similarly, the indirect effect of TMX on employee innovation through motivation (i.e., TMX→mo→in) is positive and significant [ρ = 0.137, 95% CI = (0.062, 0.228)], providing empirical backing for H3b. However, due to sample limitations (k < 3), we were unable to conduct a meta-analysis to analyze the mediating effect of the affect mechanism between TMX and innovation.

In summary, our findings indicate that LMX and employee innovation are interconnected through (a) cognition, (b) motivation, and (c) affect. On the other hand, TMX and employee innovation are linked through (a) cognition and (b) motivation but do not exhibit a significant association through (c) affect.

Discussion

Our meta-analytical examination empirically assesses the impact of social exchange relationships on employee innovation within the framework of social exchange theory. Our empirical scrutiny aligns with the proposed theoretical model delineated in Fig. 5, derived from a comprehensive review of pertinent studies. Conclusively, our findings affirm that both LMX and TMX exhibit positive associations with employee innovation. Notably, TMX demonstrated the stronger relationship with employee innovation compared to LMX. Furthermore, we elucidate the mediating influences of cognition and motivation in the association between TMX and innovation, and the roles of affect, cognition, and motivation in the relationship between LMX and innovation are also synthesized.

Theoretical implications. First, by systematically reviewing empirical literature on social exchange relationships and employee innovation based on social exchange theory, our meta-analysis responds to a recent call for a quantitative examination of social exchange relationships (Lee et al. 2022), and delineates the facilitating roles of both horizontal TMX and vertical LMX in fostering employee innovation. Diverging from previous meta-analytic studies that exclusively focused on LMX in relation to employee innovation (Dulebohn et al. 2012; Carnevale et al. 2017), our investigation encompasses individuals' social exchange

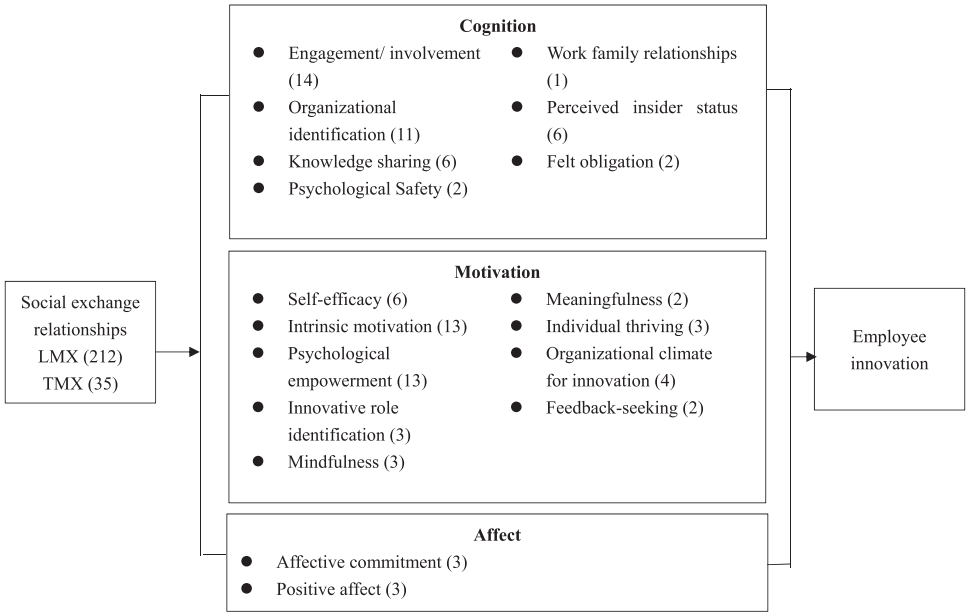

Fig. 5 Summary of mediating variables according to the previous literature.

partners in the workplace, including managers and other team members. Employing social exchange theory, we further explore the positive effects of both TMX and LMX on employee innovation. Consequently, our work extends social exchange theory in work teams (Shore et al. 2006).

Second, we conducted a Relative Weight Analysis to compare the promotive effects of social exchange relationships with different counterparts on employee innovation. The findings demonstrated that, in comparison to LMX, TMX is more effective in fostering employee innovation. While prior research extensively focused on the roles of LMX and TMX in employee innovation, scant attention has been paid to simultaneously examining the positive effects of distinct social exchange relationships. Moreover, the relative prominence of the effects of LMX and TMX on innovation has remained unclear (Lee et al. 2022). Theoretical frameworks and empirical investigations could gain value by concurrently considering multiple categories of social exchange relationships and their respective significance, rather than formulating theories solely around a singular "best" or "worst" category (Lyubykh et al. 2022). By employing appropriate meta-analytic techniques, we substantiated that, compared to LMX, TMX exerts a more pronounced influence in promoting employee innovation. This contribution provides novel insights and directions for research in the realm of social exchange relationships.

Third, our paper scrutinized three intermediary mechanisms pertaining to social exchange relationships and employee innovation, thereby addressing the call made by Hughes et al. (2018) to examine the ramifications of relatively unexplored mechanisms, such as affective and cognitive factors. Specifically, our comprehensive review guided the formulation of a theoretically grounded three-fold categorization of mediators: motivational, affective, and cognitive. Employing meta-analytic structural equation modeling, we substantiated that cognition, motivation, and affect wield pivotal influence in delineating the mechanisms linking LMX with employee innovation. Additionally, we found that cognition and motivation play substantial roles in elucidating the mechanisms connecting TMX with employee innovation. In contrast to previous research that overly accentuated the significance of motivational mechanisms in innovation (Hughes et al. 2018), our study further expounds on how both TMX (horizontal social interactions) and LMX (vertical social interactions) contribute to the facilitation of employee innovation, thereby enhancing the depth of investigation in the domain of social exchange relationships and innovation. This, in turn, encourages future researchers to direct their attention toward exploring the crucial roles of cognitional and affective mechanisms within the innovation domain.

Practical implications. In a complex and dynamic environment, employee innovation plays a crucial role in maintaining a company's competitive advantage (Liao et al. 2010). This study provides a stronger foundation for understanding how social exchange relationships can enhance employee innovation. First, organizations should encourage managers to establish high-quality LMX relationships with their subordinates, especially in high-tech industries and manufacturing sectors. Previous research has shown that a manager's leadership abilities and positive communication with subordinates can help build high-quality LMX relationships. Therefore, organizations can offer training in effective communication, emotional intelligence, and conflict management to improve managers' leadership skills. Additionally, managers can provide regular one-on-one feedback to subordinates, encourage managers to demonstrate honesty, fairness, and consistency, and show respect and recognition for subordinates' contributions to enhance their sense of belonging and identification. For instance, in high-tech companies where innovation is a core competitive advantage, and in manufacturing companies that focus on process optimization and product innovation, managers' leadership abilities and positive communication with subordinates facilitate the establishment of high-quality LMX relationships. This, in turn, provides employees with more resources and support, encouraging them to offer improvement suggestions and innovate product designs.

Second, organizations and managers should actively support the establishment of high-quality exchange relationships among employees. Given that different industries have distinct work environments and cultures, organizations should design interaction methods tailored to these industry characteristics. Managers can regularly organize team-building activities to enhance interaction and collaboration among employees. In informal

settings, such as through hackathons in the technology sector or simulation exercises in the healthcare sector, employees can forge stronger relationships, enhance team cohesion, and foster innovation. By understanding industry-specific features and designing appropriate team activities, organizations can more effectively promote employee interaction and collaboration. Furthermore, establishing an open communication culture is essential for encouraging employees to build positive interactions with colleagues and to share ideas and feedback. Setting common goals can strengthen teamwork and collective responsibility. Regular team meetings and feedback mechanisms are crucial for ensuring transparent information dissemination. In high-pressure industries, such as healthcare or emergency services, communication efficiency and transparency are particularly important. Developing clear communication protocols and emergency response procedures ensures timely and accurate information transfer during critical moments, thereby fostering trust and cooperation.

Finally, the study indicates that leveraging social relationships to foster employee innovation requires careful handling. Both cognition and motivation are key mechanisms through which social exchange relationships enhance employee innovation. Organizations and managers can adopt various strategies to strengthen employees' innovation cognition and activate their innovation motivation. For example, providing employees with innovation training and learning opportunities, organizing regular workshops or brainstorming sessions on innovation topics, and encouraging open discussions and the sharing of new ideas can be effective. Professional training can increase employees' knowledge and skills related to innovation, while material and psychological rewards can motivate employees to propose new ideas actively. Additionally, our findings suggest that LMX can enhance employee innovation through emotional mechanisms. Therefore, managers can boost employees' positive emotions and recognition of the organization by creating a positive, friendly, and inclusive work environment, providing timely positive feedback, and acknowledging their efforts and achievements.

Future research directions. Although we observed the relationship between social exchange relationships and employee innovation through the lens of process-oriented innovation, the definition and measurement of innovation have remained contentious topics in academic research (Batey 2012). Given the complexity and dynamic nature of innovation (Mumford and Mcintosh 2017), definitional ambiguities and their subsequent limitations have contributed to a lack of clarity in measuring workplace innovation. This issue is particularly evident in Chinese studies, where the prevalent practice of mixing innovation measurement scales can also be attributed to the constraints of translation. For instance, scales developed by Tierney et al. (1999) and Zhou and George (2001) have been used interchangeably to assess innovative performance, innovative behavior, creativity, and innovation, among other things. This mixing of scales highlights the challenges posed by translational differences. Consequently, we have adopted "the idea journey" (Perry-Smith and Mannucci, 2017) as our definition of innovation and have included empirical studies on social exchange relationships and process-oriented innovation in our review. Future research requires more precise and appropriate definitions and measurements of innovation, incorporating the necessary granularity to assess key stages of creativity and innovation, thereby providing a fully clear and representative metric. We believe this is an area that warrants further specialized investigation.

In our review of previous research, we found that the role of teams has not been sufficiently explored in studies on social exchange relationships. Given that teamwork is now the dominant work mode, studies on LMX and TMX should pay greater attention to team and organizational processes (Hughes et al. 2018). Notably, our findings suggest that TMX has a more positive impact on employee innovation compared to LMX. Thus, we recommend that future scholars focus more on the development of social exchange relationships within teams. For example, how does the LMX relationship evolve within a team context, and how do leaders manage both LMX and TMX relationships within teams?

Another key area for further investigation is the role of emotions in the study of social exchange relationships, which also aligns with the calls of Hughes et al. (2018). Our review, through theoretical elaboration and meta-analysis, verified the mediating mechanisms between social exchange relationships and employee innovation, including cognition, motivation, and emotion. While research has extensively explored cognitive and motivational mechanisms, the examination of emotional mechanisms remains limited. Future research could delve deeper into the role of various emotions in fostering innovation, such as the impact of negative emotions and ambivalent emotions. Additionally, scholars should make greater efforts to explore competitive mediation pathways both within categories (e.g., self-efficacy and intrinsic motivation within the motivation category) and across categories (e.g., between motivation and cognition) (Hughes et al. 2018).

Future research could further investigate the dynamic relationship between social exchange (LMX and TMX) and employee innovation by implementing feedback mechanisms to gain deeper insights. It is recommended that future studies establish regular feedback loops within organizations, employing surveys and interviews to gather feedback from employees and managers on the actual impact of LMX and TMX in the workplace. This feedback can help researchers better understand the practical influence of social exchange relationships on innovation, while also providing actionable insights for managers to make targeted improvements. Furthermore, the use of Information and Communication Technology (ICT) tools offers strong support for real-time data collection and analysis. Future studies could explore how online platforms and interactive tools can be utilized to gather employee feedback on innovative behaviors, thus expanding the breadth and depth of data collection. Drawing on the lessons from the education sector, where feedback mechanisms have improved learning outcomes, organizations can apply similar strategies to ensure that innovation initiatives are more responsive to real-world needs and enhance employees' innovative capacities.

Limitations. First, as with other meta-analyses, our findings are constrained by the availability and quality of data from the original studies (Lee et al. 2019). Many included studies rely on cross-sectional correlational designs, limiting our ability to draw causal inferences. This may result in biased estimates of relationships, especially when causal direction is ambiguous. Future research should prioritize strengthening theoretical frameworks and employing longitudinal or experimental designs to more rigorously test causal relationships. Additionally, the use of qualitative methods could further refine the conceptual foundation of these theories, or alternative contexts could be explored to assess the role of moderating mechanisms, enhancing both the generalizability of findings and the explanatory power of theoretical models.

Second, a considerable portion of the studies used in our meta-analysis relied on employee self-reports for constructs such as LMX, TMX, and innovation. Self-report data introduce the potential for common-method bias, which may inflate the

observed relationships (Dulebohn et al. 2012). Although we attempted to mitigate this by integrating data from multiple sources, the limited availability of studies utilizing objective innovation metrics (e.g., publication output) or supervisor evaluations constrains the robustness of our findings. This lack of diversity in data sources could potentially impact the reliability of the relationships we observed between LMX, TMX, and innovation, and future studies should incorporate more objective and externally validated measures of innovation.

Lastly, some of the hypotheses in our analysis, particularly those concerning mediating mechanisms like emotions in the TMX-innovation relationship, lacked sufficient empirical validation due to the limited number of primary studies available. This scarcity introduces uncertainty into our conclusions about these mechanisms, and thus, caution is advised in interpreting the mediating role of emotions. The small sample size and incomplete reporting of relevant variables further limit the ability of our meta-analysis to draw conclusive results on these mediating factors. Future research should aim to expand on this by collecting more comprehensive datasets that enable a deeper examination of emotional mechanisms.

Data availability

The datasets analysed during the current study are included within the article and its supplementary information files, and the supplementary information files are available in the Dataverse repository: https://doi.org/10.7910/DVN/VADJNX.

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Author contributions

HW contributed the central idea, analysed data, edited, revised, and confirmed the manuscript; HL contributed to refining the ideas and supervising the research process.

Competing interests

The authors declare no competing interests.

Additional information

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Correspondence and requests for materials should be addressed to Haoyu Wu or Hongjiang Lv.