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A Social Resources Perspective of Employee Innovative Behavior and Outcomes: A Moderated Mediation Model

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Abstract: Employee innovation is becoming increasingly important when organizations strive for sustainable competitive advantage. Different from previous research on employee innovation and relational/structural perspectives of social networks, the present study is the first attempt to empirically examine how social resources per se influence employee innovation. Drawing on social-resources theory, this study proposes that social resources for innovation boost employee innovation, which is strengthened by supervisor support. By conducting a field survey on 154 employees in a high-tech company and collecting the archival data of their innovative outputs, we found that employees who can access and mobilize more social resources demonstrate more innovative behavior and subsequently achieve better outputs, such as patents and invention disclosures. Supervisor support amplifies social resources' effects on employee innovative behavior and innovative outcomes. This study contributes to the literature on social networks and employee innovation by introducing a new theoretical perspective. Practically, it also adds new insights to boost innovation performance from a social-resources approach.

Keywords: social-resources theory; employee innovation; innovative behavior; organizational sustainability; supervisor support

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1. Introduction

Nowadays, significant attention has been directed to sustainable development, reflecting the harmonious development of society, economy, and ecosystem. Challenges to sustainable development are becoming increasingly complex and urging companies to be innovative in their business activities. In China's new development concept of "innovation, coordination, green, openness, sharing", innovation is the primary driving force for achieving sustainable development [1]. The relationship between sustainability and innovation has been widely studied in different fields, such as product design and development [2], the lifecycle of a product [3], cultural initiatives [4], and climate change [5]. Many studies have revealed that innovation can contribute significantly to sustainability by retaining the ecosystem and providing innovative solutions to environmental problems. For example, after reviewing the effects of energy use and technology innovation on environmental sustainability from 1991 to 2021 for the USA, Australia, Japan, and India, Imran et al. [6] found that technological innovation enhances environmental sustainability. Open innovation is endorsed by some studies as the right way to develop and deliver more sustainable and marketable products [7,8]. Innovative approaches to the performance of electric vehicles (EVs) reduce carbon emission and fuel consumption [9]. Internet of Things [3] sensors provide a cost-effective solution to check sustainability indicators, including carbon footprints, energy efficiency, and waste management [10]. Without a doubt, in the wake of the increased pace of change and complexity of global business competition, the role of

organizational innovation in building sustainable competitive advantages has become vital for companies' survival and sustainable growth [11].

With the increased pace of change and complexity of global business competition, employee innovation has become the engine for organizations to gain sustainable competitive advantages. Research in workplace innovation has generated a wealth of empirical evidence about the personal and contextual factors that may enhance or stifle employee innovation [12–14]. Fueled by the notion that innovation is a social process [15,16], it is widely believed that individuals who are better socially connected are more innovative [17–19], which leads to a burgeoning interest in identifying a wide array of features of social networks that boost or hinder employee innovation [20]. Existing work can be roughly divided into two categories: the relational perspective and the structural perspective [21]. Whereas the former emphasizes the impact of an individual's strong or weak ties on innovation [22,23], the latter focuses on the effect of structural features of social networks on innovative processes and outcomes [24]. Regardless of the perspective taken, researchers share the same underlying assumption that individuals can benefit from social networks characterized by advantageous relational and/or structural features, mainly because they have broad and early access to, strategic control over, and efficient use of social resources embedded within their social networks [17,19,25].

However, there are two major limitations in the extant research. First, few studies have gone beyond this assumption to empirically examine how social resources per se influence employee innovation. Without doing so, we will fail to reveal the mechanism of how social resources embedded in social networks are translated into innovative outputs. From the practical point of view, organizations, managers, and employees may still overlook the importance of social resources in the long journey of innovation starting from idea generation to idea implementation. Second, scant attention has been given to distinguishing employee innovative behavior—the complex behavior demonstrated by employees during the stages of idea generation, idea promotion, and idea realization [26]—from innovative outcomes [12]. It should be noted that although innovative behavior and innovative outcomes are closely related, they are by no means the same. Without distinguishing these two constructs, it remains unclear how employees manage to translate their social resources, via behavioral endeavors, into substantive innovative outputs.

The current research was conducted to address these two omissions. First, departing from the common relational and structural perspectives [19,25], our study introduces the social-resources model to examine how social resources embedded in social networks facilitate employee innovation. In doing so, we empirically explore the underlying mechanism through which social resources per se enhance employee innovation. Second, we use organization-specific records of objective innovative outcomes to measure employee innovative performance, thus helping solve a problem in the organizational innovation literature where the distinction between employees' innovative outputs and innovative behavior is blurred [12]. In doing so, our study contributes to better revealing how employees transform resources available for innovation into tangible innovative outputs (e.g., patents or invention disclosures) through innovative behavior.

The article is structured as follows. First, we briefly overview the literature on the social network–innovation link from relational and/or structural perspectives. Then, we refer to social-resources theory and examine how social resources embedded in social networks per se influence employee innovative behavior and subsequent innovative outcomes. The moderating role of supervisor support for innovation in this process is explored as well. After that, theoretical contributions and practical implications are discussed. We conclude with limitations of this study and suggest directions for future research.

2. Theory and Hypotheses

2.1. The Relational and Structural Perspectives of Social Networks on Innovation

Extant research on the social network–innovation link can be broadly categorized into relational and structural perspectives [21]. The relational perspective focuses on tie

features such as the strength, number, and type of ties. Accumulating empirical research has yielded mixed and often contradictory results about the impacts of relational features on employee innovation. Some studies indicate that strong ties enhance innovation [22,23], partly because such connections increase shared experiences and mutual trust and provide more tacit and holistic information [27–31]. Other scholars posit that the impact of weak ties on creativity is salient [32,33], because weak ties are more likely to provide access to diverse and nonredundant information and facilitate cognitive flexibility and divergent thinking due to less pressure to conform [19,33,34]. Inconsistent findings are also reported in studies addressing the effect of network size on creativity. Whereas some posit that network size has a positive influence on idea generation [35], idea implementation [20], and innovative outcomes [29], others have found that as the number of social connections increases, the accompanying returns to innovation diminish, resulting in an inverted-U-shaped relationship [29,36]. In addition, some others have shown a nonsignificant association between network size and innovation [37].

The structural perspective emphasizes the importance of individuals' ego-centric and global network structure (e.g., network density, centrality in the network, or structural hole) to innovation [21]. Similarly, the association between network density and innovation is equivocal. Some insist that dense ego networks facilitate knowledge creation owing to frequent information exchange [24], whereas others claim that such networks may inhibit innovation due to redundant and less diverse knowledge [18]. The association between network centrality and innovation can even manifest in a complex pattern in that it starts positively but ultimately spirals in a negative direction [19]. Individuals spanning structural holes often excel in innovative processes and outcomes because they can access and control the flow of resources that are otherwise unseen [18,38]. However, according to Fleming et al.'s study, inventors may encounter a dilemma in which they can benefit from structural holes to generate more inventions, but they are limited in disseminating and promoting their inventions.

A third research stream concentrates on the joint impact of relational and structural features on employee innovation. For example, McFadyen and Semadeni [39] found that scientists' knowledge creation is jointly affected by the average tie strength and ego network density of their collaboration networks, such that those who maintain mostly strong ties with their collaborators who themselves are sparsely interconnected obtain the highest levels of innovation. Likewise, the study by Baer [34] revealed the joint effect by showing that employees can be most innovative if they maintain networks characterized by optimal size, weak strength, and high diversity.

To summarize, the relational and structural perspectives commonly posit that individuals can achieve a competitive advantage by maintaining social networks with better relational features (e.g., optimal network size or tie strength) and/or structural features (e.g., structural holes, high network efficiency) because such unique network configurations offer them broad and early access or strategic control over the embedded network resources [25,33].

2.2. The Social-Resources Perspective of Employee Innovative Behavior

Departing from the aforementioned relational and structural perspectives, however, social-resources theory proposes that social networks are more than mere social relations or network structure [40,41]. Lin originally proposed the social-resources theory to better understand how individuals attain social status by obtaining and utilizing resources embedded in their social connections [40,42,43]. Its primary proposition—the social-resources proposition—highlights that it is the social resources that individuals access and mobilize from their social networks that exert effects on the outcome of an instrumental action [40]. According to this theory, what matters most is not the relationship quality or the structural position a person possesses within their networks. Instead, this theory presumes that the social resources that individuals need to access and utilize depend on the goals they are targeting [41]. Social resources may be tangible (e.g., material or financial resources,

power, information, knowledge, advice, expertise) or intangible (e.g., reputation, fame, trust, norms, social support, or sanctions) [41]. The extent to which one's social networks influence the achievement of desired goals depends on the social resources the individual has accessed from the networks and how those resources are mobilized in actions [40,41]. For example, despite better access to a variety of resources, it was recently found that individuals with large social networks do not always optimally utilize social resources in the innovative process. More often than not, those who can activate the right resources across innovation phases can accurately identify truly creative ideas and elaborate on them in the later stages.

To the best of our knowledge, social-resources theory has been mainly used to explain social and organizational phenomena such as status attainment, job searching, person–job fit, and health inequality [40,42–48]. Limited research has investigated how accessed and mobilized social resources drive employee innovation in the workplace. Innovation consists of several broad stages, including idea generation and elaboration, idea promotion, and idea implementation [17,49,50]. According to social-resources theory, embedded resources will enhance the outcomes of actions because individuals with rich resources can obtain three advantages: flow of information, exerting influence on significant others, and reinforcing identity and recognition [51]. We propose that these three advantages help employees better engage in innovative behavior, as they correspond to three stages of innovation—idea generation, promotion, and implementation [17].

First, social resources embedded in social networks accelerate the flow of information, which is essential for innovation-opportunity identification and idea generation. Extant research has consistently demonstrated that individuals with more external connections or occupying the brokerage across structural holes usually deliver higher innovative performance [20], mainly because they can have timely access to heterogeneous information and diverse perspectives [18,19,52]. As a result, they not only interpret things from a unique perspective and identify potential opportunities for innovation but also integrate and combine all the information and perspectives to generate more novel ideas [53]. Therefore, the information advantage derived from a wealth of social resources provides a setting that allows employees to think flexibly and creatively and, eventually, to identify innovation opportunities and generate novel ideas.

Second, when introducing and promoting novel ideas, employees with rich social resources are more likely to exert influence on key persons who serve as gatekeepers in the organizational decision-making process. In contrast to the stage of idea generation, idea promotion is primarily a social process in which social interactions and connections with key persons play an important part [54,55]. In addition, novel ideas inevitably come with uncertainties and risks and therefore inevitably present obstacles to promotion [56,57]. To navigate the social process, employees need to approach a wide range of contacts to gain wider rapport and support within the organization [58] and even "borrow" influence and legitimacy from their well-regarded contacts to affect gatekeepers in the way of promoting novel ideas [59,60]. Otherwise, novel ideas are often ignored or even rejected by organizational decision-makers, thus failing to move forward [61].

Third, employees with rich social resources are expected to reinforce identity and recognition [51], thus further securing more resources for idea implementation. For example, when examining the R&D project-selection process of a multinational engineering-consulting company, it was found that employees were more likely to succeed in applying for adequate funding for their highly novel R&D projects if they were co-located with at least one of the selection-panel members. Similarly, Reitzig and Sorenson [62] found that employees working in the same division and facility with evaluators could gain higher approval for their innovative proposals. Obviously, sharing the same location provides employees the opportunity to reinforce identity and recognition from decision-makers, thus exerting greater influence on resource-allocation results.

To summarize, due to these three advantages of social resources—information flow, influence on decision-makers, and identity and recognition reinforcement—employees

are better able to initiate innovative behavior characterized by the three phases of idea generation, promotion, and implementation. We suggest the following hypothesis:

Hypothesis 1. *Social resources are positively related to employee innovative behavior.*

2.3. Moderating Role of Supervisor Support for Innovation

In addition to its social-resources proposition, another well-confirmed proposition in social-resources theory is the strength of position proposition: that social resources, in turn, are impacted by ego's original position (as represented by parental resources in attained status) [41]. Whether an individual can acquire and utilize social resources from their social networks is also determined by how much support he/she receives from significant others. Many studies on status attainment have revealed that the father's status and support exert significant direct or indirect effects on ego's social resources and attained status. Likewise, in a working environment, how supervisor support amplifies the effect of social resources on employee innovative behavior deserves investigation.

It is well recognized that leaders yield significant influence on employee innovation [12,63,64]. Among leaders' multiple roles in managing innovation in the organizational context [65], the facilitating role that focuses on fostering subordinates' innovation is "more widespread across various industry and organizational contexts" [65] (p. 407). In fulfilling this facilitating role, leaders are expected to mainly make supportive contributions so that subordinates themselves can realize their potential to meet innovative goals [65]. In turn, facilitated by leaders, employees can better participate in innovative processes either by leveraging existing individual resources or developing new ones [63]. General individual resources include knowledge and thinking skills [15], motivations [15,66], creative self-efficacy [67,68], and creative identity [69,70], among others. Extant research has consistently demonstrated that with supervisor support, employees can better leverage personal resources to achieve innovation [66,71,72]. However, a missing insight in the literature is how leaders can help subordinates leverage the social resources only embedded in social networks [40,41] to participate in innovative activities given the importance of social resources in innovation.

Based on social-resources theory [40,41], we further propose that supervisor support for innovation will amplify the effect of social resources on employee innovative behavior in two ways. First, a supportive supervisor will encourage subordinates to search for new perspectives and rally support from inside and outside the working unit. It is well known that to be innovative, employees need to make efforts to establish and maintain relationships with key entities so that they can obtain novel information, perspectives, and other resources [18,19]. However, not all supervisors encourage subordinates to establish close ties with others because they tend to view subordinates' networking activities as an attempt to escape their supervision [73]. In contrast, those who are supportive of subordinates are more willing to encourage and grant them the discretion to share information and build collaborations with diverse parties [74]. Furthermore, supportive supervisors are even willing to expand subordinates' networking by referring their own social resources to them [75].

Second, supervisors who support innovation will also help subordinates mobilize externally acquired resources into the working unit and utilize them in their innovative exploration. Although those who have established abundant external connections can access diverse perspectives, they also face a salient challenge in persuading colleagues to endorse such diverse perspectives [24]. In this case, immediate supervisor support is necessary for employees with abundant outside connections to mobilize external resources into the working unit [76]. In addition, supportive supervisors are good at creating psychological safety [77,78], which is vital for employees to stay open to novel perspectives during exploration [79]. As a result, employees are more likely to navigate their novel ideas through resistance, opposition, and other obstacles during the innovative process.

To summarize, supervisors who are in support of innovation can amplify the effect of subordinates' social resources on innovative behavior by encouraging them to efficiently access existing resources, by expanding their resource pool, and by facilitating the mobilization and utilization of social resources in the innovative process. Therefore, we propose the following hypothesis:

Hypothesis 2. *Supervisor support for innovation moderates the effect of social resources on employee innovative behavior such that social resources induce more (vs. less) innovative behavior when supervisor support is high (vs. low).*

2.4. Employee Innovative Behavior and Innovative Outcomes

Innovative behavior is an individual's behavioral engagement in a series of innovative stages ranging from idea generation and idea promotion to idea implementation [26,80]. Innovative outcomes are identifiable benefits to the organization, such as better procedures, practices, or products [49]. Although innovative behavior and innovative outcomes are closely related, they are by no means the same thing or an inevitable cause-and-effect relationship. As Hughes et al. argued [12], " . . . whether generating and implementing ideas leads to improved organizational outcomes is not a feature of either creativity or innovation, rather it is an outcome" (p. 550). They caution that mixing these two concepts would give people the incorrect logic that " . . . innovative process cannot exist until after the effects are known" (p. 550). Unfortunately, researchers commonly use self- or other-rated innovative behavior as the measure of employee innovation [12,13], making these two indistinguishable. Such an approach is problematic for both theory development and managerial practice. Theoretically, without a clear distinction between them, the measure method of these two concepts cannot be developed to support further study. In addition, we cannot reveal how social resources are being used in the long journey of innovation starting from a raw idea to the finished output [17]. Practically, for many reasons beyond the control of the innovators themselves, not all efforts made in the earlier stages of the innovative process are reflected in the final outcomes or can even lead to success [81]. Given this, employees will be demotivated to actively engage in creative activities if only the tangible outcomes are valued.

Although the innovation-result track is somewhat sparse, findings do advocate a positive link between innovative behavior and outcomes [26,82]. Inspired by the social-resources framework [40,41], we conceptualize innovation as a resourced-based trial-and-error process in which employee innovative behavior catalyzes innovative outcomes. In this trial-and-error process, employees must iteratively exploit and explore their personal and external resources to reach a breakthrough [83]. Specifically, they need to engage in a series of activities, including generating an idea, promoting it for endorsement and approval, and implementing it in the real organizational setting [66]. Without these complex acts of innovative behavior, it is almost impossible to convert novel ideas into substantive and meaningful innovation [84]. For example, organizational innovations usually start from the personal explorations and insights of employees [15,85]. However, it is very rare that an organization can successfully achieve innovation by betting on a small number of raw ideas [81]. That is why many organizations and managers encourage employees to engage in creative activities [65]. Indeed, individuals who are persistent in idea generation are more likely to develop more creative ideas [86], laying a solid foundation for high-level innovation. Besides, the active practice of innovative behavior provides employees the first-hand experience to try novel ways to deal with problems. Even if the initial attempts do not lead to favorable results, the experience gained can enhance the possibility of achieving innovative outcomes in subsequent stages. Put differently, even if employees fail in one innovative task or make mistakes, they can accumulate valuable experience from those lessons for the next innovation.

In summary, employees can produce innovative outputs by actively engaging in activities of generating, promoting, and implementing creative ideas. Furthermore, since

employees with abundant social resources can excel in those innovative activities, social resources will have an indirect effect on innovative outcomes via innovative behavior. Therefore, we propose the following two hypotheses:

Hypothesis 3. *Employee innovative behavior is positively related to innovative outcomes.*

Hypothesis 4. *Social resources yield an indirect effect on innovative outcomes via innovative behavior.*

Our preceding hypotheses propose that social resources increase innovative outputs through the indirect effect of innovative behavior (Hypothesis 4), and supervisor support moderates the effect of social resources on innovative behavior (Hypothesis 2). This allows us to further propose a mediated moderation model in which the magnitude of the indirect effect is contingent on supervisor support for innovation:

Hypothesis 5. *The indirect effect of social resources on innovative outcomes via innovative behavior is moderated by supervisor support for innovation such that the indirect effect is stronger (vs. weaker) when supervisor support is high (vs. low).*

The theoretical model of this study is depicted in Figure 1.

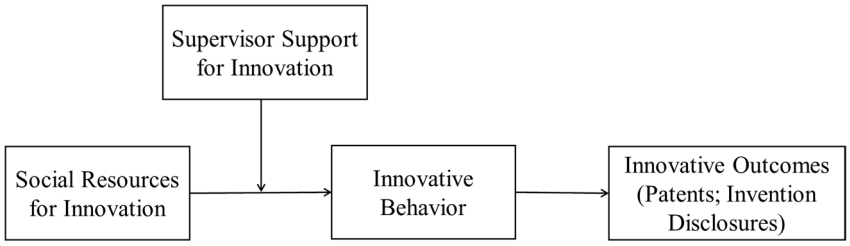

Figure 1. A social-resources model of employee innovation.

3. Materials and Methods

3.1. Research Setting

In order to test the above hypotheses with the tent of social-resources theory, we aimed to conduct a field survey in a high-tech company where social resources for innovation are available, innovative behavior is observable, and innovative outputs are objectively recorded. Specifically, we conducted our survey in the Asia Research and Development (R&D) center of an international company. The company's vision is to be "the worldwide reference in sustainable products through performance solutions". Sustainability is their core strategy and is embedded in their whole operation process, including design, manufacturing, and distribution. Not surprisingly, they regard innovation as the most powerful factor in realizing a sustainable competitive advantage. Their businesses are classified into different business units (BU). To improve R&D effectiveness, all BU R&D teams are centralized in eight regional R&D centers worldwide that are independent of business units. We believe that this ideal setting provides us an opportunity to examine how social resources can be accessed and utilized to help employees engage in more innovative behavior and then deliver more innovative outputs.

3.2. Participants and Procedures

On the basis of discussions with upper and middle management, we came to understand that this R&D center hosts several BU R&D teams providing R&D support to all BUs in the Asia region. In addition to BU R&D teams, there are two other types of teams. One is the Core Research Lab (CRL) team focusing on transversal competency research and development, which can be universally applied to different BU R&D projects. The other is supporting teams offering technical support in the areas of intellectual property,

technology analysis, human-resources development, etc. R&D employees not only respond to R&D needs from BUs but also initiate R&D projects on their own. Regardless of the kind of projects, employees need input and support from the above three internal teams and external collaborators, including colleagues from BUs, their counterparts in other regional R&D centers, and domain experts working in universities or research institutes. In other words, employees here should initiatively access and utilize all useful social resources for innovation. Therefore, it provided an ideal setting for our current study to examine the relationship between employees' social resources and innovation. Furthermore, they encourage employees to apply for invention disclosures and patents, thus offering us a unique opportunity to obtain objective records of employee innovative outcomes.

The required sample size was computed as a function of α, power, and the effect size using G-power [87]. To obtain the effect size for the social resources–innovation link, we relied on the results of an intensive meta-analysis, which indicated a corrected correlation (ρ) of 0.27 between resources and employee innovation [13]. (In this meta-analysis, the resource measure included the information, technical, instrumental, or financial support that an employee can use for innovation in the organization. Although it is not identical to the social resources in our current study, we believe that this meta-analysis result provides a valuable criterion for us to estimate the desired sample size). Accordingly, a minimum sample size of 140 was needed to achieve the same effect size (i.e., $\rho = 0.27$) with an alpha level of 0.05 and a power of 0.90. As the current study aimed to explore the effects of social resources on employee innovation, only those whose job responsibilities included innovative exploration were invited to participate in the survey. With the aid of the human-resources staff of the R&D center, we identified a total of 169 people who met the criteria and invited all of them to participate. They were invited to complete an online self-report questionnaire sent via email. Participation in the survey was completely voluntary. A total of 154 voluntarily attended and completed the questionnaire, resulting in a response rate of 91.1%. Among them, 101 were male (65.6%) and 53 were female (34.4%), with an average age of 37.15 (SD = 15.04). The average tenure in the R&D center was 5.40 years (SD = 4.50). A total of 61% of them belonged to BU R&D teams, 26% belonged to CRL teams, and the remaining 13% belonged to supporting teams. A total of 40% of participants had a PhD degree, whereas 60% had a master's degree or below.

3.3. Measures

Social resources for innovation. Consistent with social-resources theory [40], we used the position-generator method to capture participants' social resources for innovation. Researchers who study how social networks influence employee innovation often use the name-generator method to measure relational and structural properties [19]. This technique reflects the researcher's underlying assumption that social resources exist in the social relationships with each specific contact. Unlike the relational and structural perspectives, social-resources theory proposes that social resources come from each contact that is occupying a key position relevant to individuals' intended goals [40,41]. Lin and Dumin [41,42] developed the position-generator method in which participants are provided with a list of positions and are asked to indicate to what extent they relate to the incumbent of each of these positions.

For our current study, after having interviewed R&D managers and employees, we learned that employees needed resources and support from collaborators in 10 key positions from four sources: (a) scientist, engineer, and technician of the BU R&D teams; (b) scientist, engineer, and technician of the CRL team; (c) colleagues of supporting teams; and (d) three types of external collaborators, including colleagues of BUs, colleagues of other regional R&D centers, and domain experts working in universities or research institutes. Therefore, participants were asked to indicate to what extent they could obtain support from the incumbent of every 10 positions during the process of innovative explorations. Participants responded on a five-point scale (1 = never, 5 = a great deal, Cronbach's $\alpha = 0.89$).

Supervisor support for innovation. We adapted a four-item scale originally developed in the Chinese context [88] to measure the support participants received from their supervisors. A sample item is "My supervisor always encourages and supports employees to express their new ideas". Participants were asked to indicate to what extent they agree with some statements on a five-point scale (1 = strongly disagree, 5 = strongly agree, $\alpha = 0.91$).

Innovative behavior. A nine-item scale developed by Janssen [80] was used to measure innovative behavior in the workplace. The sample items were "generating original solutions to problems", "acquiring approval for innovative ideas", and "transforming innovative ideas into useful applications". Participants were asked to indicate how often they perform the following creative activities on a five-point scale (1 = never, 5 = always, $\alpha = 0.92$).

Innovative outcomes. Employees' innovative outputs, including the number of invention disclosures and patents, were obtained from archival data from 2016 to 2020. Invention disclosures refer to technical solutions concerning methods or products. Employees are supposed to write an invention-disclosure draft and submit it to the intellectual-property team for a preliminary assessment. Then, the team selects qualified drafts and submits them to the intellectual-property committee for the final decision. The committee decides whether an invention disclosure is kept as trade secret internally or should go through the patent-application process based on business needs.

Control variables. Consistent with extant research [32,76], participants' demographic information (e.g., gender, age, education level) and job-related characteristics (e.g., the type of work team, organizational tenure) were included as control variables.

Measures for the key variables of the study (social resources for innovation, supervisor support for innovation, and innovative behavior) could be found in Appendix A.

4. Results

4.1. Descriptive Statistics

Table 1 displays the results of the descriptive statistics with the correlation analysis and Cronbach's alpha. Correlation analysis showed that social resources for innovation were positively related to innovative behavior (r = 0.34, $p < 0.01$), but were not related to invention disclosures (r = 0.02) or patents (r = 0.08). Instead, innovative behavior was positively related to invention disclosures (r = 0.20) and patents (r = 0.19), $p < 0.05$, providing preliminary support for an indirect effect of social resources on invention disclosures and patents through innovative behavior.

Table 1. Results of descriptive analyses.

	Mean (S.D.)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1. Age	37.15 (15.04)	/									
2. Gender [a]	0.66 (0.48)	−0.01	/								
3. Education [b]	0.40 (0.49)	0.13	−0.06	/							
4. Tenure	5.40 (4.50)	0.18 *	0.13	−0.09	/						
5. CRL team [c]	0.26 (0.44)	0.11	0.02	0.10	0.11	/					
6. BU R&D team [c]	0.61 (0.49)	−0.09	0.07	0.05	0.00	−0.74 **	/				
7. Social resources for innovation	3.23 (0.79)	−0.11	−0.06	0.04	−0.18 *	0.19 *	−0.22 **	(0.89)			
8. Supervisor support for innovation	4.31 (0.63)	−0.06	0.06	0.02	−0.30 **	0.00	0.00	0.46 **	(0.91)		
9. Innovative behavior	3.57 (0.68)	0.02	−0.03	0.13	−0.05	0.07	−0.14	0.34 **	0.15	(0.92)	
10. Number of invention disclosures (log)	1.08 (1.27)	0.10	0.11	0.33 **	0.37 **	0.13	0.11	0.00	−0.12	0.20 *	/
11. Number of patents (log)	0.40 (0.76)	0.01	0.09	0.15	0.31 **	0.05	0.10	0.08	−0.08	0.19 *	0.73 **

Note. N = 154. [a]: Gender was dummy coded (0 = female, 1 = male). [b]: Education was dummy coded (0 = master or below, 1 = PhD). [c]: Team type was coded into two dummies with the supporting team being the reference group. Internal-consistency reliabilities appear in parentheses along the diagonal. * $p < 0.05$. ** $p < 0.01$.

4.2. Measurement Model

To examine the validity of our measurement model and to evaluate the severity of common method variance, we used confirmative factor analysis with the maximum likelihood estimation in Mplus 7.0. As shown in Table 2, the hypothesized four-factor model (social-resources for innovation, supervisor support for innovation, innovative behavior, and innovative outcomes) had a satisfactory fit with the data (χ^2 (59) = 84.61, $p < 0.05$, CFI = 0.98, TLI = 0.97, RMSEA = 0.048, SRMR = 0.046). To establish discriminant validity for variable measurement, we further constructed a series of alternative three-factor models in which two measures were combined as one factor. As seen from Table 1, none of the three-factor models fit well with the data and were significantly worse than the hypothesized four-factor model (i.e., all $\Delta\chi^2$ were significant at the level of $p < 0.001$), indicating adequate discriminant validity among all measures. Moreover, Harman's single-factor model in which all items were set to load on a single factor fit poorly, indicating that the common method variance would not significantly affect the results in our data.

Table 2. Results of confirmatory factor analysis.

	Models	χ^2 (df)	$\Delta\chi^2$ (Δdf)	CFI	TLI	RMSEA	SRMR
1.	Four-factor model (hypothesized model)	84.61 (59) *	/	0.98	0.97	0.048	0.046
2.	Three-factor model 1: social resources for innovation and supervisor support for innovation as a single model	223.04 (62) ***	138.43 (3) ***	0.85	0.81	0.117	0.111
3.	Three-factor model 2: social resources for innovation and innovative behavior as a single model	248.13 (62) ***	163.52 (3) ***	0.83	0.78	0.126	0.136
4.	Three-factor model 3: supervisor support for innovation and innovative behavior as a single model	321.78 (62) ***	237.17 (3) ***	0.76	0.69	0.149	0.142
5.	Three-factor model 4: innovative behavior and innovative outcomes as a single model	205.51 (62) ***	120.90 (3) ***	0.87	0.83	0.111	0.086
6.	Single-factor model: All variables collapsed as a single construct	572.39 (65) ***	487.78 (6) ***	0.52	0.43	0.203	0.176

Note. CFI = comparative-fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual. $\Delta\chi^2$ of each model was calculated and tested against the hypothesized four-factor model. * $p < 0.05$. *** $p < 0.001$.

4.3. Hypothesis Testing

We conducted a series of hierarchical regression analyses to test Hypotheses 1 to 3. As shown in Table 3, after controlling for some individual differences, social resources for innovation had a significant influence on innovative behavior ($\beta = 0.33$, t = 4.09, $p < 0.001$). In addition, there was a significant interaction effect between social resources for innovation and supervisor support on innovative behavior ($\beta = 0.20$, t = 2.41, $p < 0.01$). A simple slope test (see Figure 2 for the plot) further depicted that social resources for innovation triggered more innovative behavior when supervisor support was high (b = 0.46, t = 4.6, $p < 0.001$). In contrast, when supervisor support was low, there was no significant influence of social resources for innovation on innovative behavior (b = 0.05, t = 0.4, $p = 0.69$). In addition, as shown in Table 4, innovative behavior had a significant influence on consequent innovative outcomes, including invention disclosures ($\beta = 0.20$, t = 2.82, $p < 0.01$) and patents ($\beta = 0.18$, t = 2.28, $p < 0.05$). Thus, Hypotheses 1 to 3 were all supported.

Table 3. Regression analyses on innovative behavior.

Variables	Model 1	Model 2	Model 3	Model 4
Gender	0.00	0.01	0.01	0.01
Education	0.15	0.14	0.14	0.15
Tenure	−0.02	0.03	0.04	0.04
CRL team	−0.10	−0.13	−0.14	−0.15
BU R&D team	−0.22	−0.17	−0.17	−0.18
Social resources		**0.33** ***	0.32 ***	0.25 **
Supervisor support			0.01	0.06
Social resources × Supervisor support				**0.20** **
R^2	0.04	0.14	0.14	0.18
ΔR^2	0.04	0.10	0.00	0.04
F	1.37	4.04 ***	3.45 **	3.90 ***
ΔF	1.37	16.7 ***	0.03	6.23 **

Note. Standardized coefficients are presented. Values in bold are relevant to tests of hypotheses. ** $p < 0.01$. *** $p < 0.001$.

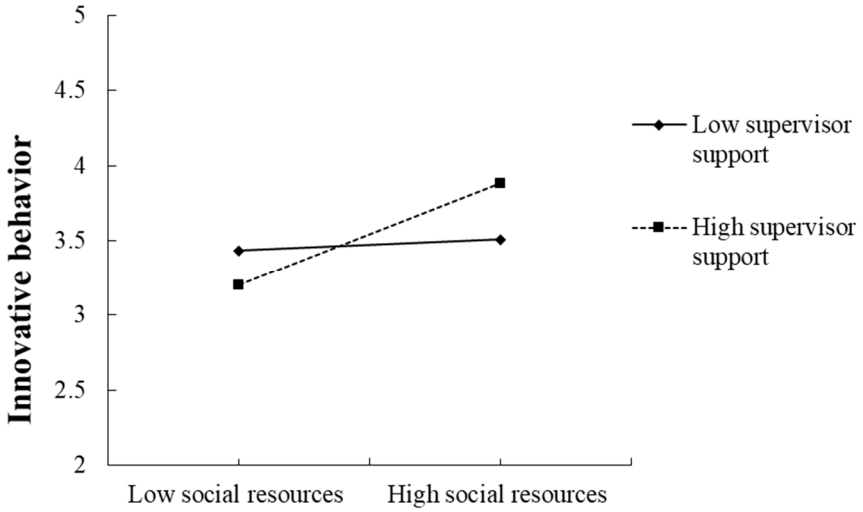

Figure 2. Interaction between social resources and supervisor support on innovative behavior.

Table 4. Regression analyses on innovative outcomes.

	Invention Disclosures			Patents		
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Gender	0.06	0.06	0.06	0.05	0.05	0.05
Education	0.33 ***	0.33 ***	0.30 ***	0.16 *	0.15 *	0.13
Tenure	0.36 ***	0.38 ***	0.37 ***	0.30 ***	0.33 ***	0.33 ***
CRL team	0.27 **	0.27 **	0.29 **	0.14	0.13	0.15
BU R&D team	0.29 **	0.31 **	0.34 ***	0.19	0.21	0.25 *
Social resources		0.08	0.01		0.16 *	0.10
Innovative behavior			**0.20** **			**0.18** *
R^2	0.32	0.32	0.36	0.15	0.17	0.20
ΔR^2	0.32	0.01	0.04	0.15	0.02	0.03
F	13.73 ***	11.64 ***	11.59 ***	5.12 ***	5.06 ***	5.20 ***
ΔF	13.73 ***	1.16	7.96 **	5.12 ***	4.19 *	5.19 *

Note. Standardized coefficients are presented. Values in bold are relevant to tests of hypotheses. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

We further tested hypotheses involving the indirect effect of innovative behavior (Hypotheses 4) and the conditional indirect effect (Hypotheses 5) using PROCESS (Model 7) in Mplus with the bias-corrected confidence intervals (iteration N = 10,000) [89,90]. Table 5 presents all results. As seen from Table 5, indirect effects of social resources for innovation via innovative behavior on invention disclosures (b = 0.081, 95% CIs = [0.008, 0.223]) and patents (b = 0.043, 95% CIs = [0.003, 0.140]) were both significant, lending full support for Hypothesis 4.

Table 5. Results of indirect-effect analyses.

Effect	Estimate	95% CIs
Indirect effect: social resources → innovative behavior → invention disclosures	0.081	[0.008, 0.223]
Conditional indirect effect at:		
Low supervisor support (−1 SD)	0.001	[−0.099, 0.146]
High supervisor support (+1 SD)	0.161	[0.044, 0.357]
Difference	0.160	[0.031, 0.400]
Indirect effect: social resources → innovative behavior → patents	0.043	[0.003, 0.140]
Conditional indirect effect at:		
Low supervisor support (-1 SD)	0.000	[−0.057, 0.084]
High supervisor support (+1 SD)	0.086	[0.015, 0.217]
Difference	0.086	[0.011, 0.244]

Note. Coefficients were unstandardized. Percentile bootstrap was used for 95% bootstrap CI (iteration N = 10,000). Gender, education, tenure, and the type of group were all controlled.

Hypothesis 5 stated that the indirect effects of social resources on innovative outcomes via innovative behavior would be stronger when supervisor support was high as opposed to when it was low. As indicated in Table 5 (upper section), the indirect effect on invention disclosures was significant when supervisor support was high (b = 0.161, 95% CI = [0.044, 0.357]) but not when it was low (b = 0.001, 95% CI = [−0.099, 0.146]). Additionally, the result of pairwise contrast revealed that the difference in indirect effects between high and low levels of supervisor support was significant (b = 0.160, 95% CI = [0.031, 0.400]). Similarly, Table 5 (lower section) indicates that the indirect effect on patents was significant for employees enjoying a high level of supervisor support (b = 0.086, 95% CI = [0.015, 0.217]) but not for the counterparts undergoing a low level of supervisor support (b = 0.000, 95% CI = [−0.057, 0.084]). Again, pairwise contrast revealed a significant difference in indirect effects between high and low levels of supervisor support (b = 0.086, 95% CI = [0.011, 0.244]). Taken together, in full support for Hypothesis 5, supervisor support moderated the indirect effect of social resources on innovative outcomes via innovative behavior.

5. Discussion and Conclusions

Building on Lin's social-resources theory [40], the current study developed and tested a model of how social resources per se, together with supervisor support, influence innovative behavior and outcomes. All hypotheses are supported by the archival and survey data obtained from the R&D center of a high-tech company. First of all, we found that employees who can access and mobilize the right social resources for innovation demonstrate more innovative behavior and perform better in terms of innovative outputs, including more patents and invention disclosures. Furthermore, supervisor support for innovation amplifies social resources' effect on subordinates' innovative behavior, so optimal innovation can be achieved via more innovative behavior when social resources and supervisor support are both high. These findings contribute to the literature on social networks, creativity and innovation, and leader's role in facilitating employee innovation.

5.1. Theoretical Contributions

First, our study makes an important contribution to the literature on social networks and employee innovation. Researchers have long been interested in determining how the relational and structural characteristics of social networks affect employee innovation. A common assumption is that individuals with advantageous relational and/or structural features have better resources for innovation [32,91,92]. However, few empirical studies have gone beyond this underlying assumption to examine how social resources per se influence innovation. By adopting social-resources theory, we initially demonstrate that social resources per se provide employees the fuel to actively engage in innovative activities and, in turn, achieve innovative outputs. In doing so, our study advances the literature by introducing a new perspective to directly reveal the role of embedded resources in facilitating innovation.

Second, benefiting from the organization-specific record of the evaluation of employee innovation, we can differentiate employees' innovative outputs from their innovative behavior. Few studies have explicitly made this distinction, partly because it is difficult to obtain an objective evaluation of employee innovation for research purposes. Not surprisingly, in their comprehensive review involving 195 empirical studies, Hughes et al. [12] found that only six studies utilized organization-specific markers as measures of employee innovation. Owing to this distinction, we can reveal the mechanism of how social resources for innovation are utilized during innovative processes and finally translated into tangible innovation. Specifically, it is through the engagement in generating, promoting, and implementing ideas that employees are turning social resources available for innovation into final innovative outputs (e.g., patents and invention disclosures in this study). Interestingly, as indicated in Table 4 (Models 2 and 5), the direct effects of social resources on innovative outcomes are very weak or even not significant. Rather, social resources can only yield an indirect influence on innovative outcomes through the transmission of innovative behavior. Without a clear distinction between these two, we would have reached the conclusion that social resources do not substantially influence innovation realization.

Third, we highlight the important role of supervisor support for innovation in the utilization of social resources. As our findings suggest, supervisor support serves as an important boundary condition in determining the extent to which social resources can enhance employee innovation. Specifically, only when supervisors are in support of innovation can employees effectively mobilize social resources to obtain high-quality outputs. In doing so, we also shed new light on leaders' facilitating role in fostering subordinates' creativity and innovation. Extant theoretical conceptualization and empirical research posit that various leaders facilitate subordinates' creativity and innovation by encouraging them to either leverage or develop personal resources such as motivation, creative self-efficacy and self-identity, and knowledge and creative skills [12,63,65]. Departing from this stream, we highlight that leaders can also turn subordinates' attention outward to access and mobilize external resources that only exist in their social networks. In this regard, our current study offers a new perspective for leaders to fulfill the facilitating role in accelerating subordinates' innovative processes and outcomes given the importance of social resources in innovation.

Fourth, we also contribute to social-resources theory by extending its application to the field of creativity and innovation research. Traditionally, social-resources theory is used for explaining social and organizational phenomena such as status attainment [40]. By extending social-resources theory to creativity and innovation literature, we shed light on the crucial role of social resources per se on employee innovation beyond social networks' relational and structural perspectives.

5.2. Practical Implications for Sustainable Innovation

Our study may offer useful insights for organizations, supervisors, and employees who are in pursuit of sustainability in the current ecosystem through innovation enhancement (e.g., innovative ideas, materials, process, and/or products). First, given the importance of social resources to innovation, companies can shape an environment and support employees in proactively accessing and utilizing internal and external social resources, particularly resources that can be transformed into innovation to gain organizational sustainability. For example, a flat organizational structure has an obvious advantage in fostering information flow compared with a complicated organizational structure. Cross-team communication platforms, including project collaboration, research seminars, trainings, and clubs, play similar roles in stimulating information exchange and idea generation. In addition, organizations can identify, attract, and retain supervisors who are supportive of innovation and provide them with trainings related to creative leadership skills [93].

For managers, the current study provides enlightenment about how to support and expedite employee innovation. They can explicitly express their support for innovation and take actions such as listening to novel ideas, tolerating mistakes, recognizing not only innovative outcomes but also innovative behavior, encouraging external social networks, and sharing their own resources so that subordinates can proactively engage in innovation with higher psychological safety.

This study also enlightens employees regarding the importance of social resources. To be creative and productive at work, employees should learn how to explore and integrate both external and internal resources for innovation. For example, they can access and mobilize all kinds of creative resources internally and externally and transform them into innovative behavior. They can also borrow influence from supervisors and other key stakeholders to successfully navigate different phases of the idea journey.

5.3. Limitations and Future Directions

This study also has several limitations that need to be addressed in future studies. The main limitation is that our study is cross-sectional and could not establish causality among variables. We measured individuals' social networks with a widely used position-generator method and then used archival data to reduce common method variance. However, considering the potential reversed causality that individuals with higher innovative performance are more likely to build better social networks, it is encouraged to validate our findings with longitudinal designs in the future.

We also caution that attention should be paid to the generalizability of our findings to other contexts. Our study was conducted in a R&D center whose employees were supposed to be innovative and were explicitly required to engage in the innovative process in their daily work. This R&D center fit well with our study because social resources for exploration and innovation were highly relevant to participants' job requirements in this setting. We argue and provide empirical evidence for the assumption that R&D employees who have more access to and are more capable of utilizing social resources achieve better innovative performance in this case. However, we are not sure to what extent our findings can be generalized to other companies of different sizes, in different industries, or in other cultures. We encourage future studies to take these contextual features into account for testing. For example, an interesting question is whether social resources have a greater or lesser impact on employee innovative behavior and innovation in firms that do not explicitly emphasize innovation.

Furthermore, although our study indicates that supervisor support for innovation moderates the effect of social resources on employee innovative behavior, there are other factors that may also serve as important boundary conditions. We call for future studies to explore how the personal (e.g., employees' self-efficacy [67]) and contextual factors (e.g., supervisors' innovation expectations [94], organizational innovation climate [83]) may strength or weaken the effect of social resources on employee innovation.

Finally, although our study highlighted the importance of social resources on innovative employee behavior and outcomes, we did not measure the relational and structural features of employees' social networks. Thus, we can neither determine the relative importance of social resources and social networks nor reveal how access to and mobilization of social resources depend on the relational/structural characteristics of social networks. Therefore, we believe it necessary for future research to integrate the relational and structural perspectives to explore the extent to which individuals with advantageous social-network configurations can better utilize embedded social resources to enhance innovation.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: All data and analyses in this study are public in the Psychological Science Data Bank (Doi: 10.57760/sciencedb.o00115.00008), and they can be accessed via the following link: https://www.scidb.cn/anonymous/cVlqSTNx (accessed on 23 May 2022).

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Appendix A. Measures for the Key Variables of the Study

1. Social resources for innovation (Lin [40]).

When you are engaging in explorative R&D projects, to what extent can you obtain support from each colleague during the process of innovative explorations? (1 = "never," 2 = "a little," 3 = "somewhat," 4 = "much," and 5 = "a great deal")

(1) Scientists from the CRL team
(2) Engineers from the CRL team
(3) Technicians from the CRL team
(4) Scientists from the BU R&D teams
(5) Engineers from the BU R&D teams
(6) Technicians from the BU R&D teams
(7) Colleagues from supporting teams
(8) Colleagues from the business units
(9) Colleagues from other regional R&D centers
(10) Experts from universities or research institutions

2. Supervisor support for innovation (Liu & Shi [88]).

To what extent do you agree with the following statements (1 = strongly disagree, 5 = strongly agree)?

(1) My supervisor tolerates and respects different opinions from employees.
(2) My supervisor encourages employees to come up with ideas to improve the product or service.
(3) My supervisor supports and coordinates with employees to implement ideas at work.
(4) My supervisor is a good example for being innovative.

3. Innovative behavior (Janssen [80]).

How often do you perform the following work activities? (1 = never, 5 = always)

(1) Acquiring approval for innovative ideas.
(2) Searching out new working methods, techniques, or instruments.

(3) Transforming innovative ideas into useful applications.
(4) Introducing innovative ideas in a systematic way.
(5) Making important organizational members enthusiastic about innovative ideas.
(6) Generating original solutions to problems.
(7) Creating new ideas for improvement.
(8) Mobilizing support for innovative ideas.
(9) Thoroughly evaluating the application of innovative ideas.

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