Volume: 15, Issue: 1
Page: 113-134
2022

International Journal of Science and Business

Journal homepage: ijsab.com/ijsb

The Relationship Between Psychological Empowerment and Innovation Performance of R&D Employees

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Abstract

Positive psychology advocates stimulating the inner positive psychology of employees and improving the enthusiasm of employees at work (Bai 2021). Based on this, this paper uses the psychological empowerment theory to study the behavior of employees at work and studies the effect mechanism of R&D personnel's psychological empowerment on innovation performance. Using 466 R&D personnel as the research sample, this study combines self-determination theory and reciprocal determinism, integrates management knowledge with psychological knowledge, comprehensively uses literature research method, interview questionnaire method, and statistical analysis method, and adopts Stata14.0 statistical software and structural equation modeling as data analysis tools to study the effect mechanism of psychological empowerment on innovation performance of R&D personnel in Suzhou science and technology enterprises, From two aspects of positive and negative behaviors of R&D personnel in the workplace and organizational contexts, this paper explores the mediating effect of engagement and employee silence and the moderating effect of power distance in the impact of R&D personnel's psychological empowerment on innovation performance. The research hypopaper and theoretical model are validated, bridging the gap of existing studies.

IJSB
Accepted 19 November 2022
Published 20 November 2022
DOI: 10.5281/zenodo.7339125

Keywords: *Psychological Empowerment, Innovation Performance, R&D, Employees.*

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1. Introduction

Innovation is the first driving force for national development, and it is also the core competitiveness of enterprise development. Effectively improving enterprise innovation performance is an important way to enhance the core competitiveness of enterprises. The realization of the innovation performance of teams and organizations originates from individual innovation, and the improvement of enterprise innovation performance depends on the R&D personnel of the enterprise. It is of great significance to study the ways to improve the innovation performance of R&D personnel to enhance the core competitiveness of enterprises. In order to improve R&D personnel's innovation performance, the current HRM departments of enterprises mainly start from the social exchange theory to motivate R&D personnel from the perspective of satisfying employees' needs, and this perspective ignores the important influence of employees' inner positive psychology on their work behavior. On the basis of the views of Conger et al., the concept of psychological empowerment originally proposed by Thomas (1990) is an important theoretical basis of the empowerment theory and also an important theoretical basis of this research.

2. Problem Statement

On the basis of the views of Conger et al., the concept of psychological empowerment originally proposed by Thomas (1990) is an important theoretical basis of the empowerment theory and also an important theoretical basis of this research. However, in the study of psychological empowerment theory, most western scholars study psychological empowerment as a mediator, but there is no in-depth study on the effect mechanism of psychological empowerment. Especially in the context of Chinese culture, there is little research on the effect mechanism of psychological empowerment of employees in specific fields. As the core employees of innovative companies, the work status of R&D personnel is largely influenced by their level of psychological empowerment. Therefore, it is theoretically necessary to study in depth the influence of R&D personnel's psychological empowerment on their work behavior and job performance in the Chinese cultural context (Bai 2021; Wang 2022: Tian 2022).

Psychological empowerment is based on the theory of self-determination, which ensures that members of the organization will complete the work of the organization with positive psychological characteristics and full enthusiasm. Improving the level of psychological empowerment of employees is an important way to effectively improve their work performance (Shi 2021). Today, when innovation is of great significance, improving the innovation performance of enterprises is an important way to improve the work performance of enterprises. However, the research on the mechanism of the role of psychological empowerment on innovation performance is still in its infancy and there are few relevant studies. Mainly, as pointed out by Sheldon (1995), individual autonomy is one of the important characteristics of being an innovative person; Mumford & Gustafson (1998) also pointed out that when employees' autonomy is supported by the organization, their innovative outcomes may increase. Janssen (2005) empirically studied that the job impact dimension of psychological empowerment has a significant positive effect on employees' innovative behavior; Chen (2005) empirically found a spiraling relationship between psychological empowerment and performance; Zhang & Bartol (2010) stated that psychological empowerment plays an important role in employees' willingness to engage in creativity; Chinese scholars Xu (2014) pointed out that psychological empowerment plays a mediating role between transformational leadership and employee innovation performance. In view of this, this paper studies the effect mechanism of R&D personnel's psychological empowerment on innovation performance, which has important theoretical significance.

3.Research Questions

Through the problem statement, the specific problems studied in this paper are as follows:
1. Does psychological empowerment of R&D personnel have a significant impact on innovation performance?
2.Does psychological empowerment of R&D personnel have a significant impact on engagement?
3.Does R&D personnel engagement have a significant impact on innovation performance?
4.Does psychological empowerment of R&D personnel have a significant impact on employee silence?
5.Does R&D staff silence have a significant impact on innovation performance?
6.Does engagement and employee silence have a double mediator effect?

4.LITERATURE REVIEW

4.1Dependent Variables: Innovation Behavior

Scholars such as Janssen (2000) divided innovation performance from the perspective of the innovation process. They believed that innovation performance is the unity of operational, novel, and valuable ideas, methods, processes, and products produced at the individual level. Their measurement of innovation performance includes innovation intention, innovation behavior, and innovation result, thus dividing innovation performance into three dimensions: innovative thinking generation, innovative thinking promotion, and innovative thinking realization. Domestic scholar Han (2007) accepted Janssen's point of view and believed that employee innovation performance is a process, which includes the dissemination of innovative thinking, the generation of innovation intention, the promotion of innovative behavior, and the transformation of innovation achievements. Therefore, innovation performance is divided into three dimensions: innovation intention, innovation action, and innovation result. Some scholars have measured innovation performance from the perspective of innovation results. Thou & Georgy (2003) proposed that innovation performance is the output of innovation, i.e., novel and practical ideas, which can be about product innovation, service innovation, method innovation, and program innovation. Wang & Ahmed (2004) divided and measured innovation performance from five dimensions, including corporate behavior, product, process, market, and strategy.

Some scholars believe that innovative products come from innovative behaviors, so they measure innovation performance from two aspects: innovation process and innovation result. Loch & Tapper (2002) divided innovation performance into two dimensions: product innovation and process innovation. Scholars Gao and Wang (2004) believed that technological innovation performance is the efficiency of the technological innovation process, the result of output, and its contribution to business success, so technological innovation performance is divided into two dimensions: output performance and process performance. Guo (2011) accepted Loch & Tapper's point of view to divide the innovation performance of R&D personnel into product innovation and process innovation. Scholar Wu (2008) divided innovation performance into employee innovation behavior and innovation output performance. From the above scholars' studies on innovation performance measurement and dimensions, it can be seen that scholars have mainly classified the dimensions of innovation performance from the perspective of process, outcome, and the combination of process and outcome. Thus, the measurement of individual innovation performance mainly uses innovation behavior and innovation result as evaluation tools, innovation result comes from innovation behavior, and innovation performance is the unity of innovation behavior and innovation result. The innovation process leads to innovation outcomes, and the creation of good innovation outcomes is inseparable from the innovation process. The two are inseparable. Therefore, this

paper conducts relevant research on innovation performance from the dual perspective of process and outcome. Since the generation of innovative thinking, the promotion of innovative thinking, and the production of innovation outcomes are in a continuous unity, we cannot separate them diametrically, therefore, in this paper, the innovation performance of R&D personnel is studied as a whole in order to ensure the continuity of the innovation process.

4.2 Independent Variable (IV): Psychological Empowerment

Conger & Kanungo (1988) thought that psychological empowerment embodies the motivational concept of self-efficacy, and therefore believed that psychological empowerment is a one-dimensional variable composed of self-efficacy. However, it only proposed the concept and dimension of psychological empowerment and did not design an effective scale to measure psychological empowerment. Menon (2001) analyzed psychological empowerment from the individual level, uses psychological methods to study psychological empowerment and divides psychological empowerment into three dimensions: a sense of perceived control, competence, and goal internalization. The sense of perceived control reflects the process of sharing power and the improvement of employee autonomy in this process, which is equivalent to the "impact" or "self-determination" in the psychological empowerment theory; the connotation of competency accepts Conger & Thomas et al.'s view and is similar to their "self-efficacy"; goal internalization reflects the employee's commitment to the organization and its goals and represents the motivational aspect of empowerment. At the same time, he compiled a psychological empowerment scale with 3 dimensions, 3 items in each dimension, and 9 items in total.

Thomas & Velthouse (1990) divided psychological empowerment into four dimensions: sense of impact, competence, meaningfulness, and choice., but they only divided the dimensions of psychological empowerment and did not design a measurement scale for psychological empowerment. Spitzer (1992), on the basis of Thomas & Velthouse's research, put forward through empirical research that psychological empowerment includes four dimensions of meaning, competence, self-determination, and impact. Spitzer (1995) verified these four dimensions, and on this basis developed a widely used psychological empowerment scale, which includes four dimensions and 12 items. Chinese scholar Li (2006) conducted an empirical test on Spitzer's psychological empowerment dimension for the first time in China. In the context of China, he verified that the reliability and validity of the scale are relatively good, and it is suitable for use in China.

4.3 Independent variable (IV): Engagement

May et al. (2004) developed a pre-test scale for engagement, but in the process of factor analysis, the expected results were not obtained. It formed three stable independent dimensions, and finally, 13 items were finally formed into an overall scale to measure engagement. This scale can better reflect the physiological, perceptual, and emotional dimensions of employee engagement. Schaufeli et al. (2002) developed the UWES (Utrecht Work Engagement Scale) scale. The scale includes three subscales of vigor, absorption, and dedication, of which vigor includes 6 items, absorption includes 6 items, and dedication includes 5 items, for a total of 17 items. The internal consistency of the three dimensions of the scale was good, and the goodness-of-fit of the two-factor model of job burnout and employee engagement was very good. This suggests that engagement and job burnout are two opposite extremes of the same state. The scale has been widely used in empirical research on the relationship between engagement and other variables. Domestic scholars Wang et al. (2015) conducted a reliability test of the translated UWES scale in the Chinese context. The reliability of the scale reached 0.95, indicating that the scale is suitable for localized use in the Chinese

context. In view of this, Schaufeli's UWES scale is used to measure engagement in this study. According to their own engagement theory, Britt et al. (2001) developed and compiled an engagement scale including responsibility, commitment, and performance impact. The developed scale includes 6 items.

4.4 Mediator (IV): Power Distance

Hofsted (1986) measured power distance from a cross-cultural perspective. The power distance scale compiled by him includes three items, through which the PDI (Power Distance Index) of a single country is measured, and then PDI is used to express the acceptance degree of power distance in a specific culture. Erea & Earley (1987) developed a power distance perception scale from the organizational individual level, which measured the individual's perception of power distance through 8 items. Dorfman & Howell (1988) measured the power distance from the level of the individual organization, and the power distance scale compiled by them includes 6 items. Among the 6 items, the fourth item measures the contact between superiors and subordinates outside work, and the rest of the items measure the distance between supervisors and subordinates in the workplace and organizational situations in terms of job functions. The internal consistency reliability of this scale reaches 0.70, and it is currently the most widely used scale for measuring power distance.

5.Research Framework

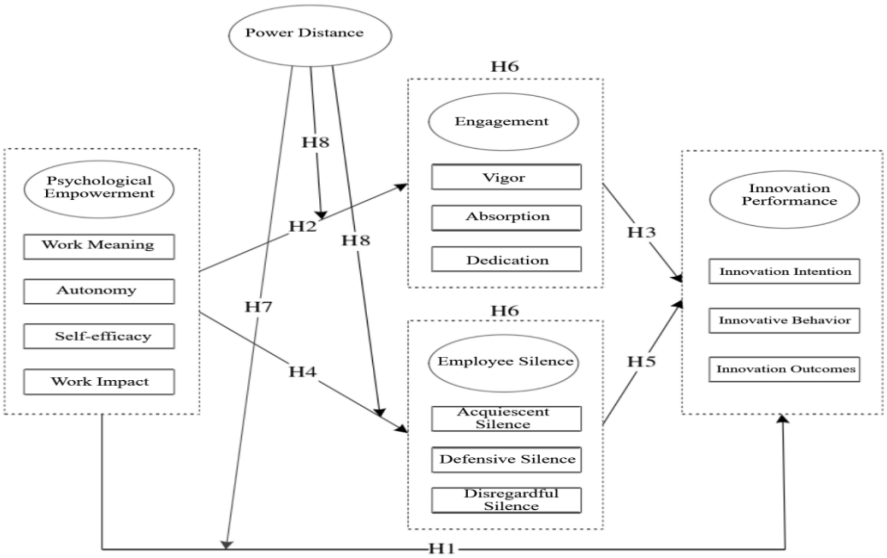

Figure 2-1 Research Framework

This paper proposes the theme of research by analyzing the research background and research significance. Based on the analysis of mainstream literature at home and abroad, this paper sorts out the literature on R&D personnel, psychological empowerment, engagement, employee silence, power distance, and innovation performance. Based on self-determination theory and reciprocal determinism, the theoretical model of this study is constructed, and research hypotheses are put forward. On the basis of defining each variable, the measurement scale is determined, the content reliability of the questionnaire is improved through pre-test interviews and questionnaire pilot surveys, the structural reliability and validity of the questionnaire are analyzed through testing of small samples, and finally, a formal questionnaire is developed for large sample analysis. In the end, through the empirical test and analysis of a large sample, the research conclusion is drawn.

6.METHODOLOGY

By sorting out domestic and foreign literature, and based on the theory of self-determination and reciprocal determinism, this research systematically analyzes the relationship among R&D personnel's psychological empowerment, engagement, employee silence, power distance, and innovation performance, and explores the effect mechanism of R&D personnel's psychological empowerment on innovation performance. Through analysis, this paper believes that the psychological empowerment of R&D personnel can not only directly affect innovation performance, but also affect innovation performance through two paths of engagement and employee silence. In addition, power distance plays a moderating role between R&D personnel's psychological empowerment and innovation performance, and the moderating effect can also affect innovation performance through two paths of engagement and employee silence.

7. Profile of Respondents

In order to study the influence of R&D personnel's personality characteristics on their innovation performance, this study designed a statistical table of R&D personnel's basic data based on the statistical variables of employees' personality characteristics. The statistical table is divided into nine parts, including gender, age, educational background, position, professional and technical title, years of service in the unit, annual income, nature of the company, and nature of the industry. The details are shown in figure 4-1:

Table 4-1 Basic Information Statistical Measurement Scale

Items		Sources
Q1:	1. Gender: (1) Male (2) Female	Prepared according to the "Questionnaire Design Manual", Guo (2003)
Q2:	Your age: (1) Less than 25 years old (2) 25-35 years old (3) 36-45 years old (4) 45 years old and above	
Q3:	Your educational background: (1) Junior college and below (2) Undergraduate (3) Master (4) Doctor	
Q4:	Your position: (1) Ordinary employee (2) Primary manager (3) Middle managers (4) Senior managers	
Q5:	Your professional and technical title: (1) Primary (2)Intermediate (3) Vice-senior (4) Senior (5) Others	
Q6:	Your working years: (1) less than 3 years (2) 3–5 years (3) more than 5 years–10 years (4) More than 10 years–20 years (5) More than 20 years	
Q7:	Your annual income: (1) less than 50,000 yuan (2) 50,000 yuan–100,000 yuan (3) more than 100,000 yuan–150,000 yuan (4) More than 150,000 yuan–200,000 yuan (5) More than 200,000 yuan	
Q8:	The nature of your current company: (1) State-owned and state-controlled enterprises (2) Private and private holding companies (3) Foreign and foreign holding companies (4) Others	
Q9:	1. Nature of your company's industry: (1) IT/Computer hardware and software/Computer services (2) Communication/Telecommunication operation/Network equipment/Value-added services (3) Internet/E-commerce (4) Instrumentation/Work automation (5) Electronic technology/Semiconductor/Integrated circuit (6) Automobiles and spare parts (7) Machinery/Equipment/Heavy industry (8) Others	

The data for each variable required for this study were filled in by the same subject population, and all scales were filled in by subject self-report, so artificial covariation between predictor variables and criterion variables was inevitable, i.e., the common method bias problem (CMB). The common method bias problem can be controlled through both process control and statistical control (Xiong et al., 2012).

The process control method is pre-control, which means that in the process of filling in the questionnaire, strict control is carried out on the data source, the measured object, the time and place of the measurement, etc., to ensure the authenticity and validity of the obtained data. The main process controls adopted in this study are: For the source of data, in the same enterprise, the questionnaire should be distributed to different R&D departments to fill in, and cannot be filled in by employees of the same department. No more than 40 questionnaires should be filled out by employees of the same enterprise; to reduce the retrospective error of the subjects, the main variables are misordered in the design of the questionnaire; Adopting a mature scale with high reliability and validity; for different sub-questionnaires; designing an introduction to inform the respondents of the purpose of the test, etc.

Statistical control methods are post-control, including Harman's single-factor test, partial correlation procedures, controlling for the effects of latent methods factor, etc. Among the above methods, Harman's single-factor test method proposed by Long et al. (2004) is widely used, and this study also adopts Harman's single-factor test method. The test procedure of Harman's single-factor test method is as follows: put all variables into an exploratory factor analysis, test the unrotated factor analysis results, examine the number of factors with eigenvalues greater than 1, and the cumulative percentage of variance of the first factor, When the percentage is less than the threshold value of 40%, the degree of common method bias can be judged to be small.

As shown in Table 4-2, this study used exploratory factor analysis in Harman's single-factor test method for common method bias testing, and the question items of all variables were put into the same model for exploratory factor analysis, and a total of 10 factors with eigenvalues greater than 1 were extracted from the single-factor test results for all measured question items, which collectively explained 61.056% of the variance. The maximum percentage of variance explained is 30.900%, which is less than the critical standard of 40%, indicating that there is no obvious common method deviation between the variable items involved in this study, and subsequent empirical analysis can be carried out.

Table 4-2 Analysis of Common Method Bias Test

Initial Eigenvalue				Extraction sums of squared loadings			
Components	Total	% of Variance	Cumulative % of	Total	% of Variance	Cumulative % of	
1	19.158	30.900	30.900	19.158	30.900	30.900	
2	6.245	10.073	40.973	6.245	10.073	40.973	
3	2.685	4.330	45.304	2.685	4.330	45.304	
4	1.947	3.141	48.445	1.947	3.141	48.445	
5	1.765	2.846	51.291	1.765	2.846	51.291	
6	1.536	2.478	53.769	1.536	2.478	53.769	
7	1.309	2.111	55.880	1.309	2.111	55.880	
8	1.265	2.041	57.921	1.265	2.041	57.921	
9	1.131	1.824	59.745	1.131	1.824	59.745	
10	1.092	1.761	61.506	1.092	1.761	61.506	

8. Finding and discussion

8.1 Research Objective 1 (R.O.1) Psychological Empowerment and Innovation Performance of R&D Personnel

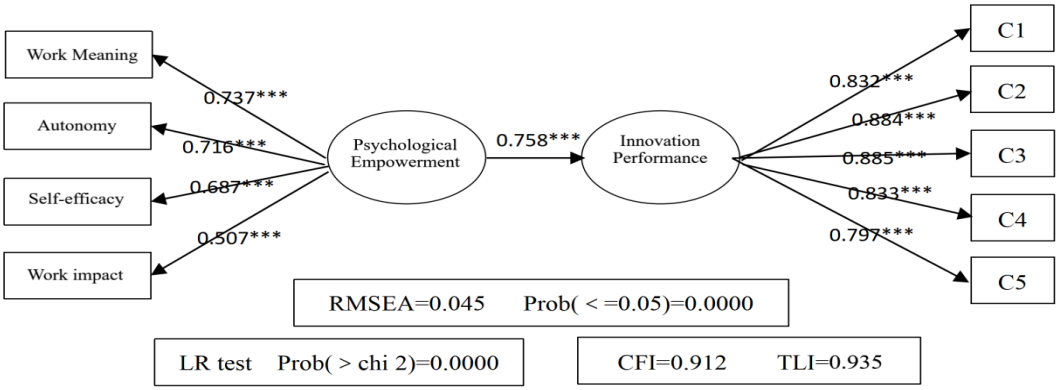

Figure 4-1 Model of Impact of Psychological Empowerment on Innovation Performance
Note: ***, p<0.01; **, P<0.05; *, P<0.1

Figure 4-1 shows the model fitting results of the structural equation for the effect of R&D personnel's psychological empowerment on innovation performance, with RMSEA of 0.045, which meets the requirement of RMSEA less than 0.08; CFI of 0.912 and TLI of 0.935, which meets the requirement of both CFI and TLI greater than 0.9. The results of the fit indices show that the overall model fitting of the structural equation model of the impact of R&D personnel's psychological empowerment on innovation performance is good. The results of the empirical test in Figure 4-1 show that the standardized path coefficient between R&D personnel's psychological empowerment and innovation performance is 0.758, with a p-value less than 0.01, indicating that psychological empowerment of R&D personnel has a significant positive impact on innovation performance, and enhancing the psychological empowerment of R&D personnel helps to improve the innovation performance of R&D personnel. So Hypopaper H1: the psychological empowerment of R&D personnel has a positive impact on innovation performance, is supported by empirical results.

Figure 4-2 shows the model fitting results of the structural equation for the effects of work meaning, autonomy, self-efficacy and work impact on innovation performance of R&D personnel, with RMSEA of 0.049, which meets the requirement of RMSEA less than 0.08; CFI of 0.928 and TLI of 0.946, which meets the requirement of both CFI and TLI greater than 0.9. The results of the fit indices show that the overall model fitting of the structural equation model of the impact of R&D personnel's job meaning, autonomy, self-efficacy, and job impact on innovation performance is good.

The results of the empirical tests in Figure 4-2 show that the standardized path coefficients between R&D personnel's autonomy, self-efficacy and work impact and innovation performance range from 0.465 to 0.721, with p-values less than 0.01 for autonomy and self-efficacy and less than 0.05 for work impact, indicating that there is a significant positive effect of R&D personnel's autonomy, self-efficacy and work impact on innovation performance, enhancing R&D personnel's autonomy, self-efficacy and work impact at work can help to enhance R&D personnel's innovation performance. So Hypotheses H1b, H1c, H1d: R&D personnel's autonomy, self-efficacy, and work impact have positive impacts on innovation

performance, is supported by empirical results. The standardized path coefficient between R&D personnel's work meaning and innovation performance is 0.102, and the P value is greater than 0.1, indicating that R&D personnel's work meaning has no significant impact on innovation performance. So Hypopaper H1a: the job meaning of R&D personnel has a positive impact on innovation performance, is not supported by empirical results.

8.2 Research Objective 2 (R.O.2) Psychological Empowerment of R&D Personnel, Engagement, and Employee Silence

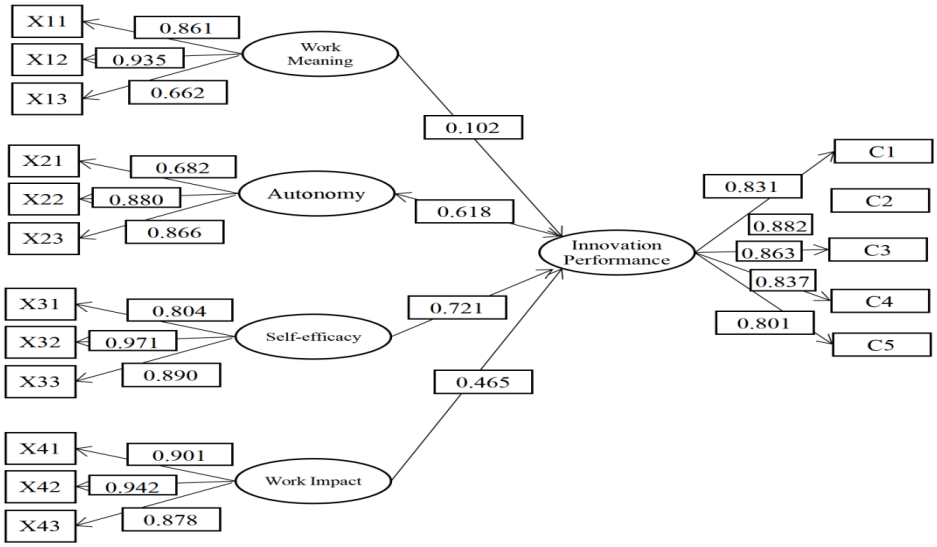

Figure 4-2 Model of Impact of Various Dimensions of Psychological Empowerment on Innovation Performance

Note: ***, p<0.01; **, P<0.05; *, P<0.1

Figure 4-3 shows the model fitting results of the structural equation for the effect of psychological empowerment of R&D personnel on engagement and employee silence, with RMSEA of 0.052, which meets the requirement of RMSEA less than 0.08, CFI of 0.931, and TLI of 0.927, which meets the requirement of both CFI and TLI greater than 0.9. The results of the fit indices show that the overall model fitting of the structural equation model of the impact of R&D personnel's psychological empowerment on engagement and employee silence is good.

The results of the empirical test in Figure 4-3 show that the standardized path coefficient between R&D personnel's psychological empowerment and engagement is 0.920, with a p-value less than 0.01, indicating that psychological empowerment of R&D personnel has a significant positive impact on engagement, and enhancing the psychological empowerment of R&D personnel helps to improve the engagement of R&D personnel. The standardized path coefficient between R&D personnel's psychological empowerment and employee silence is -0.703, with a p-value less than 0.01, indicating that there is a significant negative effect of R&D personnel's psychological empowerment on employee silence, and enhancing R&D personnel's psychological empowerment can effectively weaken the degree of employee silence. So Hypopaper H2: the psychological empowerment of R&D personnel has a positive impact on engagement, and Hypopaper H4: the psychological empowerment of R&D personnel have a negative impact on employee silence, are all supported by empirical results.

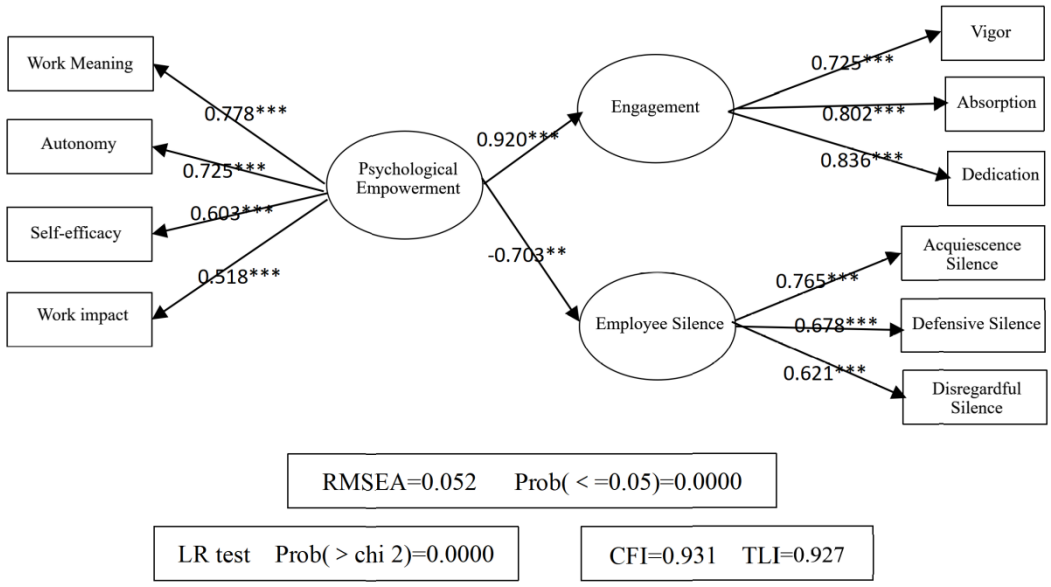

Figure 4-3 Model of Impact of Psychological Empowerment on Engagement and Employee Silence

Note: ***: p<0.01; **: P<0.05; *: P<0.1

Figure 4-4 shows the model fitting results of the structural equation for the effect of psychological empowerment of R&D personnel on vigor, absorption, and dedication, with RMSEA of 0.059, which meets the requirement of RMSEA less than 0.08; CFI of 0.937 and TLI of 0.938, which meets the requirement of both CFI and TLI greater than 0.9. The results of the fit indices show that the overall model fitting of the structural equation model of the influence of R&D personnel's psychological empowerment on vigor, absorption, and dedication is good.

Figure 4-4 empirical test results show that the standardized path coefficients between R&D personnel's psychological empowerment and absorption, and dedication are 0.851 and 0.768, respectively, with p-values less than 0.01, indicating that there is a significant positive impact of R&D personnel's psychological empowerment on absorption and dedication, and enhancing R&D personnel's psychological empowerment helps to improve R&D personnel's absorption and dedication to their work. So Hypopaper H2b: the psychological empowerment of R&D personnel has a positive impact on absorption, and H2c: the psychological empowerment of R&D personnel has a positive impact on dedication, are supported by empirical results. The standardized path coefficient between R&D personnel's psychological empowerment and vigor is -0.312, and the P value is less than 0.01, indicating that R&D personnel's psychological empowerment has a significant negative impact on vigor. So Hypopaper H2a: the psychological empowerment of R&D personnel has a positive impact on vigor, is supported by empirical results.

Figures 4-5 show the model fitting results of the structural equations for the effect of R&D personnel's psychological empowerment on acquiescent silence, defensive silence, and disregardful silence, with RMSEA of 0.071, which meets the requirement of RMSEA less than 0.08; CFI of 0.969 and TLI of 0.971, which meets the requirement of both CFI and TLI greater than 0.9. The results of the fit indices show that the overall model fitting of the structural

equation model of the impact of R&D personnel's psychological empowerment on acquiescent silence, defensive silence, and disregardful silence is good.

The results of the empirical tests in Figures 4-5 show that the standardized path coefficients between R&D personnel's psychological empowerment and acquiescent silence and disregardful silence are -0.731 and -0.813, respectively, with p-values less than 0.01, indicating that there is a significant negative effect of R&D personnel's psychological empowerment on acquiescent silence and disregarded silence, and that enhancing R&D personnel's psychological empowerment can effectively weaken the degree of employees' acquiescent silence and disregardful silence. So Hypopaper H4a: the psychological empowerment of R&D personnel has a negative impact on acquiescent silence, and H4c: the psychological empowerment of R&D personnel has a negative impact on disregardful silence, are supported by empirical results. The standardized path coefficient between the psychological empowerment of R&D personnel and defensive silence is -0.243, and the P value is greater than 0.01, indicating that the psychological empowerment of R&D personnel has no effect on defensive silence. So Hypopaper H4b: the psychological empowerment of R&D personnel has a negative impact on defensive silence, is supported by empirical results.

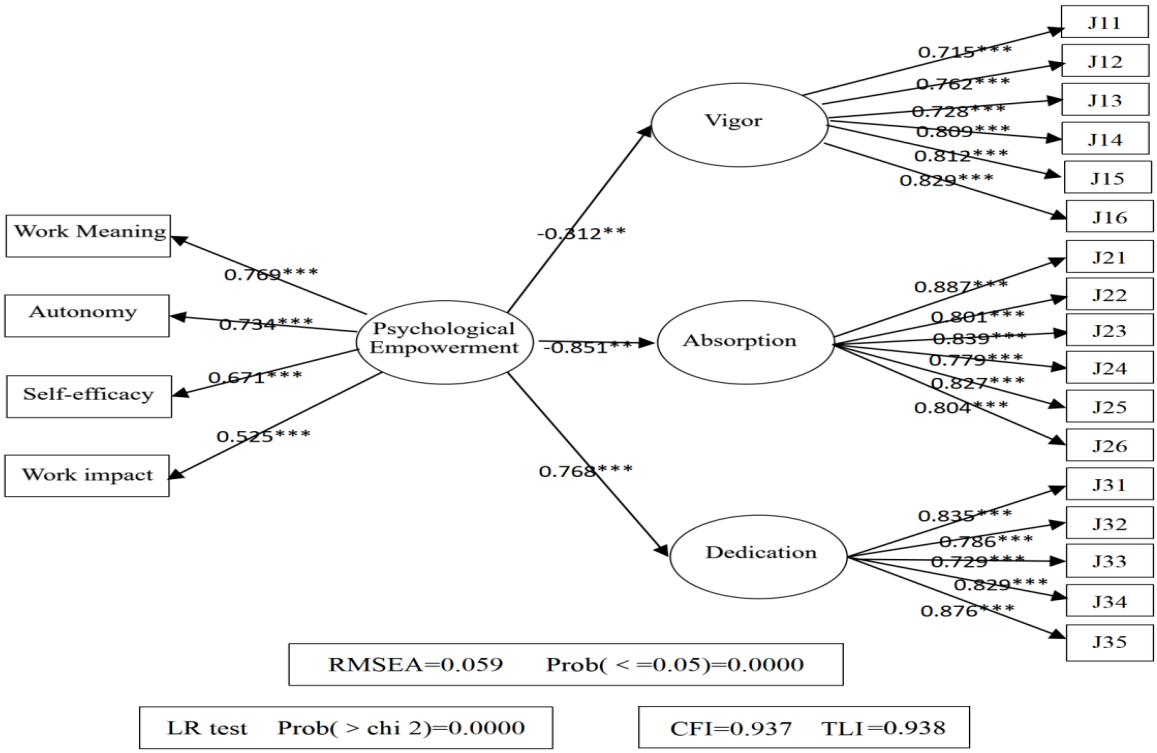

Figure 4-4 Model of Impact of Psychological Empowerment on Each Dimension of Engagement
Note: ***: p<0.01; **: P<0.05; *: P<0.1

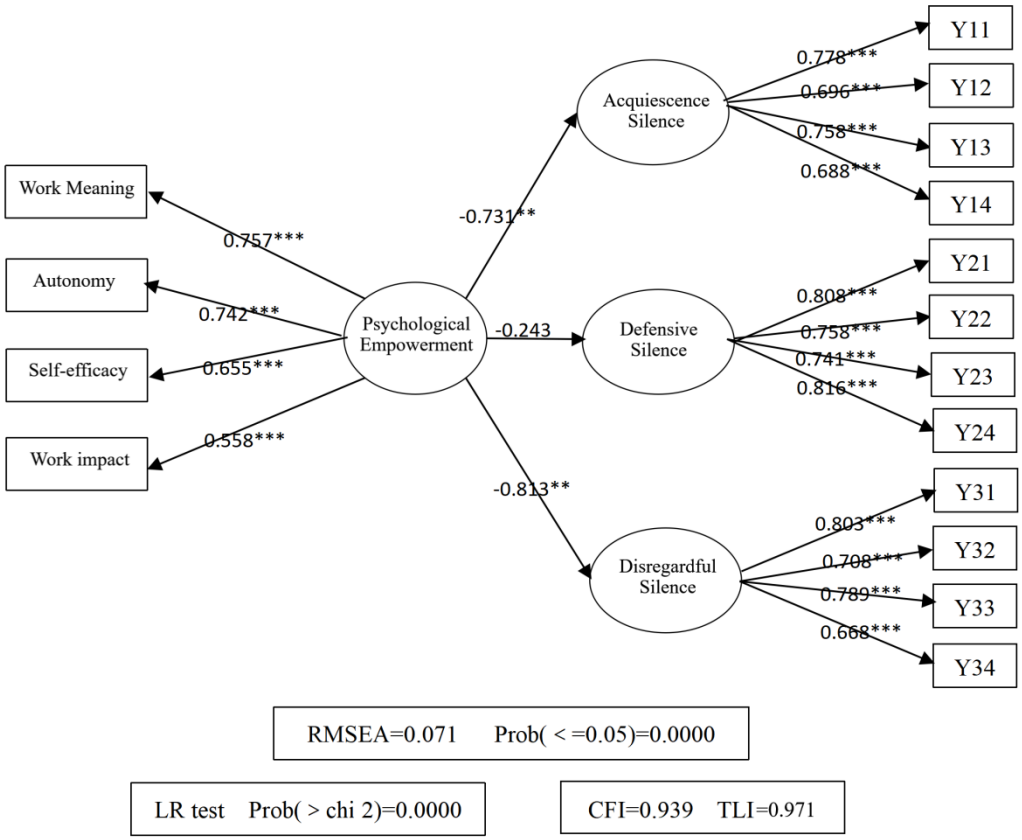

Figure 4-5 Model of Impact of Psychological Empowerment on Various Dimensions of Employee Silence

Note: ***, p<0.01; **, P<0.05; *, P<0.1

8.3 Research Objective 3 (R.O.3) Engagement and Employee Silence of R&D personnel and Innovation Performance

Figure 4-6 shows the model fitting results of the structural equation for the impact of engagement and employee silence of R&D personnel on innovation performance, with RMSEA of 0.059, which meets the requirement of RMSEA less than 0.08; CFI of 0.945 and TLI of 0.958, which met the requirement that both CFI and TLI greater than 0.9. The results of the fit indices show that the overall model fitting of the structural equation model of the impact of R&D personnel's engagement and employee silence on innovation performance is good.

The empirical test results in Figure 4-6 show that the standardized path coefficient between R&D personnel's engagement and innovation performance is 0.826, and the P value is less than 0.01, indicating that R&D personnel's engagement has a significant positive impact on innovation performance, and improving the degree of R&D personnel's engagement helps to improve the innovation performance of R & D personnel. The standardized path coefficient between R&D personnel's employee silence and innovation performance is -0.732, and the P value is less than 0.01, indicating that R&D personnel's employee silence has a significant negative impact on innovation performance, and suppressing R&D personnel's employee silence can effectively improve staff innovation performance. So Hypopaper H3: the engagement of R&D personnel has a positive impact on innovation performance, and Hypopaper H5: the employee silence of R&D personnel has a negative impact on innovation performance, are all supported by empirical results.

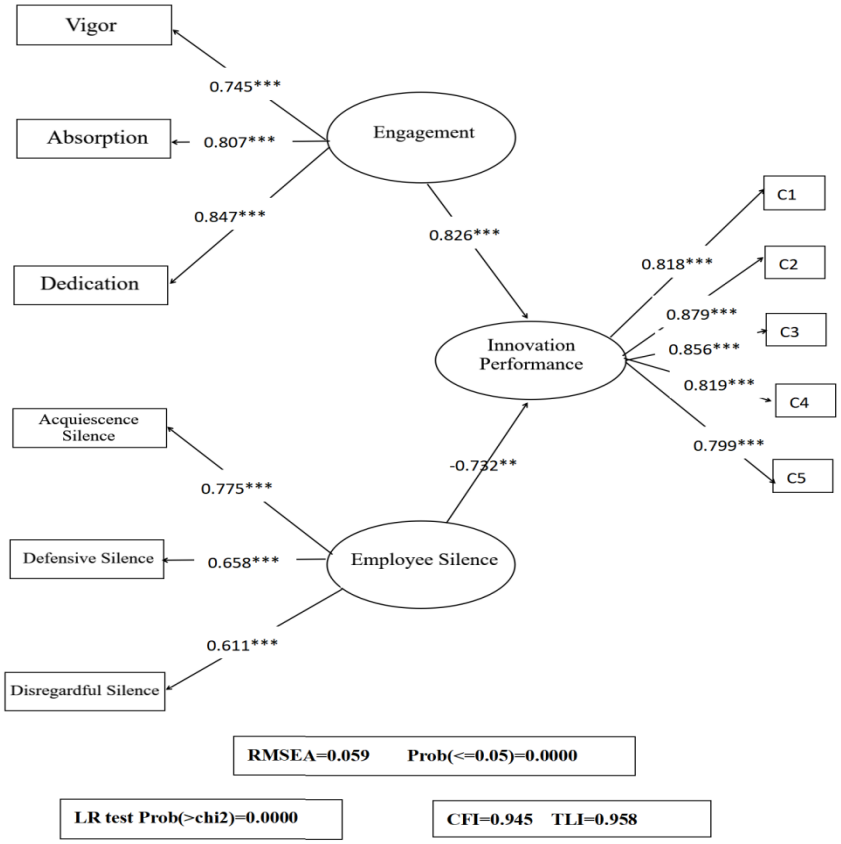

Figure 4-6 Model of Impact of Engagement and Employee Silence on Innovation Performance
Note: ***: p<0.01; **: P<0.05; *: P<0.1

Figure 4-7 shows the model fitting results of the structural equation for the effects of vigor, absorption, and dedication of R&D personnel on innovation performance, with RMSEA of 0.042, which meets the requirement of RMSEA less than 0.08, CFI of 0.939 and TLI of 0.943, which meets the requirement of both CFI and TLI greater than 0.9. The results of the fit indices show that the overall model fitting of the structural equation model of the impact of R&D personnel's vigor, absorption, and dedication on innovation performance is good.

The results of the empirical tests in Figure 4-7 show that the standardized path coefficients between R&D personnel's vigor, absorption, and dedication and innovation performance are 0.657, 0.726 and 0.524, respectively, with p-values less than 0.01, indicating that the vigor, absorption, and dedication of R&D personnel have significant positive impacts on innovation performance, and that enhancing R&D personnel's vigor, absorption, and dedication in their work helps to improve R&D personnel's engagement. So Hypotheses H3a, H3b, and H3c: R&D personnel's vigor, absorption, and dedication have positive impacts on innovation performance, are all supported by empirical results.

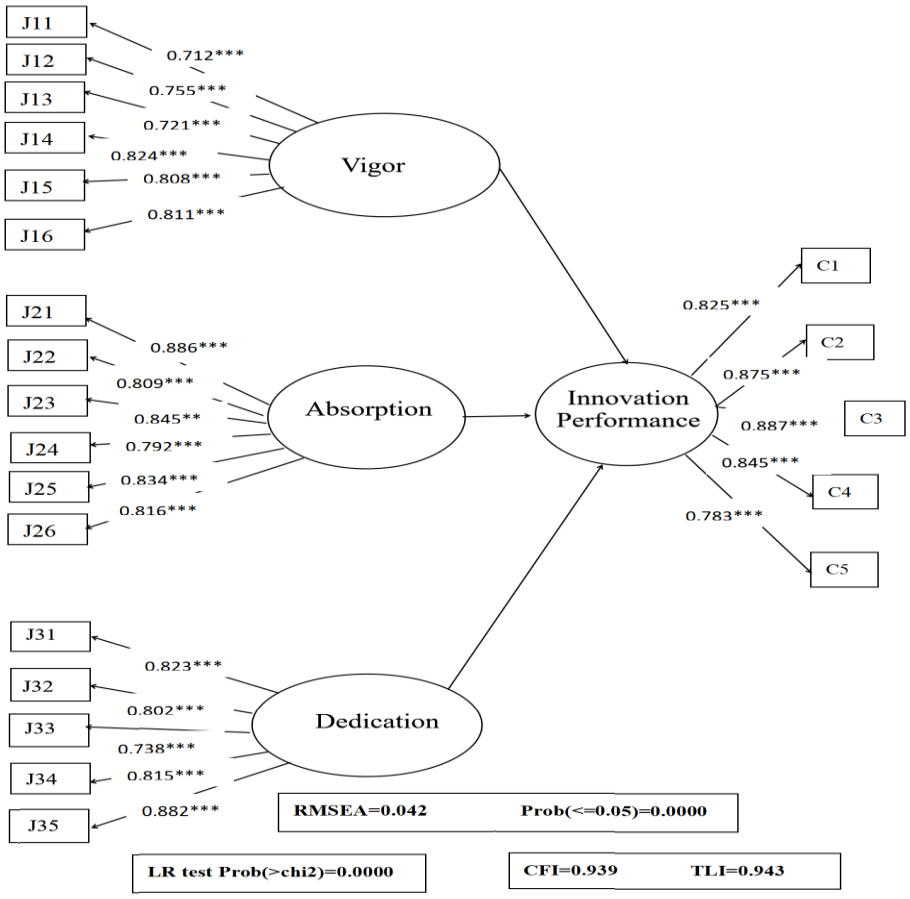

Figure 4-7 Model of Impact of Each Dimension of Engagement on Innovation Performance
Note: ***: p<0.01; **: P<0.05; *: P<0.1

Figures 4-8 show the model fitting results of structural equations for the effects of R&D personnel's acquiescent silence, defensive silence, and disregardful silence on innovation performance, with RMSEA of 0.069, which meets the requirement of RMSEA less than 0.08, CFI of 0.956 and TLI of 0.967, which meets the requirement of both CFI and TLI greater than 0.9. The results of the fit indices show that the overall model fitting of the structural equation models of the impact of R&D personnel's acquiescent silence, defensive silence, and disregardful silence on innovation performance is good.

The results of the empirical tests in Figures 4-8 show that the standardized path coefficients between R&D personnel's acquiescent silence, defensive silence, and disregardful silence and innovation performance are -0.578, -0.625, and -0.593, respectively, with p-values less than 0.01, indicating that R&D personnel's acquiescent silence, defensive silence, and disregardful silence have significant negative impacts on innovation performance, and suppressing R&D personnel's acquiescent silence, defensive silence, and disregardful silence at work helps to improve the innovation performance of R&D personnel. So Hypotheses H5a, H5b, and H5c: acquiescent silence, defensive silence, and disregardful silence of R&D personnel have negative impacts on innovation performance, are supported by empirical results.

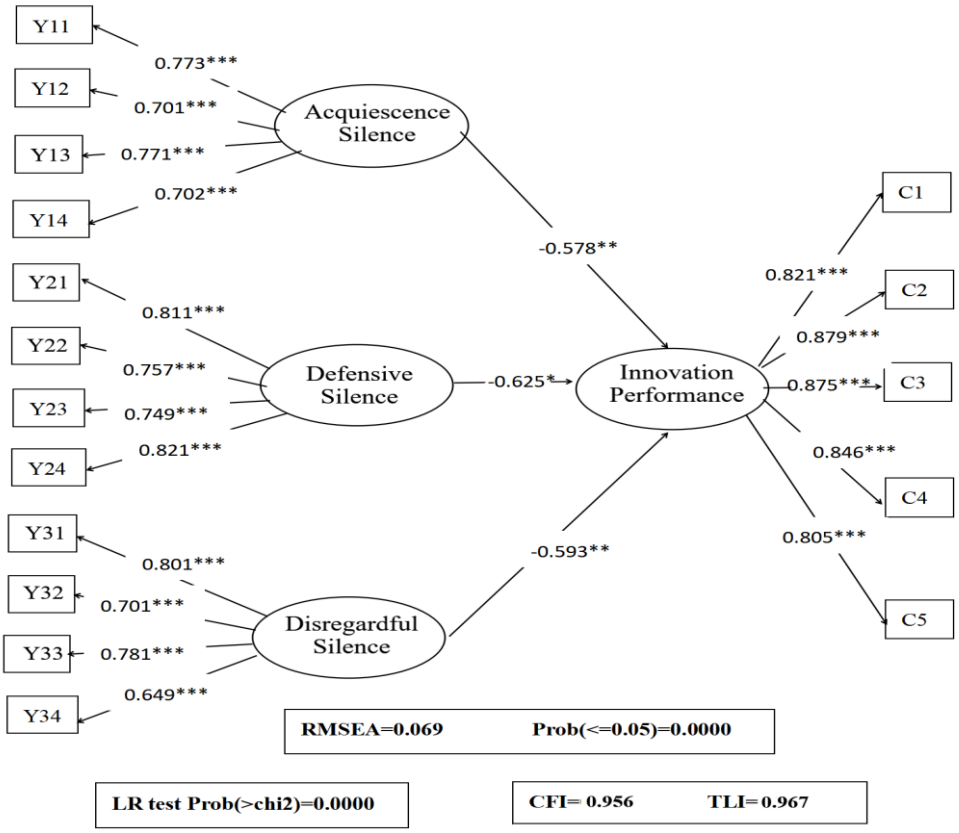

Figure 4-8 Model of Impact of Employee Silence on Innovation Performance
Note: ***: p<0.01; **: P<0.05; *: P<0.1

8.4 Research Objective 4 (R.O.4): Dual Mediating Effect of Engagement and Employee Silence

Figure 4-9 shows the model fitting results of the structural equation for the dual mediating effect of engagement and employee silence, with RMSEA of 0.078, which meets the requirement of RMSEA less than 0.08, CFI of 0.969, and TLI of 0.963, which meets the requirement of both CFI and TLI greater than 0.9. The results of the fit indices show that the overall model fitting of the structural equation model of the dual mediating effects of engagement and employee silence is good.

The results of the empirical tests in Figure 4-9 show that the standardized path coefficient between R&D personnel‘s psychological empowerment and engagement is 0.828, and the standardized path coefficient between R&D personnel's engagement and innovation performance is 0.839, with p-values less than 0.01, indicating that there is a significant positive impact of R&D personnel's psychological empowerment on innovation performance through the engagement path, and enhancing R&D personnel's psychological empowerment helps to improve their engagement, and ultimately achieve the purpose of improving R&D personnel's innovation performance. The standardized path coefficient between R&D personnel‘s psychological empowerment and employee silence is -0.608, and the standardized path coefficient between R&D personnel employee's employee silence and innovation performance is -0.652, both with p-values less than 0.01, indicating that there is a significant positive effect of R&D personnel's psychological empowerment on innovation performance through employee silence path, and enhancing R&D personnel's psychological empowerment can effectively weaken the degree of employee silence and inhibit the damage of employee silence

on innovation performance, thus improving the innovation performance of R&D personnel. So Hypopaper H6: engagement and employee silence have a dual mediating role in the impact of R&D personnel's psychological empowerment on innovation performance, is supported by empirical results.

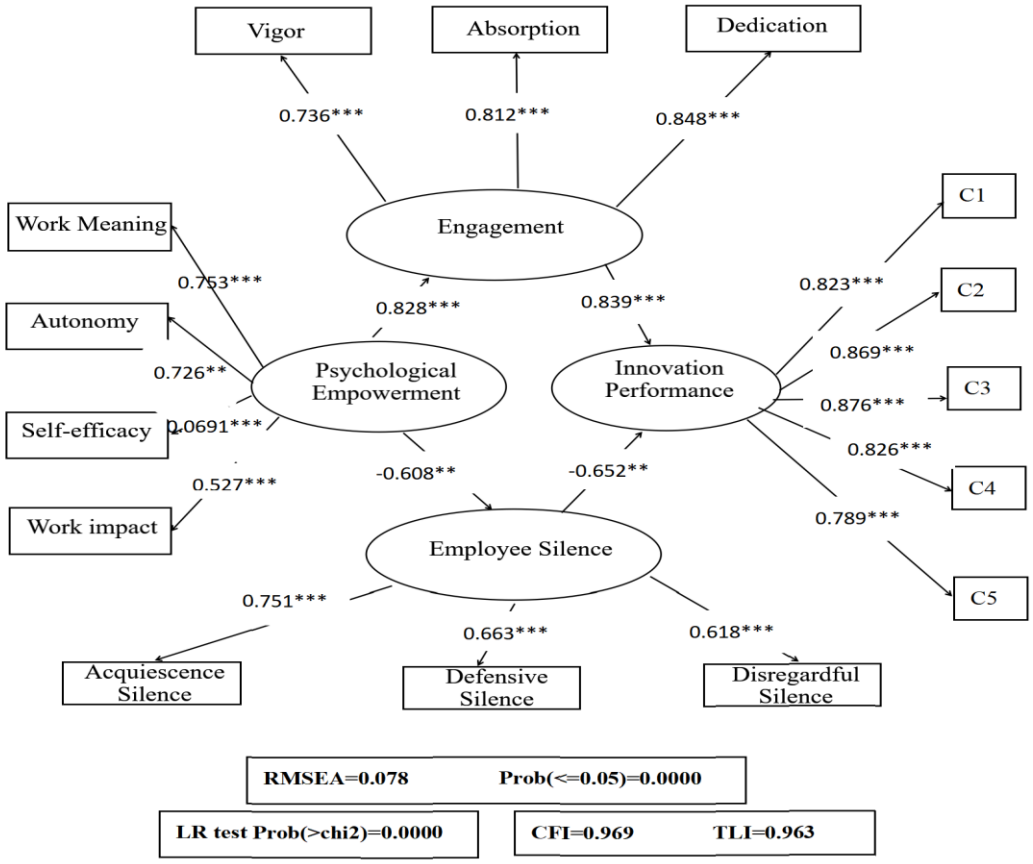

Figure 4-9 Dual Mediating Effect Model of Engagement and Employee Silence
Note: ***: p<0.01; **: P<0.05; *: P<0.1

Further analysis of the empirical test results in Figure 4-9 shows that the indirect effect of R&D personnel's psychological empowerment on innovation performance through the engagement path is 0.695 (a1b1: 0.828×0.839), and the indirect effect of R&D personnel's psychological empowerment on innovation performance through the employee silence path is 0.396 (a2b2: -0.608×-0.652). A nonlinear test (Ho: a1×b1-a2×b2=0) is conducted to test the difference in the indirect effects of the two paths of psychological empowerment of R&D personnel on innovation performance, and the test results (a1×b1-a2×b2=0.299, p=0.038) indicate that the difference in the indirect effect coefficients of the two paths reaches a significance level of 5%, and the indirect effect of the engagement path is greater than that of the employee silence path indirect effect, indicating that the magnitude of the effect of R&D personnel's psychological empowerment on innovation performance through the engagement path is greater than the magnitude of the effect of psychological empowerment on innovation performance through the employee silence path.

8.5 Research Objective 5 (R.O.5): Moderating Effect of Power Distance

Figure 4-10 shows the model fitting results of the structural equation for the moderating effect of power distance on the relationship between psychological empowerment and innovation

performance of R&D personnel, with RMSEA of 0.076, which meets the requirement of RMSEA less than 0.08, CFI of 0.963, and TLI of 0.975, which meets the requirement of both CFI and TLI greater than 0.9. The results of the fit indices show that the overall model fitting of the structural equation model of the power distance's moderate effect on the relationship between R&D personnel's psychological empowerment and innovation performance is good.

The results of the empirical tests in Figure 4-10 show that the standardized path coefficient between R&D personnel's psychological empowerment and innovation performance is 0.706, with a p-value less than 0.01, and the standardized path coefficient between the interaction term of R&D personnel's psychological empowerment×power distance and innovation performance is -0.204, with p less than 0.01, indicating that power distance can moderate the effect of R&D personnel's psychological empowerment on innovation performance, and there is moderating effect. The standardized path coefficient between R&D personnel's psychological empowerment and innovation performance is positive, and the standardized path coefficient between the interaction term of R&D personnel's psychological empowerment×power distance and innovation performance is negative, indicating that the moderating effect is an interference-type moderating effect, and the degree of influence of R&D personnel's psychological empowerment on innovation performance decreases with increasing power distance. So Hypopaper H7: power distance has a moderating role in the impact of R&D personnel's psychological empowerment on innovation performance, is supported by empirical results.

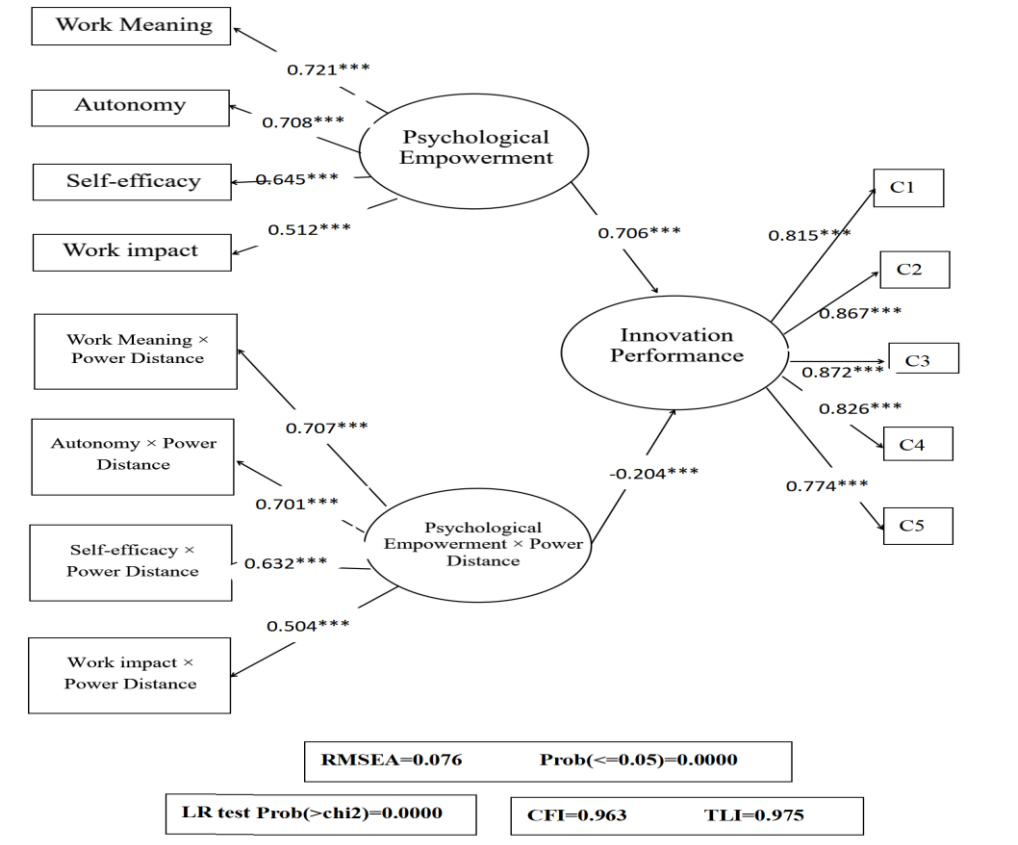

Figure 4-10 Power Distance Moderating Effect Model
Note: ***: p<0.01; **: P<0.05; *: P<0.1

8.6 Moderating Effects With Mediators

Figure 4-11 shows the model fitting results of the structural equation of the moderating effect of power distance mediated by dedication and employee silence, with RMSEA of 0.081, which is basically close to the requirement that RMSEA is less than 0.08 and has little effect on the overall fit of the structural equation, CFI of 0.989, and TLI of 0.993, which meets the requirement that both CFI and TLI are greater than 0.9. The results of the fit indices show that the overall model fitting of the structural equation model of the moderating effect of power distance mediated by engagement and employee silence is good.

The results of the empirical tests in Figure 4-11 show that the standardized path coefficient between R&D personnel's psychological empowerment and engagement is 0.817, with a p-value less than 0.01, and the standardized path coefficient between it and employee silence is -0.593, with a p-value less than 0.01. The standardized path coefficient between the interaction term of R&D personnel's psychological empowerment×power distance and engagement is -0.487, with a P value of less than 0.01, and the standardized path coefficient between it and employee silence is 0.247, with a P value of less than 0.01. It shows that the moderating effect of power distance on R&D personnel's psychological empowerment and innovation performance also works through engagement and employee silence paths. Engagement and employee silence play a dual mediating role in the process of power distance moderating the relationship between R&D personnel's psychological empowerment and innovation performance. The moderating effect is an interference moderating effect, and the influence of R&D personnel's psychological empowerment on engagement and employee silence will decrease with the increase of power distance. So Hypopaper H8: power distance uses engagement and employee silence as dual mediators to moderate the impact of R&D personnel's psychological empowerment on innovation performance, which is a moderating effect with dual mediators, is supported by empirical results.

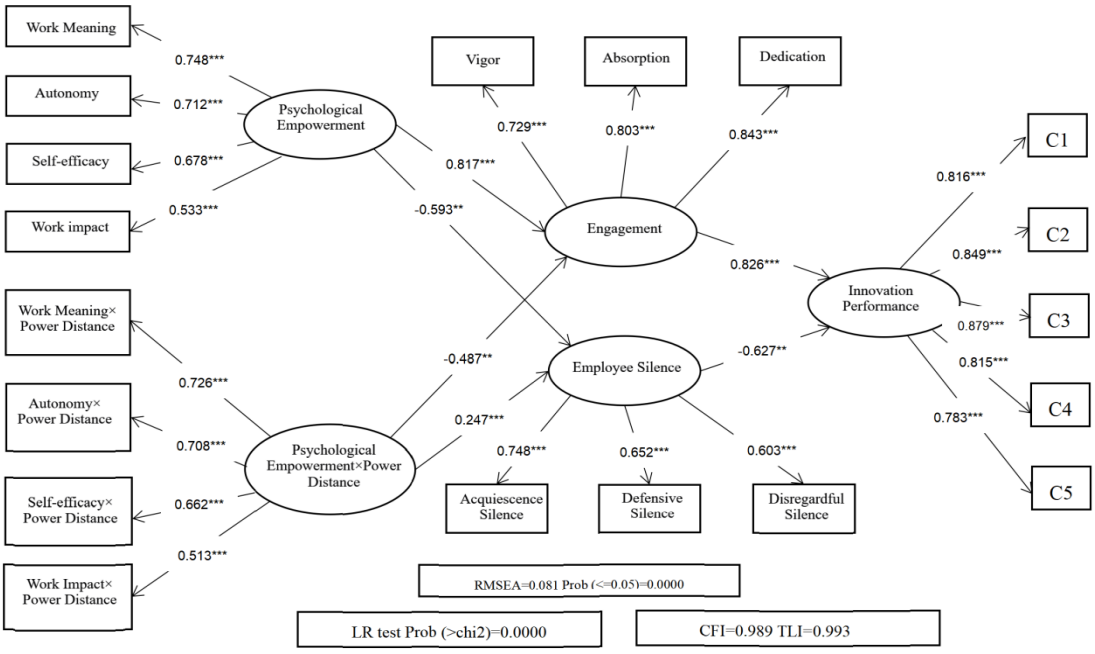

Figure 4-11 Mediated Moderating Effect Model of Power Distance
Note: ***, p<0.01; **, P<0.05; *, P<0.1

Conclusion

Through the empirical test of the sample data in this chapter, the empirical test results of each research paper are obtained, and the specific summary is shown in Table 4-3.

Table 4-3 Summary of Test Results of Research Hypotheses

Serial number	Content of hypopaper	Result
H1	The psychological empowerment of R&D personnel has a positive impact on innovation performance.	Supported
H1a	The job meaning of R&D personnel has a positive impact on innovation performance.	Not supported
H1b	The autonomy of R&D personnel has a positive impact on innovation performance.	Supported
H1c	The self-efficacy of R&D personnel has a positive impact on innovation performance.	Supported
H1d	The work impact of R&D personnel has a positive impact on innovation performance.	Supported
H2	The psychological empowerment of R&D personnel has a positive impact on engagement.	Supported
H2a	The psychological empowerment of R&D personnel has a positive impact on vigor.	Not supported
H2b	The psychological empowerment of R&D personnel has a positive impact on absorption.	Supported
H2c	The psychological empowerment of R&D personnel has a positive impact on dedication.	Supported
H3	The engagement of R&D personnel has a positive impact on innovation performance.	Supported
H3a	The vigor of R&D personnel has a positive impact on innovation performance.	Supported
H3b	The absorption of R&D personnel has a positive impact on innovation performance.	Supported
H3c	The dedication of R&D personnel has a positive impact on innovation performance.	Supported
H4	The psychological empowerment of R&D personnel has a negative impact on employee silence.	Supported
H4a	The psychological empowerment of R&D personnel has a negative impact on acquiescent silence.	Supported
H4b	The psychological empowerment of R&D personnel has a negative impact on defensive silence.	Not supported
H4c	The psychological empowerment of R&D personnel has a negative impact on disregardful silence.	Supported
H5	The employee silence of R&D personnel has a negative impact on innovation performance.	Supported
H5a	The acquiescent silence of R&D personnel has a negative impact on innovation performance.	Supported
H5b	The defensive silence of R&D personnel has a negative impact on innovation performance.	Supported
H5c	The disregardful silence of R&D personnel has a negative impact on innovation performance.	Supported
H6	Engagement and employee silence have a dual mediating role in the impact of R&D personnel's psychological empowerment on innovation performance.	Supported
H7	Power distance has a moderating role in the impact of R&D personnel's psychological empowerment on innovation performance.	Supported
H8	Power distance uses engagement and employee silence as dual mediators to moderate the impact of R&D personnel's psychological empowerment on innovation	Supported

In order to improve R&D personnel's innovation performance, the current HRM departments of enterprises mainly start from the social exchange theory to motivate R&D personnel from the perspective of satisfying employees' needs, and this perspective ignores the important influence of employees' inner positive psychology on their work behavior (Bai 2021; Wang 2022: Tian 2022).

As the core employees of innovative companies, the work status of R&D personnel is largely influenced by their level of psychological empowerment. Therefore, it is theoretically supported to study in depth the influence of R&D personnel's psychological empowerment on their work behavior and job performance in the Chinese cultural context (Bai 2021; Wang 2022: Tian 2022).

However, in the limitation of studies of psychological empowerment theory, most western scholars' study psychological empowerment as a mediator, in-depth study on the effect of overall mechanism of psychological empowerment thus can be considered for the future research (Wang 2022: Tian 2022). Especially in the context of Chinese culture, there is little research on the effect mechanism of psychological empowerment of employees in specific fields.

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Cite this article:

Xia Ronghua (2022). The Relationship Between Psychological Empowerment and Innovation Performance of R&D Employees. *International Journal of Science and Business, 15*(1), 113-134. doi: https://doi.org/10.5281/zenodo.7339125

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