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Unlock the potential of regional innovation environment: The promotion of innovative behavior from the career perspective

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ABSTRACT

This study conducts an empirical analysis on the relationship between the regional innovation environment (RIE) and scientific workers' innovative behavior. Additionally, it examines the role of career satisfaction and the need for achievement in the relationship between RIE and innovative behavior. A questionnaire is used to elicit responses from a sample of 4,007 scientific workers in China. The data are analyzed on the SmartPLS software using a structural equation model. The results show a positive and significant effect of RIE on innovative behavior, while career satisfaction plays a partial mediating role in the relationship. The need for achievement serves as a moderator between career satisfaction and innovative behavior, such that the relationship is stronger for scientific workers with less need for achievement. Additionally, an importance-performance map analysis of RIE is conducted; the results suggest that three of the RIE aspects (industry-university-research cooperation, policy on entrepreneurship, and policy on talents) are in urgent need of improvement. The study aims to understand RIE more fully and shed light on the relationships between RIE, career satisfaction, need for achievement, and scientific workers' innovative behavior and to obtain valuable information for designing strategies aimed at creating a favorable RIE for stimulating scientific workers' innovation.

Introduction

In recent years, a consensus has been reached that science and technology innovation provides strategic support for increasing social productivity and improving aggregate national strength. China's provincial and municipal governments have successively introduced numerous policies on innovation promotion to realize an innovation-driven development strategy for the country. However, earlier policies emphasized increased investment in R&D activities and neglected the creation of an innovation environment, thus limiting innovation capabilities (Wang et al., 2016). RIE refers to all the elements that facilitate a city's technological innovation activities; it has become a crucial variable in innovation research within this context (Buesa et al., 2006; Wang et al., 2016; Shan, 2017). Previous studies focused on exploring the impact of RIE on regional-level variables (e.g., innovation efficiency), or the influence of a single dimension of RIE (e.g., a culture that tolerates risk and encourages innovation) on the willingness and behavior of R&D personnel (Martin-de Castro et al., 2013). No consensus has been reached on the connotations and empirical results of RIE (Wang et al., 2016), while research on the relationship between RIE and individual innovative behavior has been limited, especially regarding scientific workers. They regard scientific research as a major professional activity, and innovation as a basic social responsibility; hence, they play a fundamental role in the development of science and technology (Gong et al., 2015). This study examines the influence of RIE on scientific workers' innovative behavior, to gain insights into the underlying impact of RIE on innovation.

A viewpoint has emerged on how contextual variables impact innovative behavior through the intrinsic factor of innovators, consistent with the propositions of the S-O-R behavior model (Mehrabian & Russell, 1974; Shalley et al., 2004; Yuan & Woodman, 2010; Kang et al., 2016). According to this model, external stimuli appear in the form of environmental factors, and their perception may lead to changes in internal psychological processes, including self-efficacy, subjective well-being, and expectancy for better outcomes, which

Abbreviations: RIE, regional innovation environment; S-O-R, stimulus-organism-response; AVE, average variance extracted; CR, composite reliability; IPMA, importance-performance map analysis; I-U-R, industry-university-research; PLS, partial least squares; R&D, research and development; SEM, structural equation model; VC, venture capital; VIF, variance inflation factor

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help to capture behavioral responses and elements (Bagozzi, 1983; Yuan & Woodman, 2010; Animesh et al., 2011; Yang et al., 2021). Another relevant psychological aspect suggested by previous studies is that employees may exhibit innovative behavior based on career satisfaction (George & Jennifer, 1990; Strauss et al., 2015; Wipulanusat et al., 2020). Career satisfaction represents an evaluation of both current work conditions and satisfaction with career recognition, growth, and prospects, reflecting a long-term work attitude (Barnett & Bradley, 2007; Pool & Qualter, 2013). When employees are sufficiently satisfied with their occupation, they are motivated to generate, share, promote, and implement their ideas out of internal satisfaction and external expectations. Employees are more likely to engage in innovative behavior when there is a strong motivation to secure successful future careers (Kline & Rosenberg, 2009). Additionally, experiencing positive affective states associated with career satisfaction helps to develop and build resources for innovation and overcome setbacks from negative shocks (George & Jennifer, 1990; Strauss et al., 2015).

Creative workers may draw on their city context in their career-related sense-making, and are expected to locate cities that are suitable for their work and career purposes (Hracs & Stolarick, 2014; Montanari et al., 2021). A city represents a macro-context that provides creative workers with structural, economic, social, and symbolic resources, which includes job opportunities, career prospects, and recognition as scientific workers (Storper & Scott, 2009; Faggian et al., 2013). Living in an environment that is conductive to career development may lead employees to a deeper sense of purpose and greater intrinsic values in their careers, thus leading to a psychological state known as career satisfaction, which facilitates the ability to use their strengths at work and greater intrinsic work motivation (Littman-Ovadia & Steger, 2010). This suggests that improving career satisfaction may enhance the chances of innovative behavior in the presence of RIE; the role of career satisfaction in the relationship between RIE and innovative behavior is evaluated in this study. When there is no contextual driving force for innovation, internal psychological needs have a stronger influence (Wu et al., 2014). In other words, the motivation to innovate, triggered by inner needs, are flinked with the external environment. As described in the need-motive-value theory, people have different values and innate human needs that motivate them to behave in a manner that satisfies their needs (Alderfer, 1969). According to the achievement motivation theory, high achievers are better at finding and evaluating opportunities, standardizing their behaviors, and spontaneously investing time, energy, and other innovation resources toward achieving innovation performance (McClelland, 1961; Johnson, 1990). This study considers the need for achievement as a boundary condition that affects the intensity and frequency of innovative behavior, and investigates whether it moderates the relationship between career satisfaction and innovative behavior.

The study makes three contributions to the literature. First, it bridges the gap by investigating and discussing the connotations and dimensions of RIE, which suggests that RIE is multi-dimensional rather than uni-directional. The study contributes to the existing RIE literature by including factor, policy, and cultural environments in its theoretical framework. Second, it takes an initial step toward enhancing the understanding of scientific workers' innovative behavior by examining the impact of RIE. Additionally, it sheds light on the role of external factors in innovative behavior because innovative behavior is often considered through the interactions of individual-, unit-, and organizational-level factors (Ng, 2017). The impact of RIE on innovative behavior is explored in the context of China, an economically developing eastern country with many scientific workers, which practically contributes to the body of RIE. Third, the study examines the impact of career satisfaction on the environment-innovation relationship and performs a moderation analysis in which the need for achievement moderates the relationship between career satisfaction and innovative behavior. It responds to the calls for more attention on the mechanism of the environment-innovation relationship and deeper consideration of the contextual factors that stimulate innovation (Hunter et al., 2007; Liu et al., 2019). The results are intended to guide the improvement of RIE and the design of governments' strategies on innovation.

In the following sections, we first review relevant studies on the relationships among RIE, career satisfaction, need for achievement, and innovative behavior. Based on the literature review, we propose and test the hypotheses. We further explore the RIE components that must be improved using an IPMA method. Last, the study concludes by discussing the implications of the findings, study limitations, and future research suggestions.

Theoretical background

RIE and individual innovative behavior

RIE is closely related to innovation. It was used to measure cities' development of science and technology innovation in the "Report on the Development of Chinese Urban Science and Technology Innovation 2020." Notably, there is no consensus on the connotations and dimensions of RIE. Shan (2017) views RIE as one of the four aspects of regional innovation capacity, which refers to environmental support for innovation activities. Wang et al. (2016) define RIE as an urban network system that ensures the realization of innovators' scientific behaviors, including all the elements that facilitate a city's technological innovation activities, which are shared by all enterprises. Generally, RIE is roughly divided into a "soft" and "hard" environment in the Chinese context. A "soft environment" refers to intangible conditions that are shaped by policies, regulations, and cultural values, whereas a "hard environment" refers to tangible conditions, such as infrastructure and resources for innovation (Wang, 2011). The dimensions of RIE are better understood when divided into three categories: factor, policy, and cultural environments. A factor environment refers to essential elements that facilitate innovation, including capital and partnership; a policy environment refers to the practices that are established through the regulations and policies on innovation that are promulgated by city governments; and a cultural environment refers to the culture that promotes innovation, which is established through informal institutional settings, such as a city's social norms, and is gradually accepted through practice (Jie, 2015). Thus, from the perspective of scientific workers, RIE can be defined as a cognitive description of the innovative working environment of the city where they live, which represents the perceived degree of support for innovative activities from the urban factor, policy, and cultural environments.

Although RIE has been measured in different ways, indicators of financial and cooperation resources and cultural environment are commonly used to measure environmental support for innovation activities (Shan, 2017; Kalcheva et al., 2018; Zhang & Wang, 2022). Financial resources (e.g., funding and access to investors) are crucial elements that support innovation, which complement the financial motivation argument for innovation (Watkins-Mathys & Foster, 2006; Radosevic & Myrzakhmet, 2009; Schmidt et al., 2016). Apart from financial resources, cooperation networks between universities, industries, and research institutes, and actions that facilitate access to collaboration are advantageous to the R&D activities, especially for firms in science-based industries (Veugelers & Cassiman, 2005; Gao et al., 2014; Schmidt et al., 2016). Cooperation facilitates the integration and alignment of intangible resources such as knowledge, which is crucial for innovation from the viewpoint of knowledge sharing; the involvement of research institutions creates research awareness among partners, provides insights for future research, and acts as an ombudsman by anticipating and translating the complex nature of ongoing research (Hall et al., 2003; Martelo-Landroguez &

Cegarra-Navarro, 2014). The cultural environment that innovation relies on is also used to measure environmental support (Shan, 2017). On the one hand, a supportive culture will reduce barriers to innovation, as innovation entails risks of failure and may attract criticism from conservative people (Lu et al., 2012). On the other hand, according to the sense-making theoretical framework, an environment with cues that encourage creativity creates a different perspective, resulting in a shift from habitual actions toward creative behavior (Madjar et al., 2011).

We capture the characteristics of RIE that nurture innovative behavior from the three dimensions of factor, policy, and culture. Financial and cooperation resources are two important characteristics of a factor environment, according to the aforementioned literature, while the degree of I-U-R cooperation and availability of VC are used in their measurement. VC is chosen because it is the major funding source for small private companies (Kalcheva et al., 2018). Tolerating failure, challenging authority, and emphasizing academic independence are indicators of a cultural environment, as they are conducive to ensuring the independence and freedom of individual innovative activities, thereby reducing the trial-and-error cost of innovation, and increasing the frequency of innovation attempts (Madjar et al., 2011; Kang et al., 2016). Policy environment is considered in this study. Science and technology policies are found to stimulate innovation through innovation resource input, technology spillover, and innovation cooperation (Pang et al., 2020; Zhou & Li, 2021). The symbolic function of innovative acts is also considered: innovations may sometimes be adopted for their symbolic meaning; that is, potential innovators may realize that being innovative makes them look good, through a desirable image, if an environment favors change and delivers expectancy for innovation (Yuan & Woodman, 2010). Policies on innovation, entrepreneurship, talents, and protection of intellectual property are considered as indicators of a policy environment, since they not only provide guidance and help for innovation, but also deliver expectancy for it (Yuan & Woodman, 2010; Reiner et al., 2017; Pang et al., 2020).

Individual innovative behavior refers to individuals' actions that introduce new factors related to work, including processes to generate, promote, and realize innovative ideas through efforts (Scott & Bruce, 1994; Janssen, 2004). It emphasizes the process of investing individuals' effort in an outcome, and not the outcome itself; it is important to be creative and willing to take risks in the process (Liu et al., 2019), depending on both personal ability and abundance of contextual resources. The linkage effect of an innovation environment on innovative behavior is reflected through two aspects: providing abundant innovation resources and encouraging innovation attempts (Kang et al., 2016). Scientific workers are expected to generate more innovative ideas in an environment that encourages the independence and freedom of individuals' innovative activities (Madjar et al., 2011; Kang et al., 2016). Accordingly, we propose the following hypothesis:

Hypothesis 1. RIE is positively associated with innovative behavior.

Career satisfaction as a mediator in the environment-innovation relationship

According to Allen et al., and Lima (2004), scientists' career satisfaction can be defined as their positive working experiences in the science and technology field, and a positive belief that they can succeed in their careers. Career satisfaction represents the positive psychological state obtained from the inner and outer aspects of the profession (Armstrong-Stassen & Ursel, 2009). It reflects not only the employees' evaluation of their current work content, but also their satisfaction with work progress, career prospects, and work significance (Pool & Qualter, 2013). Career satisfaction is often associated with the achievement of career goals, the measurement of career success, and the expectation of future development (Greenhaus & Wormley, 1990; Judge et al., 1995).

According to the social exchange theory, employees will be more satisfied with their jobs when they are provided with some benefit, and will respond positively and return something more valuable, such as exhibiting better work behaviors (Cropanzano & Mitchell, 2005; Pignata et al., 2016). Prior studies show that a higher level of career satisfaction enhances employees' career loyalty, increases work engagement, helps to maintain high-quality performance, and reduces employees' turnover intention (Kang et al., 2015; Strauss et al., 2015). Career satisfaction has also been proven to be positively related to innovative behavior. Employees may be motivated to generate, share, promote, and implement creative ideas out of a strong motivation to ensure the safety and success of their future careers (Kline & Rosenberg, 2009). Experiencing positive affective states associated with career satisfaction helps to develop innovative resources and overcome setbacks, such as failed innovative attempts (George & Jennifer, 1990; Strauss et al., 2015). In particular, knowledge workers' satisfaction has been shown to positively affect knowledge-based innovation (Shujahat et al., 2018). It is assumed that scientific workers that are knowledge workers are likely to show an active initiative in work, produce more innovative behaviors, and overcome setbacks from failure when they are satisfied with their careers.

Hypothesis 2. Career satisfaction is positively associated with innovative behavior.

Individuals need resources to cope with vocational changes and address issues that involve work-related tasks and vocational transitions, to attain career success and satisfaction (Lee et al., 2014). Knowledge and skill resources are important for attaining objective career success, while environmental resources have been confirmed by research to be more important for attaining subjective career success and satisfaction (Haenggli & Hirschi, 2020). A supportive environment provides the kind of resources necessary to improve workers' satisfaction: work social support, instructional resources, etc. (Karatepe & Olugbade, 2017; Farinde-Wu & Fitchett, 2018; Okada et al., 2021). It has been suggested that innovation resources and career development opportunities have significant impacts on career satisfaction (Thomas et al., 2005; Haenggli & Hirschi, 2020). An individual-environment interaction impacts one's career development; in such an interaction, employees engage in a sense-making procedure that evaluates the career opportunities and resources offered in the environment (Chong & Leong, 2017). Ehrhart and Makransky (2007) found that individuals' perceptions of compatibility with the work environment influenced factors, such as career success and satisfaction.

A positive relationship between culture/the values that are embedded in an environment and employees' satisfaction has also been reported. We may not be aware of our values, which are the deepest part of a culture; however, they shape our specific tendencies to affairs (Bukowski & Rudnicki, 2019). Values of a profession that are developed in an external environment are concerned with job satisfaction, such that employees feel satisfied with their jobs when they perceive the value and contribution of their work (Okada et al., 2021). Farinde-Wu and Fitchett (2018) found that black female teachers obtained job satisfaction in urban schools, partly because urban areas brought greater occupational fulfillment and provided a favorable cultural background. Lee et al. (2014) found that an open innovation climate (i.e., a set of attitudes and values that are favorable to innovation and are accepted by all members) was conducive to higher levels of employee job satisfaction. To sum up, we conjecture that RIE has a positive impact on scientists' career satisfaction.

According to the self-determination and person-organization fit theories, the external environment may eventually affect individual behavior through motivation and intention (Ryan & Deci, 2000;

Kristof, 2010; Wang & Chang, 2017), which provides a theoretical perspective for this study. RIE contains factors that are conducive to scientists' career success, providing career development resources and growth opportunities (Chong & Leong, 2017), thus leading to the career satisfaction that motivates scientific workers to innovate. We propose the following hypotheses:

Hypothesis 3. RIE is positively associated with career satisfaction.

Hypothesis 4. Career satisfaction mediates the relationship between RIE and innovative behavior.

Moderating role of the need for achievement

McClelland's achievement motivation theory (also known as achievement need theory) reflects an individual's sense of achievement in expending efforts to realize their career goals (McClelland, 1961). Furnham (2021) maintains that a need for achievement is the need to pursue success, better performance, and a sense of excellence. High achievers enjoy the process of overcoming difficulties and solving problems in pursuit of success, and often set challenging goals that are hard to realize with certainty (Chen et al., 2012). They are found to have a risk-taking propensity (Chen et al., 2012). In addition, they are better at finding and evaluating innovation opportunities, regulating behavior, and spontaneously investing in innovation resources (Johnson, 1990). In conclusion, high achievers are proficient at coping with difficulties when things are not going well, and are driven to achieve higher goals in their pursuit of progress. Need for achievement was found to be a predictor of innovation, which certainly influences the relationship between a supportive environment and individual innovation development (Urbach et al., 2016; Gao et al., 2020). A predisposition to the need for achievement is mainly determined by personality, which may influence the role of motivation under environmental influences (Gao et al., 2020).

People with a high need for achievement have an intrinsic motivation to do meaningful things in the hope of success, and strive to pursue the psychological satisfaction that is brought about by achievement itself (Furnham, 2021), and not by external factors. The convenience and feasibility that are brought about by an external environment (such as providing various resources) may reduce the difficulty of completing a task and speed up its completion, while they cannot trigger the intrinsic motivation that is brought about by the task itself. According to the aforementioned literature, scientific workers with a high need for achievement may spontaneously generate more innovative behavior, in which case the satisfaction caused by the external environment has less influence on innovativeness. Those with a low need for achievement are the opposite: low achievers tend to choose extremely easy tasks to achieve success or extremely difficult tasks to create an excuse for failure (Hagtvet & Renmin, 1996). Achievement of the task itself has little incentive for them; however, changes in the external environment brings about conveniences that help to reduce the possibility of failure and increase innovation attempts. This study presumes that low achievers are more likely to be driven by better performance and career development than by increasing innovative behaviors for achievement motivation. Accordingly, the following hypothesis is proposed:

Hypothesis 5. The relationship between career satisfaction and innovative behavior is moderated by a need for achievement.

Methods

Participants and procedure

The study was based on a survey of Chinese scientific workers in 2020. A quantitative approach and survey methodology were used to collect data. To ensure the comprehensiveness and representativeness of the questionnaire, stratified sampling was conducted in proportion to the number of scientific workers in each district. The participants came mainly from the electronic information, biotechnology, medicine, and high-tech service industries; in these industries, innovation is necessary for continued evolution. The participants were informed of the purpose and process of the survey. We promised confidentiality to ensure maximum authenticity and validity of the answers. A total of 4007 valid questionnaires were obtained after excluding unqualified cases with incomplete questionnaires. The demographic information is shown in Table 1.

Table 1
Summary of Demographics of Participants.

Characteristic		F	%	M	SD
Gender	Male	2151	53.7%	1.46	0.5
	Female	1856	46.3%		
Education level	Junior college	824	20.6%	3.02	0.92
	Undergraduate	2256	56.3%		
	Master/Doctor degree	927	23.1%		
Years of working	< 5	955	23.8%	12.25	8.72
	6−10	1025	25.6%		
	>10	2027	50.6%		
Match between job and major	Unrelated	585	14.6%	3.09	1.27
	Related	3422	85.4%		
Type of work	R&D	1135	28.3%	2.43	1.18
	R&D management and service	1177	29.4%		
	R&D assisting work	1695	42.3%		

Note: *N* = 4007. *M*=means of constructs; SD=Standard Deviation.

Measures

RIE was measured using a self-compiled questionnaire with a 5-point Likert-type scale. According to Jie's (2015) definition, the RIE scale is designed with nine questions in three categories: factor, policy, and cultural environments. Sample items included the following: "The government has introduced many policies to promote innovation" (policy), "Venture capital can be obtained for innovation" (factor), and "An atmosphere of tolerance for failure" (cultural). Cronbach's alpha for this scale was 0.973.

Innovative behavior was measured using five items with a 5-point Likert-type scale from the translated version of the two-dimensional scale of innovative behavior (Scott & Bruce, 1994). Sample items included, "I will actively seek to apply new technology, new processes or new methods at work." Cronbach's alpha for this scale was 0.922.

Career satisfaction was measured using four items with a 5-point Likert-type scale adapted from the career satisfaction scale (Liu et al., 2007), including items such as, "In general, I feel a sense of belonging to my current employer." Cronbach's alpha for the scale was 0.899.

Need for achievement was measured using four items with a 5-point Likert-type scale, from the adapted Chinese version of the achievement motivation scale (Nygard & Gjesme, 1973; Hagtvet & Renmin, 1996). Sample items included, "I like novel and difficult tasks and even take risks." Cronbach's alpha for this scale was 0.790.

Control Variables. We considered gender (1 = male, 2 = female), years of working, education level (1 = under university degree; 2 = bachelor; 3 = postgraduate), match between job and major (1 = unrelated, 2 = related), and type of work (1 = R&D, 2 = R&D management and services, and 3 = R&D assisting) as control variables.

Data analysis

As a first step, we performed calculations on the SPSS 26.0 software. Common method variance may occur for the self-reported questionnaires. The Harman single-factor detection method was

Table 2
Analysis of the results of SEM measurement model.

	AVE	Composite reliability	Cronbach's alpha	rho_A	Q^2
RIE	0.837	0.979	0.973	0.977	0.789
CS	0.769	0.930	0.899	0.905	0.603
IB	0.762	0.941	0.922	0.925	0.635
NA	0.617	0.866	0.790	0.827	0.363

Note: RIE= Regional innovation environment; CS=career satisfaction; IB=innovative behavior; NA=need for achievement. Data are extracted from the SmartPLS 3.0 software.

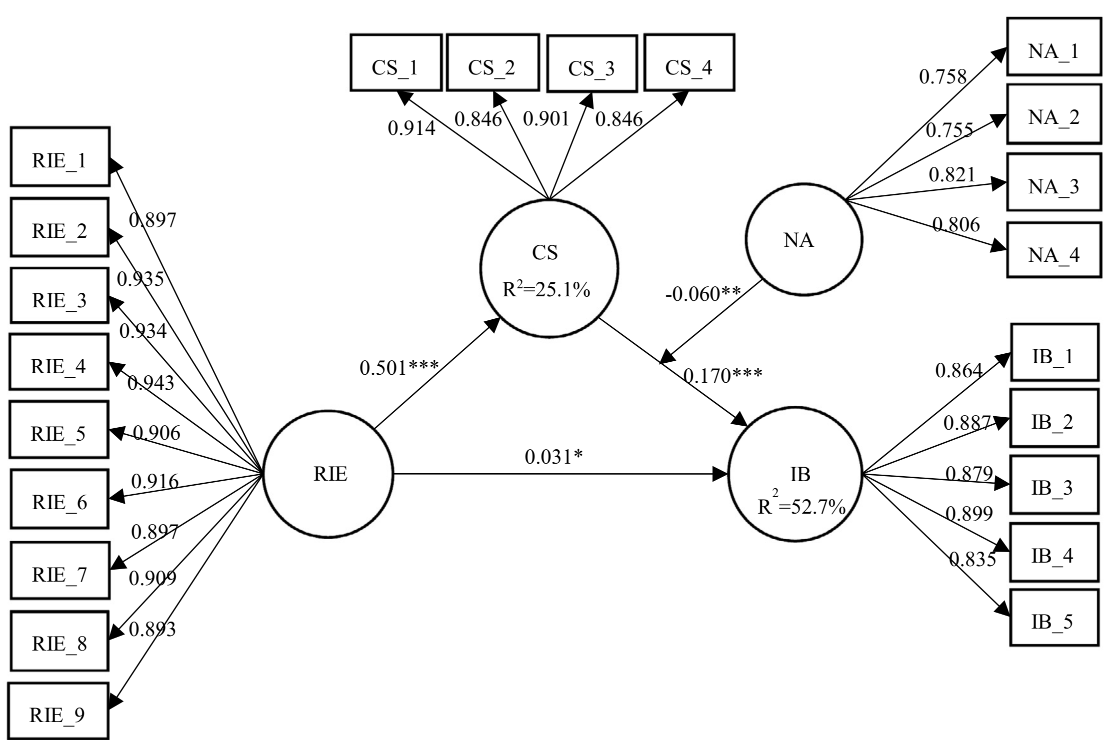
adopted to conduct principal component analysis on all the survey items. Rotation was stopped when more than one eigenvalue was obtained. The explained proportion for the first principal component was 35.63%, which was less than the 40% the standard value for empirical judgment. It was considered that a single factor did not explain most of the variation, and common method deviations were acceptable. VIF values of the variables were between 1 and 10; thus, there was no serious multicollinearity. The Kolmogorov-Smirnov test yielded results of $P < 0.5$ on all the observations, which showed the non-normality of the model. Therefore, the PLS method was adopted for the non-normal distribution (Sarstedt et al., 2016).

To examine the measurement model and test the hypotheses, we built a SEM using SmartPLS 3.0. A bootstrap method with 5000 samples was employed to calculate t-values for hypothesis testing of significance. The PLS-SEM results reflect the relative theoretical importance of the constructs, which contributes to an IPMA at the indicator level (Ringle & Sarstedt, 2016). In this study, a reflection indicator model was established, and relevant test results were obtained through the PLS algorithm, bootstrapping, and blindfolding. An IPMA was conducted to identify room for improvement based on the PLS-SEM results.

Results

In addition to the reasonably high alpha coefficient, we verified the reliability and validity of the scales. The reliability of the scales was measured by CR and Cronbach's alpha, while the validity was measured by AVE and the variables' correlation coefficients. Table 2 presents the results. The variables' CR values are all above 0.8, while Cronbach's alpha values are all above the threshold value of 0.7, indicating the acceptable reliability of the internal consistency of the scales. The load values of the observation variables are all greater than 0.7 (see Fig. 1), suggesting good convergence validity of the measurement indexes. The AVE values of the latent variables are all greater than 0.6, exceeding the threshold of 0.5. In addition, for each latent variable, the AVE square root is greater than the correlation coefficient for any other latent variable (Table 3), indicating that the discriminant validity is acceptable (Fornell & Larcker, 1981). Therefore, it is considered that the model's convergence and discriminant validities pass the test.

Table 4 lists the path coefficients and significance estimated by the SmartPLS 3.0 software, while detailed information is shown in Fig. 1. The *t*-test values in the model, which are above the given level of relevance, indicate casual relationships in the hypotheses. According to the variance result or coefficients of Pearson's determination (R^2), this model explains 52.7% of the RIE effect on innovative behavior, which is above the threshold value of 0.26. The R^2 for the proposed model is considered high. The results reveal that RIE has a significantly positive effect on scientific workers' innovative behavior (β = 0.116, P < 0.001), supporting Hypothesis 1. When career



Note: RIE= Regional innovation environment; CS=career satisfaction; IB=innovative behavior; NA=need for achievement. A number is added to the letters of the main construct showing the indicators. T value in the range of 1 .645-2.326 between as *, 2 .326-3.28 between as **, above 3.28 as ***, represent statistical significance.

Fig. 1. Factor loading, path coefficient, and significance of SEM model.

Table 3
Discriminant validity analysis (Fornell-Lacker criterion).

	RIE	CS	IB	NA
RIE	**0.915**			
CS	0.501	**0.877**		
IB	0.268	0.414	**0.873**	
NA	0.249	0.341	0.690	**0.786**

Note: RIE= Regional innovation environment; CS=career satisfaction; IB=innovative behavior; NA=need for achievement. Bold diagonal values for variables AVE root. Data are extracted from the SmartPLS 3.0 software.

satisfaction is introduced into the relationship, the results show that it is positively related to innovative behavior (β = 0.170, $P < 0.001$), thus supporting Hypothesis 2. RIE has a significant positive effect on scientific workers' career satisfaction (β = 0.501, $P < 0.001$), while career satisfaction has a significant mediating effect (β = 0.085, $P < 0.001$), thus supporting Hypotheses 3 and 4. The direct effect of RIE on innovative behavior remains significant but small (β = 0.031, $P < 0.05$), indicating that RIE works on innovative behavior mainly through the effect of internal career satisfaction.

The model also confirms the moderating effect of the need for achievement on the relationship between career satisfaction and innovative behavior ($\gamma = -0.060$, $P < 0.05$), supporting Hypothesis 5. To further test the direction of the moderating effect, its graph was drawn based on the path analysis parameters (Fig. 2). Fig. 2 shows that when the level of need for achievement is low, career satisfaction has a stronger positive effect on innovative behavior.

IPMA is a useful tool for identifying any room for improvement that management activities should address (Ringle & Sarstedt, 2016). To see if an IPMA is required, our analysis proceeded with a computation of the RIE latent variables' performance values and their importance values. The factor loadings of the RIE latent variables were distributed in the range 0.8–1, representing their importance values. The average score for each dimension of RIE reflected scientific workers' perceptions, representing their performance values. The predecessor constructs with low performance but high importance for predicting the target construct that indicates potential areas of improvement (Ringle & Sarstedt, 2016). According to the output in Table 5, RIE has relatively high importance in increasing scientific workers' innovative behavior (0.91 out of 1.00), but relatively low performance (7.0 out of 10.0). Therefore, an IPMA was conducted on the PLS-SEM results at the indicator level to formulate suggestions on the improvement of RIE.

From Fig. 3 and Table 5, the three dimensions in the second quadrant (I-U-R cooperation, entrepreneurship policy, and talent policy) should be noted, as they are vital to innovation but yet underperforming. Other RIE dimensions are relatively high in performance values compared to their importance, which implies satisfaction in these dimensions.

Table 4
Path coefficient and significance of SEM model.

Hypothesis	Path	Path Coefficient	Standard Deviation	T value	*P* value	Support the hypothesis
H1	RIE→IB	0.116	0.013	8.953	0.000	Yes
H2	CS→IB	0.170	0.016	10.794	0.000	Yes
H3	RIE→CS	0.501	0.015	33.987	0.000	Yes
H4	RIE→CS→IB	0.085	0.008	10.074	0.000	Yes
H5	CS*NA→IB	−0.060	0.023	2.563	0.010	Yes

Note: RIE= Regional innovation environment; CS=career satisfaction; IB=innovative behavior; NA=need for achievement; CS* NA represents the intersection of CS and NA.

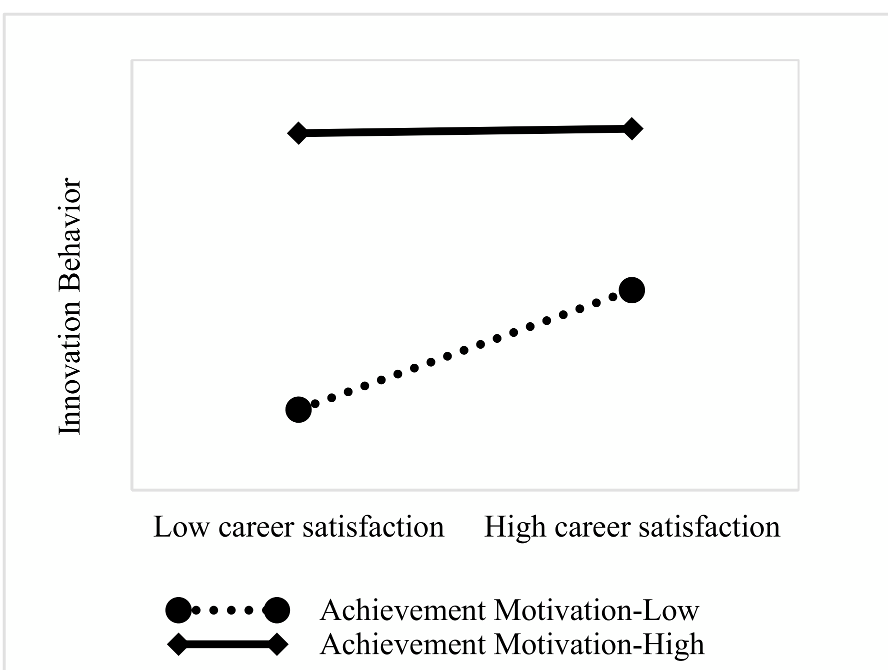


Fig. 2. The moderating effect of need for achievement.
Note: RIE= Regional innovation environment; CS=career satisfaction; IB=innovative behavior; NA=need for achievement. A number is added to the letters of the main construct showing the indicators. T value in the range of 1 0.645–2.326 between as *, 2 0.326–3.28 between as **, above 3.28 as ***, represent statistical significance.

Table 5
Importance and performance data for indicators of RIE construct.

Construct	Codes	Indicators	Indicator importance	Indicator performance	Construct importance	Construct performance
RIE	RIE_1	Policy on innovation	0.90	7.14	0.91	7.00
	RIE_2	Policy on entrepreneurship	0.94	7.03		
	RIE_3	Policy on talents	0.93	7.01		
	RIE_4	I-U-R cooperation	0.94	6.99		
	RIE_5	Intellectual property protection	0.91	7.22		
	RIE_6	Availability of venture capital	0.92	6.91		
	RIE_7	Failure tolerance	0.90	6.93		
	RIE_8	Challenging academic authority	0.91	6.87		
	RIE_9	Academic independence	0.89	6.91		

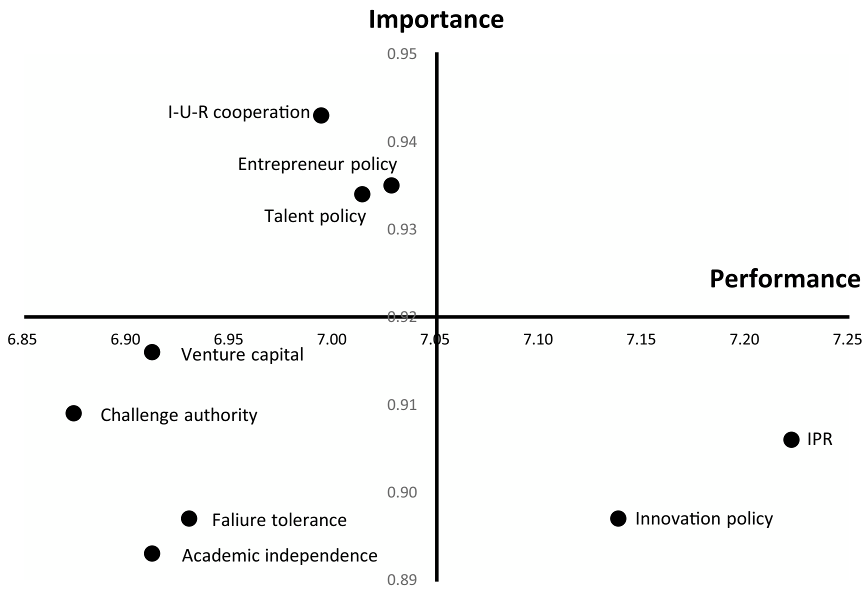


Fig. 3. Importance-Performance Map for Regional Innovation Environment.

Discussion

RIE refers to resources that facilitate innovation; it is the context in which scientific workers conduct innovation activities (Wang et al., 2016). Previous research on RIE revealed its relationship with regional innovation performance and innovation development (Wang et al., 2016; Shan, 2017). Our study sheds light on the influence of RIE on scientific workers' innovative behavior, and finds a positive relationship between them. This suggests that the underlying effect of RIE on innovation development may be accomplished by increasing innovative behaviors. Ignoring the importance of the innovation environment may limit the creation of innovative behaviors, thus negatively impacting regional innovation capabilities (Shan, 2017).

Existing studies have shown that both intrinsic and extrinsic motivations affect the relationship between the innovation environment and individual innovation (Wang & Chang, 2017). Therefore, we explored the role of two kinds of motivation: career satisfaction and need for achievement. Although it has been agreed that contextual variables impact innovative behavior by influencing the intrinsic factor of innovators, the satisfaction perspective has not been considered as an influence mechanism (Bagozzi, 1983; Yuan & Woodman, 2010; Yang et al., 2021). We found the unique explanatory power of career satisfaction that served as the organism in the environment-innovation relationship. This was consistent with the mechanism proposed in the S-O-R behavior model (Mehrabian & Russell, 1974). Career satisfaction reflects scientific workers' positive evaluation of their current job and career development, and often leads to a higher work initiative and creativity (Kline & Rosenberg, 2009). This mediating effect of career satisfaction may be because RIE is rich in innovation resources and career development opportunities or successfully shapes the symbolic meaning of the technology profession (Hracs & Stolarick, 2014; Montanari et al., 2021). The results confirm that scientific workers are more likely to immerse themselves in innovation and constantly invent new ideas when they are satisfied with their careers. Additionally, the results show that the mediating effect of career satisfaction on innovative behavior is reversed by the level of need for achievement. People with higher levels are proficient at discovering and grasping opportunities for innovation, while they enjoy the process of overcoming difficulties and solving problems (Johnson, 1990). In most cases, high achievers strive for the psychological satisfaction of achievement, and engage in challenging activities to pursue success (Chen et al., 2012). Our findings highlight the role of a trait-oriented need for achievement as a contingent factor that shapes the relationship between career satisfaction and innovative behavior. Scientific workers with a high need for achievement would increase innovation attempts purely for the sense of accomplishment, while the motivation to innovate that is driven by career satisfaction would simultaneously be weakened. High achievers tend to exhibit more innovative behavior, which may be because their characteristics are conducive to innovation activities, which is consistent with Johnson (1990).

The RIE IPMA generated additional findings for three areas of improvement to promote scientific workers' innovation: I-U-R cooperation, policy on entrepreneurship, and policy on talents. The result suggests the importance of strengthening cooperation between enterprises, universities, and research institutes. I-U-R cooperation contributes to tremendous innovation resources like knowledge, which are mainly concentrated in universities and research institutes; therefore, it reduces potential resource constraints in firms (Gao et al., 2014). More innovative behaviors may be generated from the fusion and collision of ideas from multi-party participation (Hall et al., 2003; Martelo-Landroguez & Cegarra-Navarro, 2014). It is easier to share scientific and technological resources and develop complementary capabilities with I-U-R cooperation. Policies on entrepreneurship and talents are also found to greatly impact scientific workers' innovative behavior. Favorable policies may attract talent and motivate them to create paths toward high performance from the resources of innovation, career, and the symbolic meaning of policies (Yuan & Woodman, 2010; Reiner et al., 2017). In addition, Fig. 3 shows that four areas score poorly, with both low importance and low performance: failure tolerance, academic independence, challenging academic authority, and availability of VC. This IPMA result provides a practical reference for suggestions on how RIE dimensions can better support scientific and technological innovation.

Theoretical implications

The findings of this study contribute to the existing literature in several ways: First, there is no consensus on the connotations and dimensions of RIE. We capture the characteristics of RIE from the three dimensions of factor, policy, and cultural environments in the theoretical framework. Second, this study considers multi-level factors that include both regional and individual factors. The findings suggest that a multi-level analysis investigating individual behavior should consider factors that are external to organizations. From a holistic level, individual innovative behavior is not only the outcome of the interaction of individual-, unit-, and organizational-level factors (Ng, 2017), but also the result of external factors. Third, the present study validates the applicability of the interactionist approach in increasing individual innovative behavior within a regional context, as we find that innovative behavior is influenced by RIE, enhanced by individual career satisfaction, and affected by a need for achievement. The findings add new empirical evidence to the effectiveness of career satisfaction, which is often associated with the achievement of career goals and considered an indicator of subjective career success (Thomas et al., 2005). Fourth, we combine the IPMA and PLS-SEM methods and offer ideas on the improvement of RIE indicators.

Managerial implications

The results show that, to stimulate scientific workers' innovation, it is necessary to improve RIE to more than just an organizational innovation environment. RIE is the context in which organizations and individuals live. It affects both an individual's career decisions and their career development path. According to the IPMA results, the three aspects of RIE (I-U-R cooperation, policy on entrepreneurship, and policy on talents) are in urgent need of improvement. Measures should be taken to facilitate access to collaboration between universities, industries, and research institutes, as well as provide research support mechanisms. In terms of the cultivation of innovative talents, policies on talent introduction, cultivation, and other aspects should be further assessed to expand on the high level of scientific workers' scale and enhance their innovation efficiency (Reiner et al., 2017). To build an ecological environment for innovation and entrepreneurship, the following measures should be taken: the creation of a positive innovation atmosphere, development of entrepreneurship services, and provision of entrepreneurial support (Zhuo et al., 2021). In the case of future abundant innovation resources, attention should be focused on the four aspects (availability of VC, failure tolerance, challenging academic authority, and academic independence) in the third quadrant with low importance and low performance, to optimize the future innovation environment and stimulate innovation. The results show that RIE alone cannot engender individual innovative behavior; we should also consider career satisfaction and the need for achievement. Full consideration should be given to scientific workers' psychological needs to enhance their satisfaction within their current job. To foster subjective career satisfaction in general, it is recommended that employees' sense of mission and belonging be enhanced, with a focus on environmental career resources (e.g., career opportunities within the organization) (Haenggli & Hirschi, 2020). Furthermore, many scientific workers are driven by the needs for success and achievement; they will be encouraged when organizations find ways to afford employees just and valuable recognition for their success (Furnham, 2021). Thus, more attention should be paid to employees' achievement motivation.

Limitations and future research

Despite this study's theoretical and practical significance, limitations and areas of improvement for future research remain. The sample used in this study comprised of scientific workers in organizations within the geographical boundaries of China, which may limit the generalizability of the results. Future studies conducted in other areas or countries would help test the conclusion and thus increase the generalizability. Cross-sectional data were adopted in this study, which may lead to concerns about the causality relationships. Therefore, a longitudinal or experimental research design should be introduced in the future. The use of self-reported questionnaires might also raise concerns regarding accuracy; thus, data from paired questionnaires, that is objective, or from multiple time points would mitigate this concern. Evidently, career satisfaction partially mediates the relationship between RIE and scientific workers' innovative behavior; it is recommended that future studies explore other paths through which RIE may promote innovation. Finally, future researchers could use an experimental design to examine casual links.

Conclusion

Based on the S-O-R model and achievement motivation theory (McClelland, 1961; Mehrabian & Russell, 1974), our study not only highlights the importance of RIE for understanding scientific workers' innovative behavior, but also suggests that mediators and moderators should be examined to better understand the complex environment-innovation relationship. The results show that career satisfaction plays a partial mediating role in the relationship between RIE and innovative behavior, and that the relationship between career satisfaction and innovative behavior is stronger for those with a low need for achievement. The adopted model can explain 52.7% (adjusted R^2) of the environment-innovation relationship. Given that 47.3% of the effects have not been explained by this study, this research allows for new perspectives that future research could adopt (other than mediating or moderating mechanisms) to understand the relationship. In addition, we provide evidence from the evaluation of each dimension of RIE. The IPMA results show that the three RIE aspects (I-U-R cooperation, policy on entrepreneurship, and policy on talents) perform poorly but are crucial for increasing innovative behavior. Thus, these aspects of RIE can be precisely targeted to promote regional innovation. Our research contributes to a more thorough understanding of the specific role of RIE in improving innovation and career satisfaction, providing insights into the effect of the external environment on individuals.

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Declaration of Competing Interest

None.

Declaration of informed consent: Informed consent was obtained for experimentation with human subjects. The privacy rights of human subjects are always observed in this study.

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