The “Double-Edged Sword” Effect of Perceived AI Application on Knowledge Workers'Innovative Behavior: Empowerment Perception and Replacement Anxiety as Parallel Mediators

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Abstract

This study examines the mechanisms through which perceptions of AI applications influence the innovative behavior of knowledge workers from the perspective of employee cognitive psychology. Building on this foundation, it proposes a parallel mediation model that integrates psychological empowerment theory, job insecurity theory, and resource conservation theory, with AI empowerment and AI replacement anxiety serving as mediating variables. Data were collected via questionnaires and analyzed using regression analysis and the Bootstrap method. The findings indicate that perceptions of AI applications can enhance the innovative behavior of knowledge workers, and this effect operates through two distinct mechanisms: First, perceptions of AI applications increase AI empowerment, which in turn enhances employees' self-efficacy and sense of resource control, thereby promoting innovative behavior; second, perceptions of AI applications also trigger AI replacement anxiety, which conversely inhibits the development of innovative behavior; Mediation analysis revealed that both factors play a partial mediating role but in opposite directions, indicating that AI application exhibits a “double-edged sword effect.” The study also found that the impact of perceived AI application on employee behavior is multi-layered and complex. By examining both positive and negative aspects, this paper not only contributes to understanding employee behavior in an AI environment but also provides insights for enterprises to better apply artificial intelligence and enhance their innovation capabilities.

Keywords**:** *Perception of AI applications, anxiety about AI replacement, knowledge workers, innovative behavior, mediating effect*

1. Introduction

Currently, AI technology is penetrating the core operations of various industries at an unprecedented pace. While transforming work patterns, it is also having a profound impact on many professions that require deep expertise, experience, and tacit skills. Furthermore, AI is already capable of effectively handling tasks such as data processing, article writing, and proposal drafting, making tasks once thought to be exclusive to humans standardizable, automatable, and even optimizable. The application of artificial intelligence is significantly transforming the work patterns of knowledge workers. While it boosts labor productivity, it also reshapes the professional ecosystem. It has created an entirely new set of tools, yet it has brought about numerous complex psychological and social challenges. In this context, knowledge workers’ subjective perceptions of AI applications—rather than the technology itself—determine their willingness to adopt it. These perceptions are distinctly dual-natured: On one hand, knowledge workers may view AI as a powerful assistant capable of handling routine, repetitive tasks, offering advice to help them perform better, and even expanding their capabilities—thereby fostering a sense of accomplishment and confidence, known as “empowerment.” On the other hand, the potential for AI to replace human labor fuels concerns about career security, personal uniqueness, and the future, giving rise to a pervasive sense of replacement anxiety. These two conflicting sentiments constitute the dual aspects of the psychological state of knowledge workers in the AI era.

Knowledge workers refer to employees who perform their job duties by leveraging their knowledge, skills, creativity, and intellectual capital. Their work is characterized by a focus on the analysis of information and data, as well as innovation. They engage in tasks that require specialized knowledge and technical expertise, and through continuous learning and creativity, they enhance their own value while simultaneously increasing the value of the company. However, the appreciation of intellectual capital and the optimal utilization of organizational resources both rely on the carriers of knowledge—knowledge workers. Overall, knowledge workers are the individuals or groups within an organization that pursue autonomy, personalization,

differentiation, and innovation; they are a vital force for promoting internal innovation and enhancing the company's competitiveness.

This psychological process leads employees to exhibit two distinct tendencies in innovative behavior. A sense of empowerment can motivate employees to actively try new methods and explore new areas, manifesting as promotive innovative behavior; conversely, replacement anxiety causes them to fear failure or devaluation, leading them to avoid risks and stick to established practices, thereby engaging in defensive behavior or inhibiting innovation. Therefore, this paper analyzes the "double-edged sword" effect of perceptions regarding AI applications on the innovative behavior of knowledge workers—specifically, the mediating influence of both a sense of empowerment and replacement anxiety—and examines how these perceptions alter knowledge workers' innovative behavior through these two parallel pathways: "sense of empowerment" and "replacement anxiety." This holds significant theoretical and practical implications for understanding the micro-psychological foundations of organizational innovation in the era of human-machine collaboration, as well as for how managers should manage technological change to stimulate innovative behavior without stifling talent potential. This paper focuses on the following three research questions:

RQ1: How does the perception of AI applications affect employees' psychological well-being?

RQ2: How do a sense of empowerment and displacement anxiety each influence the innovative behavior of knowledge workers?

RQ3: Do a sense of empowerment and displacement anxiety mediate the relationship between the perception of AI applications and employees innovative behavior?

2. Objectives

Based on the above research questions, the objectives of this study are as follows:

1) To examine whether perceptions of AI applications simultaneously evoke a positive sense of empowerment and negative anxiety about job displacement among employees—that is, whether the impact of technological immersion on employees' internal psychological resources acts as a double-edged sword—thereby laying the foundation for understanding employees' emotional responses in the AI era.
2) To establish a psychological mechanism model of employee innovation in an AI environment. Furthermore, to test the following: First, whether perceptions of AI applications can promote a sense of empowerment, thereby stimulating employees' willingness to innovate—that is, whether such perceptions can foster empowerment and subsequently drive employees to engage in innovative activities; second, whether perceptions of AI applications can alleviate anxiety, thereby reducing the mediating effects of two pathways on employee innovative behavior, thus providing a more comprehensive explanation of the psychological mechanisms underlying the coexistence of technological empowerment and technological threat.
3) Theoretically explore the impact of perceptions of AI applications on employee innovation behavior, and outline the research background and significance.
4) Specifically elaborate on how perceptions of AI applications influence employee innovation behavior through the dual pathways of a sense of empowerment and replacement anxiety.
5) Specifically analyze the psychological changes brought about by AI applications among internal employees, as well as how these psychological changes further influence employee innovation behavior, and draw conclusions accordingly.

3. Literature Review

1)Main Effect Hypothesis

The Double-Edged Sword Effect of AI Applications

The application of AI technology within organizations brings significant changes to employees' work methods, task requirements, and access to resources. Moreover, the impact of AI on employee innovation is a complex relationship. Employees' frequency of AI tool usage, degree of reliance on these tools, and perception of changes to their workflows are collectively referred to as "perceptions of AI application." These perceptions, in turn, influence employee innovation through the interaction of two psychological mechanisms: "sense of empowerment" and "replacement anxiety."

From a positive perspective, "empowerment" refers to AI serving as an intelligent tool that, to a certain extent, provides people with abundant information resources and convenient ways of working. While these tools enhance work efficiency, they also inspire users with new ideas and perspectives, enabling them to complete tasks with greater ease. This, in turn, fosters creativity and generates novel ideas, encouraging them to explore various approaches and engage in discussions on diverse topics (Raisch & Krakowski, 2021). However, from a negative perspective, the application of AI may lead to changes such as the standardization of workflows and the automation of decision-making, causing employees to question the value of their positions and worry that their autonomy will be restricted or that they may even lose their jobs.

Although AI adoption has the aforementioned two-way impact on employees' innovative behavior, scholars agree that the increased resources provided by AI are the primary factor and play a decisive role. By offering employees convenient, efficient tools and abundant resources, AI generally fosters their cognitive engagement, thereby alleviating "replacement anxiety" to some extent and ultimately promoting innovative behavior.

H1:Perceived AI usage has a positive effect on employees' innovative behavior.

2) Hypothesis on Direct Effects

The promotional effect of perceived AI usage on the sense of AI empowerment

The sense of AI empowerment refers to employees' perception that AI technology has enhanced their own capabilities, knowledge, or work efficiency; it serves as a crucial psychological mediating variable linking the perception of AI applications to employees' innovative capabilities. Employees' subjective perceptions regarding the frequency of AI tool usage, the extent of their use, and changes in workflows cannot be simply equated with a sense of empowerment. Rather, the process of transforming perception into empowerment requires a certain cognitive process or contextual framework, and must also account for the influence of individual technology integration capabilities. This process can be summarized as "perception—transformation—empowerment." As employees become more familiar with AI functions, they are more likely to perceive the impact of AI on enhancing their capabilities and expanding their resources (Von Krogh, G., 2018) . That is, AI can significantly enhance employees' data processing capabilities, knowledge acquisition, and decision-making levels, granting them greater control and initiative in their work; this sense of control and initiative is the primary source of AI-driven empowerment (Cheng, Lin & Kong, 2023).

If employees view AI merely as an external support system without understanding how it works or integrating it into their task evaluations and personal decisions, then the application of AI can only lead to actual psychological empowerment for employees once they gradually develop a cognitive model that views AI as a cognitive enhancement partner and use it to define problems or complete tasks. Conversely, AI collaboration tends to be more superficial in nature, with limited effects on enhancing a sense of competence or autonomy (Baer, I., Waardenburg, L., & Huysman, M., 2025).

H2: Perceptions of AI adoption have a significant positive impact on the sense of empowerment from AI.

The mechanism by which perceptions of AI adoption trigger replacement anxiety

Anxiety about AI replacement is, in fact, a deep-seated sense of panic among employees regarding the value of their skills, their career prospects, and their professional viability in the face of the growing prevalence of AI technology. It goes beyond mere fear of job displacement; it also encompasses "skill devaluation" and "role reshaping," and there is a positive correlation between the two.

When external technological changes challenge the clarity and stability of existing job roles, the absence of appropriate organizational guidance and skill support can easily lead to role ambiguity and a sense of confusion (GreenhAigh & Rosenblatt, 1984). The theoretical foundation of the relationship is the theory of job insecurity, which posits that technological change brings not only a "quantitative" threat of unemployment but, more significantly, a "qualitative insecurity" regarding the value of individual skills and professional identity (Shoss, 2017).

The adoption of AI not only brings benefits but also poses the risk of job displacement and the obsolescence of skills. When employees believe that AI can replace the work they do—or even an entire professional field—their anxiety about being "replaced" naturally increases (Susskind, 2020; Kim, 2024). This concern goes far beyond the general issue of losing job security; it represents a fundamental doubt about the importance of humans in the era of intelligence and the future prospects for their professional development, with broader and more profound implications. Therefore, researching the mechanisms and boundaries of how

perceptions of AI applications influence displacement anxiety can help promote the responsible development of AI and reduce negative emotions among employees.

H3：Perceptions of AI applications have a significant positive impact on anxiety about AI replacement.

The mechanism through which AI empowerment drives innovative behavior

The sense of AI empowerment serves as a mediating variable between the perception of AI applications and employees' innovative behavior, playing a crucial role in fostering employee innovation. This relationship is grounded in two key concepts: the first is the theory of psychological empowerment (Spreitzer, 1995). This theory posits that if an employee can experience "a sense of meaning, competence, autonomy, and influence" in their work, they possess the most important intrinsic motivation for innovation. The second is the Conservation of Resources (COR) theory, which suggests that abundant resources make people more inclined to engage in growth-oriented and exploratory activities. AI-enabled empowerment is an important psychological resource that employees derive from technology, which can drive innovative behavior (Amabile & Pratt, 2016).

In workplaces reshaped by AI, the sense of AI empowerment forms a "perception-motivation-action" reinforcement loop that generates new practices along three mutually reinforcing pathways. However, this sense of AI empowerment does not necessarily lead to innovative actions; its impact is influenced by external conditions. The space for trial and error, resource support, and a culture of innovation provided by organizations all play a significant role in employees' willingness and ability to translate psychological empowerment into concrete actions—a positive organizational environment can reduce employees' perception of the risks associated with innovation and amplify the positive effects of the empowerment experience, whereas a conservative organizational environment can hinder this transformation. This has important implications for our overall understanding of the mechanisms underlying innovative behavior in the AI era.

H4: The perception of AI empowerment has a significant positive impact on employees' innovative behavior.

The inhibitory effect of AI replacement anxiety on innovative behavior

Replacement anxiety caused by AI applications, as a primary negative emotion, can have a significant negative impact on employees' innovative behavior (Hobfoll, 1989). Resource conservation theory posits that anxiety is a sense of potential loss of personal resources; in AI-induced anxiety, the threat of anticipated resource loss plays a primary role. With the advancement of AI technology, people are forced to expend considerable effort to prevent themselves from being replaced. The costs incurred to mitigate this risk directly consume the mental bandwidth and cognitive capacity that should be devoted to innovative thinking, leaving people unable to devote sufficient attention to generating new ideas or trying new approaches (Lam & Xu, 2019).

From a behavioral perspective, AI replacement anxiety leads people to engage in "resource-preserving—defensive behaviors." Resource conservation theory posits that when resources are scarce, people tend to "preserve limited resources" rather than "acquire more." In the workplace, this manifests as a reluctance to take on additional risks or invest more in innovation. While employees may appear to be actively learning new technologies, their learning is actually forced, fragmented, and conducted in a state of panic. Under such strain, not only does this fail to enhance corporate competitiveness, but it also depletes the psychological capital required for innovation. Furthermore, displacement anxiety can lead to a diminished sense of security among employees, which in turn reduces their motivation to innovate and take action toward innovation.

H5: AI replacement anxiety has a significant negative impact on employees' innovative behavior.

3) Hypotheses on Mediating Effects

The mediating role of AI empowerment

AI empowerment is not a single psychological variable, but a core mediating factor between the external technological environment and individual innovative behavior. This mediating role is clearly evident in both the practical implementation chain and content production. Its function is to transform the overt advantages brought by AI applications into people's internal perceptions, thereby stimulating their intrinsic motivation for innovation and promoting innovative behavior. This fully embodies the process of "technology perception—psychological change—behavioral manifestation."

AI-empowerment comprises four psychological states: competence, autonomy, meaning, and influence. The "Situation-Psychology-Behavior" framework posits that the perception of AI applications serves as an external situational signal; by altering work characteristics, it elicits corresponding emotional experiences in individuals. This mediating process is grounded in psychological empowerment theory and the "Situation-

Psychology-Behavior" framework. Psychological empowerment theory posits that the motivation for innovative activities does not stem solely from external conditions. These positive feelings, in turn, stimulate intrinsic motivation, reduce psychological barriers to innovation, and encourage employees to proactively break with convention, try new things, and explore new problems.

The perception of AI application does not directly drive innovation; rather, it requires AI empowerment as an intermediary step to bridge the gap between "perceived tool usage" and "the occurrence of innovative behavior." Therefore, in the process by which the perception of AI application influences employees' innovative behavior, the sense of AI empowerment acts as a positive mediator. In other words, the perception of AI application makes employees more willing to engage in innovative activities by enhancing their sense of AI empowerment.

H6: The sense of AI empowerment can facilitate the positive influence of perceived AI adoption on employees' innovative behavior.

The Mediating Role of AI Replacement Anxiety

AI replacement anxiety acts as a negative mediator in the relationship between perceived AI adoption and employee innovation behavior. Specifically, it hinders the connection between technology perception and innovation behavior by inducing a defensive mindset in employees and consuming their cognitive resources, thereby creating a negative chain of "technology perception → anxiety generation → innovation inhibition."

Replacement anxiety leads employees to adopt a defensive mindset, diverting their limited cognitive and emotional resources toward guarding against potential risks—such as blindly participating in short-term training, getting caught up in traditional task-oriented competition, or excessively worrying about job security. This inevitably reduces the mental space and capacity that could otherwise be dedicated to innovative thinking . Replacement anxiety makes employees feel insecure and psychologically reluctant to invest more effort in trying new things, thereby significantly hindering both their perception of AI applications and their innovative behavior . Therefore, AI replacement anxiety acts as a negative mediator between the perception of AI applications and employees' innovative behavior: that is, the perception of AI applications can intensify employees' AI replacement anxiety, thereby reducing their innovative behavior.

H7: AI replacement anxiety has a negative impact on perceptions of AI application and employee innovative behavior.

In summary, this study proposes a model comprising two parallel mediating pathways— "perceptions of AI application—AI empowerment/AI replacement anxiety—employee innovative behavior"—following the "independent variable—mediator—dependent variable" framework. In this model, AI application perception serves as the independent variable, empowerment/replacement anxiety as the mediating variables, and employee innovation behavior as the dependent variable. Through these two parallel mediating pathways—empowerment and replacement anxiety—the model exerts an influence on employee innovation behavior, thereby affecting the intermediate stages. This mediating model better elucidates the mechanism through which AI applications influence employee innovation behavior, providing a more comprehensive understanding of the relationship between technology and people explored in this study, and offering practical guidance for enterprises implementing AI applications. The research framework is illustrated in Figure 1.

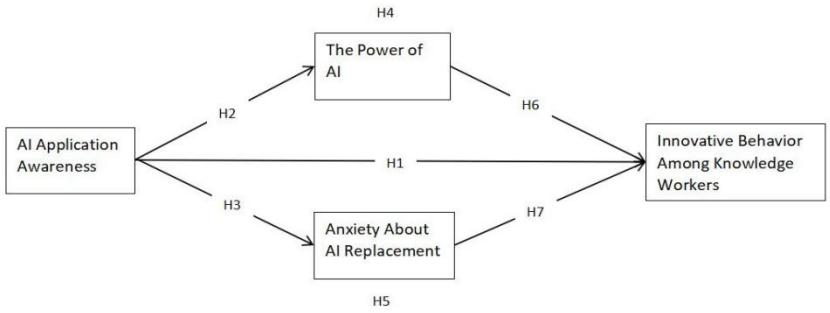

Figure 1 Research Framework

4. Materials and Methods

4.1 Research Methodology

Quantitative analysis was employed, utilizing SPSS 26.0 statistical analysis software to analyze the questionnaire survey results. Descriptive statistical analysis was used to understand the basic profiles of the participants and the characteristics of each variable; correlation analysis was used to explore the relationships among the variables; and reliability and validity tests were conducted to ensure the authenticity and reliability of the data. This study employed a questionnaire survey to collect data, selecting knowledge workers from three sectors in China—the internet, finance, and consulting—as the sample. These three sectors are primarily knowledge-intensive service industries, with knowledge workers constituting the largest proportion of their workforce. Furthermore, the application of artificial intelligence (AI) is relatively widespread in these sectors, and employees are significantly impacted by AI. Consequently, these sectors effectively illustrate the issues explored in this paper: "Perceptions of AI Application—Empowerment and Replacement Anxiety—Employee Innovative Behavior."

4.2 Research Instruments

The scale encompasses two core dimensions: independent and dependent variables. The independent variable is "Perception of AI Application," and the dependent variable is "Innovative Behavior of Knowledge Workers." The mediating variables are "Sense of AI Empowerment (resource gain pathway)" and "Anxiety about AI Replacement (resource threat pathway)." The item design for each dimension draws on established scales developed by scholars to ensure the academic rigor and appropriateness of the measurement tools.

Among these, "Perception of AI Application" serves as the independent variable, with the study's starting point being employees' perceptions regarding the frequency of AI tool usage, their level of reliance on such tools, and the extent to which their workflows have changed. "Innovative Behavior of Knowledge Workers" serves as the dependent variable, referring to the behavior of knowledge workers who generate novel and valuable ideas during their work and put them into action. From the basic principles of COR theory, the extent and direction of employee innovative behavior are determined by the "net resource effect"—the balance between "resource gains" derived from AI-empowerment and "resource losses" caused by AI-replacement anxiety.

"AI empowerment" serves as the mediating variable in this study, defined as the psychological increase in resources employees gain from AI, specifically their experiences in four dimensions: a sense of meaning, a sense of competence, autonomy, and influence. AI displacement anxiety (resource threat pathway) refers to an individual's cognitive perception of "anticipated resource reduction" caused by AI, such as concerns about the devaluation of one's skills, unclear job responsibilities, and a crisis of professional identity.

All scales in this study employ a 5-point Likert scale. Given the vast differences in the types of AI and their forms of application within organizations, there is currently no widely accepted employee perception scale for AI. For employees, the subjective perception of "how AI is used" cannot be described using general technology acceptance scales. Based on this research background, this study adopts a situational measurement approach to define perceptions of AI application. The questionnaire design draws on empirical research approaches regarding AI adoption in organizations and its relevance to work , while also incorporating perspectives on human-machine collaboration and technology embedding. It measures employees' perceptions based on the frequency of AI use in their daily work, the degree of task embedding, and the nature of collaboration.This refers to employees' overall perceptions, based on their own experiences, of the role AI plays in their work.

4.3Research Participants and Data Collection

To ensure consistency in the identification of research subjects, this study operationalizes the definition of knowledge workers as follows: in terms of educational attainment, respondents must hold a bachelor's degree or higher; this serves as a proxy variable for knowledge workers, drawing on the research findings of Fuller et al. In terms of job content, respondents must engage in non-routine work, such as problem-solving, strategy formulation, innovation and R&D, and decision-making; In terms of occupational type, the selection is based on the International Standard Classification of Occupations (ISCO-08) and relevant Chinese occupational classifications, such as product managers, data analysts, financial analysts, consultants, and researchers.

4.4 Sample

Regarding sample representativeness, this study will employ stratified sampling to ensure sample quality. In terms of industry representativeness, we selected enterprises of various types and sizes across three major

sectors—internet, finance, and consulting—such as large platform companies, medium-sized professional service firms, and small innovative companies. In terms of job role representativeness, the sample covers different types of knowledge workers, such as technical staff, product specialists, analysts, and managers; In terms of hierarchical representation, the study involves knowledge workers at the entry-level, mid-level, and senior levels to compare differences in perceptions of AI across various career stages; regarding geographic representation, the study covers Beijing, Shanghai, Hangzhou, and other locations where knowledge workers in the aforementioned three industries are highly concentrated. A well-designed questionnaire will be used to ensure good reliability and validity across all dimensions. The questionnaire included questions regarding perceptions of AI applications, a sense of empowerment, replacement anxiety, and employee innovation behaviors, while also collecting basic employee information—such as gender, age, and educational background—to serve as control variables.

A total of 520 questionnaires were distributed. After excluding incomplete responses, 500 valid questionnaires were recovered, resulting in a response rate of 96.15%.

5. Results and Discussion

Reliability and Validity

This study conducted reliability and validity tests, employing multiple methods to ensure that the research results possess high reliability and validity. As shown in Table 1, the Cronbach's α values for Perceived AI Application (0.958), Perceived AI Empowerment (0.969), AI Replacement Anxiety (0.957), and Knowledge Workers' Innovative Behavior (0.960) are all greater than 0.9. This indicates good internal consistency among these variables, confirming their reliability.

Table 1 Summary of Reliability Analysis

Variable	Cronbach's a	Number of topics
AI Application Awareness	0.958	15
The Power of AI	0.969	20
Anxiety About AI Replacing Human Jobs	0.957	15
Innovative Behavior Among Knowledge Workers	0.960	15

Regarding the issue of variable validity, this thesis primarily employs content validity and discriminant validity as measures. In terms of content validity, the measurement items used in this study—covering perceptions of AI applications, feelings of AI empowerment, anxiety about AI replacement, and innovative behaviors of knowledge workers—draw upon existing, well-established scales and have been appropriately adjusted to reflect the characteristics of knowledge workers. Therefore, it can be concluded that the scale used in this thesis possesses a high degree of content validity.

As shown in Table 2, the standard loadings (Std. Estimate) for all items on the scale are greater than 0.7, indicating good reliability. Regarding measurement relationships, the absolute values of the standardized loadings for each measurement relationship are greater than 0.6 and statistically significant, indicating strong measurement relationships.

Table 2 Summary of Factor Loadings

Dimension	Number of items	Std. Estimate	Significance (Sig.)
AI Application Awareness	15	0.778	0.000
The Power of AI	20	0.786	0.000
Anxiety About AI Replacing Human Jobs	15	0.775	0.000
Innovative Behavior Among Knowledge Workers	15	0.784	0.000

In Table 3, an AVE greater than 0.5 and a CR greater than 0.7 indicate good convergent validity. Since the AVE for all four factors is greater than 0.5 and all CRs exceed 0.7, this indicates that the data used in this study possess good convergent validity. All criteria used in this study to assess the quality of the model have met the required standards, indicating that the questionnaire used in this study has good reliability.

Table 3 Summary of AVE and CR Results for the Model

Factor	Average Variance Extraction (AVE)	Composite Reliability (CR)
AI Application Awareness	0.607	0.959
The Power of AI	0.616	0.970
Anxiety About AI Replacing Human Jobs	0.601	0.958
Innovative Behavior Among Knowledge Workers	0.615	0.960

Correlation Analysis

Pearson’s correlation analysis was used to examine the pairwise relationships among the seven main variables, and two-tailed tests were conducted to determine their statistical significance.

As shown in Table 4:

The correlation coefficient between AI application perception and knowledge workers’ innovative behavior is 0.128 and is significant at the 1% level, indicating a significant positive correlation between the two and supporting Hypothesis H1;

The correlation coefficient between AI application perception and AI empowerment perception is 0.271 and is significant at the 1% level, indicating a significant positive correlation between the two and supporting Hypothesis H2;

the correlation coefficient between AI application perception and AI replacement anxiety is 0.25 and is significant at the 1% level, indicating a significant positive correlation between the two and supporting Hypothesis H3;

The correlation coefficient between AI’s impact on innovation behavior among emotional and knowledge-based employees is 0.234, which is significant at the 1% level, indicating a significant positive correlation between the two and supporting Hypothesis H4;

The correlation coefficient between AI replacement anxiety and innovation behavior among knowledge-based employees is -0.417, which is significant at the 1% level, indicating a significant negative correlation between the two and supporting Hypothesis H5.

Table 4 Summary of Correlation analysis matrix

ingredient	1	2	3	4
AI Application Awareness	1			
The Power of AI	.271**	1		
Anxiety About AI Replacing Human Jobs	.250**	.095*	1	
Innovative Behavior Among Knowledge Workers	.128**	.234**	-.415**	1

Significantly correlated at the 0.05 level (two-tailed); ** Significantly correlated at the 0.01 level (two-tailed).

Regarding the mediation hypotheses H6 and H7, the correlation analysis indicates that the requirements for conducting mediation tests are met, meaning that there are significant correlations between the independent variable and the mediator, as well as between the mediator and the dependent variable, all of which are significant at the 1% level. and there is also a significant correlation between the independent variable and the dependent variable ($p < 0.001$). This lays the foundation for further testing the positive mediating effect of AI empowerment on AI replacement anxiety and the negative mediating effect of AI replacement anxiety on job satisfaction.

Regression Analysis

1) Regression Analysis of Perceived AI Application on Knowledge Workers' Innovative Behavior.

Using multiple linear regression, as shown in Table 5, the regression coefficient for perceived AI application is 0.126, which is significant at the 1% level. There is a positive correlation between perceived AI application and knowledge workers' innovative behavior, indicating that perceived AI application has a positive promotional effect on knowledge workers' innovative behavior ($t = 2.795$, $p < 0.001$). The specific regression equation is as follows: Innovative behavior of knowledge workers = 3.345 + 0.126 × Perceived AI Adoption. This regression model explains 18% of the variation in the innovative behavior of knowledge workers ($R^2 = 0.027$, $F = 2.787$). There are no issues of multicollinearity, and the entire model is valid. Perceived AI adoption plays a positive role in the innovative behavior of knowledge workers, and Hypothesis H1 is supported.

Table 5 AI Application Perception and Staff Innovative Behavior Regression

Variable	β	t	p	VIF	R^2	F
Constant	3.345	11.455	0.000	1	0.027	2.787
AI Applications	0.126	2.795	0.000	1.002		

Dependent variable: Knowledge workers' innovative behavior

2)Regression Analysis of Perceived AI Application on Perceived AI Empowerment

As shown in Table 6, the regression coefficient for perceived AI application is 0.278 and is significant at the 1% level. This indicates a positive correlation between perceived AI application and perceived AI empowerment, suggesting that perceived AI application has a positive effect on perceived AI empowerment. The t-value is 6.235, $p < 0.001$. The regression equation is: Sense of AI Empowerment = 2.291 + 0.278 × Perceived AI Application. This model explains 6.7% of the variation in knowledge workers' sense of AI empowerment, with $R^2 = 0.077$. There are no issues of multicollinearity, and the entire model is significant. Perceived AI Application has a positive effect on the sense of AI empowerment, and Hypothesis H2 is supported.

Table 6 Regression of AI Application Perception & AI Empowerment

Variable	β	t	p	VIF	R^2	F
Constant	2.291	7.913	0.000	1	0.077	8.212
AI Applications	0.278	6.235	0.000	1.002		

Dependent variable: Perceived AI empowerment

3) Regression Analysis of Perceived AI Adoption on AI Replacement Anxiety

As shown in Table 7, the regression coefficient for perceived AI adoption is 0.256 and is significant at the 1% level, indicating a positive correlation between perceived AI adoption and AI replacement anxiety. In other words, perceived AI adoption has a significant positive effect on AI replacement anxiety, with a t-value of 5.798, $p < 0.001$. The regression equation is: AI Replacement Anxiety = 2.293 + 0.256 × Perceived AI Adoption. This model explains 6.4% of the variation in knowledge workers' AI replacement anxiety, with $R^2 = 0.073$, which is significant at the 1% level. The entire model is significant and shows no multicollinearity issues. Therefore, perceived AI adoption has a positive impact on AI replacement anxiety, and Hypothesis H3 is supported.

Table 7 Regression of AI Application Perception & AI Replacement Anxiety

Variable	β	t	p	VIF	R^2	F
Constant	2.293	8.004	0.000	1	0.073	7.808
AI Applications	0.256	5.798	0.000	1.002		

Dependent variable: Anxiety about AI replacement

4)Regression Analysis of AI Empowerment on the Innovative Behavior of Knowledge Workers

As shown by the regression results in Table 8, the regression coefficient for AI empowerment is 0.227 and is significant at the 1% confidence level. This indicates a positive relationship between AI empowerment and the innovative behavior of knowledge workers; AI empowerment can promote innovative behavior among knowledge workers. The t-value is 5.307, and $p < 0.001$. The regression equation is as follows: Innovative Behavior of Knowledge Workers = 3.051 + 0.227 × Sense of AI Empowerment. This indicates that the sense of AI empowerment among knowledge workers accounts for 5.6% of the variance in their innovative behavior. $R^2 = 0.065$. The entire regression model is significant, confirming that the sense of AI empowerment promotes innovative behavior among knowledge workers. Hypothesis H4 is thus supported.

Table 8 Regression of AI Perceived Impact & Knowledge Workers' Innovative Behavior

Variable	β	t	p	VIF	R^2	F
Constant	3.051	11.049	0.000	1	0.065	6.907
The Power of AI	0.227	5.307	0.000	1.004		

Dependent variable: Knowledge workers' innovative behavior

4) Regression of AI Replacement Anxiety on Workers' Innovative Behavior

As shown in Table 9, the regression coefficient for AI replacement anxiety is -0.412 and is significant at the 1% level. This indicates a negative correlation between AI replacement anxiety and the innovative behavior of knowledge workers; that is, the more knowledge workers worry about being replaced by artificial intelligence, the less likely they are to engage in innovative activities. The t-value is -10.109, $p < 0.001$. The regression equation is: Knowledge Workers' Innovative Behavior = 5.128 − 0.412 × AI Replacement Anxiety. This model explains 17.3% of the variation in knowledge workers' innovative behavior attributable to their anxiety about being replaced by AI, with $R^2 = 0.181$. The model is significant, indicating that AI replacement anxiety has a significant negative effect on knowledge workers' innovative behavior. Hypothesis H5 is supported.

Table 9 Regression of AI Replacement Anxiety & Knowledge Workers' Innovative Behavior

Variable	β	t	p	VIF	R^2	F
Constant	5.128	19.887	0.000	1		
Anxiety about AI Replacing Human Jobs	-0.412	-10.109	0.000	1.010	0.181	21.897

Dependent variable: Knowledge workers' innovative behavior

Parallel Mediation Effects

This study used the Bootstrap method to examine the pathways through which perceptions of AI applications influence the innovative behavior of knowledge workers. As shown in Table 10, perceptions of AI applications have a significant but complex impact on employees' innovative behavior. Overall, the total effect of AI application perception on innovative behavior is 0.1300, and the confidence interval does not include zero, suggesting a positive influence. After including the mediating variable, the direct effect is 0.1895 and is also significant. Furthermore, the direct effect is greater than the total effect, indicating that the mediating variable does not strengthen the original relationship; rather, it weakens the overall process, demonstrating a clear suppression effect. This suggests that, when employee psychological factors are not taken into account, the actual impact of AI application perception on innovative behavior is underestimated.

From the mediation path analysis, regarding the total indirect effect, the total indirect effect is -0.0595, and its confidence interval does not include zero, indicating that the mediating effect plays a significant inhibitory role in the entire process. Specifically, the indirect effect of AI application perception on empowerment is 0.0631 (95% CI [0.0353, 0.0957]), which is a positive effect: that is, if employees believe AI can enhance their capabilities and work efficiency, they will be more willing to engage in innovative activities. At the same time, the indirect effect driven by replacement anxiety is -0.1225 (95% CI [-0.1728, -0.0756]), and this value is significantly greater than the effect of empowerment, indicating that employees' concerns about being replaced by technology reduce their creativity.

The fact that these mediating pathways run in opposite directions and have different strengths is the reason for the masking effect. Furthermore, as shown in Table 4, the effect size of the substitution anxiety pathway (0.1225) is significantly larger than that of the empowerment pathway (0.0631); the difference between the two is 0.1856, and since the confidence interval does not include zero, we can conclude that there is a significant difference between these two pathways. However, it is important to note that "a greater negative effect" does not imply that the positive effect is insignificant; rather, it indicates that the effects produced by these two mechanisms differ. In other words, both positive and negative effects are present, but the negative effect plays a more significant role. In terms of relative contribution, the empowerment pathway accounts for 34.0% (0.0631/0.1856), while the displacement anxiety pathway accounts for 66.0% (0.1225/0.1856), indicating that the negative pathway plays a primary role in the overall process. It is precisely this "strong negative, weak positive" dynamic that causes the positive effects originally associated with the perception of AI applications to be somewhat weakened during transmission, resulting in a pattern of "direct promotion—indirect inhibition."

Bootstrap results indicate that the total indirect effect is -0.0595 (95% CI [-0.1170, -0.0037]). Since the confidence interval does not include 0, it can be concluded that a mediating effect exists and is negative.

Further testing of individual pathways revealed that the indirect effect of AI empowerment was 0.0631 (95% CI [0.0353, 0.0957]), indicating a facilitating role—that is, the perception of AI application has a positive impact on innovative behavior, Hypothesis H6 is supported.

The indirect effect of AI replacement anxiety is -0.1225 (95% CI [-0.1728, -0.0756]), indicating that it acts as a hindrance; that is, the perception of AI application has a negative impact on innovative behavior. Therefore, Hypothesis H7 is supported.

Table 10 Summary of Mediating Effects Analysis

Effect Type	Effect size	Boot standard error	95%confidence interval
Overall effect	0.1300	0.0451	[0.0414,0.2185]
Direct effect	0.1895	0.0413	[0.1083,0.2706]
Total indirect effect	-0.0595	0.0289	[-0.1170,-0.0037]
Indirect Effects (AI Empowerment)	0.0631	0.0155	[0.0353,0.0957]
Indirect Effects (AI Replacement Anxiety)	-0.1225	0.0247	[-0.1728,-0.0756]
Contrast Effect (Empowerment from AI vs. AI Replacement Anxiety)	0.1856	0.0294	[0.1313,0.2457]

Further comparison revealed that the two mediating effects have opposite directions and differ in magnitude, with a contrast effect of 0.1856 (95% CI [0.1313, 0.2457]), indicating significant differences between the two mediating mechanisms. Specifically, anxiety about AI replacement accounts for approximately 66.0% of the total mediating effect, while the sense of empowerment from AI accounts for approximately 34.0%, with the negative mechanism playing the dominant role. Therefore, considering the entire process, the perception of AI application exerts an "interactive effect of direct promotion—indirect inhibition" on the innovative behavior of knowledge workers. Since the absolute value of the negative mediating effect exceeds that of the positive mediating effect, the total indirect effect is negative, thereby generating a "suppression effect." That is, the mediating effect statistically weakens the relationship between the independent and dependent variables, resulting in the direct effect being greater than the total effect.

In summary, the impact of AI application perception on employee innovative behavior is not merely positive; rather, it is the result of the combined effects of two mechanisms: "empowerment promotion" and "anxiety inhibition." Furthermore, displacement anxiety is the primary influencing factor, which not only explains the negative overall indirect effect but also illustrates that the application of AI entails certain intangible psychological costs. Therefore, building upon the dual-pathway framework, this paper further elucidates how AI adoption influences employee behavior. Specifically, in a technological context, employee behavior is not determined by the presence or absence of a single pathway, but rather by which pathway is stronger and the process by which the two pathways offset each other.

Based on the above research and after a thorough review of the relevant literature, the proposed hypotheses were empirically tested, and all hypotheses were supported and proven to be valid.

Table 11 Summary of research hypothesis results

Hypothesis	Hypothesis Content	Test Result
H1	Perceived AI usage has a positive effect on employees' innovative behavior.	Supported
H2	Perceptions of AI adoption have a significant positive impact on the sense of empowerment from AI.	Supported
H3	Perceptions of AI applications have a significant positive impact on anxiety about AI replacement.	Supported
H4	The perception of AI empowerment has a significant positive impact on employees' innovative behavior.	Supported
H5	AI replacement anxiety has a significant negative impact on employees' innovative behavior.	Supported
H6	The sense of AI empowerment can facilitate the positive influence of perceived AI adoption on employees' innovative behavior.	Supported
H7	AI replacement anxiety has a negative impact on perceptions of AI application and employee innovative behavior.	Supported

6. Conclusion

Through empirical research, this paper theoretically examines the relationship among perceptions of AI adoption, employees' psychological states (sense of empowerment and replacement anxiety), and innovative behavior. The findings indicate that perceptions of AI adoption have a significant dual impact on employees' psychological well-being. On the one hand, perceptions of AI adoption can greatly enhance employees' sense of empowerment; within the organization, the application of AI technology can boost employees' confidence in their own abilities and work efficiency. On the other hand, these perceptions can also trigger strong anxiety about replacement, as while providing employees with more resources, they simultaneously raise concerns about whether their jobs might be replaced by robots. Therefore, for employees, perceptions of AI adoption serve as both a "resource enhancer" and a "source of stress."

Further research has shown that different psychological states exert varying influences on employees' innovative behavior. A sense of empowerment has a positive impact on employees' innovative behavior; specifically, enhanced competence and a sense of resource support can effectively promote innovation. Conversely, substitution anxiety has a negative impact on innovative behavior; that is, feelings of threat and uncertainty reduce employees' motivation to innovate.

From the perspective of mediating mechanisms, the study identified two opposing pathways of influence. The positive influence of AI application perception on innovative behavior operates through a sense of empowerment, while simultaneously exerting a negative influence through displacement anxiety. That is, these two psychological mechanisms act concurrently but in opposite directions. Within the overall mediating effect, displacement anxiety accounts for a larger proportion (approximately 66%), while a sense of empowerment accounts for a smaller proportion (approximately 34%), leading to the dominance of the negative psychological mechanism in the entire model.

It is important to note that while the empirical results show a negative overall indirect effect, the direct effect is greater than the total effect. This indicates that the mediating variables collectively suppress the original positive relationship—a phenomenon known as the masking effect. In other words, the influence of AI application perception on innovative behavior is weakened to some extent by psychological factors, resulting in a total effect that is smaller than the direct effect.

Overall, the influence of AI application perception on the innovative behavior of knowledge workers is not linear but rather a two-way dynamic. The two opposing forces of "empowerment promotion" and replacement inhibition" coexist, and their imbalance results in a masking relationship. The stronger influence of the negative pathway determines the overall negative indirect effect and reflects the role that AI applications play for enterprises.

Theoretically, this study has identified a "competitive relationship between two pathways" in employee behavioral responses to AI contexts: both the resource acquisition pathway (empowerment) and the resource loss pathway (substitution anxiety) influence human behavior, and the differing roles these two forces play determine the final form of behavioral expression. Furthermore, the findings of this study validate a key tenet of Resource Conservation Theory: that people are more concerned with potential resource loss than with resource gain, and thus negative psychological factors play a primary role throughout the process. This provides a clearer understanding of how AI applications influence employee behavior and why technological environments lead to varying behavioral responses among different individuals.

7. Limitations and future research directions

1)The sample used in this study has certain limitations

The participants were selected from China, which does not allow for a comprehensive coverage of various situations in the international market. Furthermore, the questionnaire focused only on the internet, finance, and consulting sectors, without conducting cross-industry comparisons. Future research could increase the sample size and modify data collection methods, introduce representative samples from other countries for survey research, and conduct multi-faceted comparisons across different industries.

2)The theoretical explanation is insufficient

The presence of dual mediating variables resulted in a masking effect, where the total indirect effect was negative and the direct effect exceeded the total effect, creating a suppression effect. However, while this study provided a statistical explanation, it did not offer a theoretical explanation for why anxiety masks the positive effects of AI, indicating insufficient theoretical exploration.

8. Acknowledgements

The successful completion of this thesis would not have been possible without the dedicated guidance of Professor Jiang Haiyue. From the selection of the topic to the completion of the final draft, I received her guidance and support throughout the process. Finally, I would like to thank my family, colleagues, and interviewees; it is thanks to everyone's cooperation that I was able to successfully complete this thesis.

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