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Research on the Impact of Perceived Robot Threat on Turnover Intention among Manufacturing Employees

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Abstract

The rapid development of artificial intelligence has not only enhanced production efficiency but also raised employees' concerns about career security and future employment prospects. Based on the Conservation of Resources Theory (COR), this study constructs a moderated mediation model to explore the mechanism through which perceived robot threat affects turnover intention among manufacturing employees. It examines the mediating role of job insecurity and the moderating role of perceived organizational support (POS). The analysis of survey data from 356 Chinese manufacturing employees revealed three key findings. First, a significant positive correlation was observed between perceived robot threat and turnover intention. Second, job insecurity was found to mediate the relationship between perceived robot threat and turnover intention. Third, POS moderated both the direct association between perceived robot threat and turnover intention and the indirect association mediated by job insecurity.

Keywords: *Perceived Robot Threat; Turnover Intention; Job Insecurity; Perceived Organizational Support (POS); Conservation of Resources Theory (COR)*

Introduction

With the rapid evolution of science and technology, artificial intelligence and robotics are penetrating various sectors of the socio-economic landscape at an unprecedented pace. In manufacturing, in particular, the application of robots has become a critical driver for enhancing production efficiency and reducing costs(Zhang *et al.*, 2022). Numerous enterprises have introduced robots to assist employees, aiming to secure competitive advantages in an increasingly fierce market. Within the manufacturing sector, the widespread adoption of robots is gradually reshaping employees' work patterns and career prospects, ushering in transformative changes in production(Fuentes-Moraleda *et al.*, 2020). However, while such technological advancements boost productivity, they also trigger profound perceptions of

robot threat among employees—specifically, concerns that their jobs may be replaced by robots, thereby jeopardizing occupational stability and economic security.

Employee turnover has long been a focal issue for scholars and organizational managers. Turnover Intention is influenced by multiple factors, including individual-level intrinsic elements such as age, education level, organizational identification, and organizational commitment(El Akremi *et al.*, 2014), as well as extrinsic factors related to work environments and external conditions, such as job characteristics, leadership and organizational behaviors, and labor market dynamics(Babalola *et al.*, 2016). Against the backdrop of robotics proliferation, perceived robot threat, as an emerging work-related stressor, may serve as a novel trigger for Turnover Intention(Shum *et al.*, 2024). Existing studies have preliminarily indicated that increased human-robot interaction may lead to employee turnover(Shum *et al.*, 2024). However, the specific mechanisms linking perceived robot threat to Turnover Intention, as well as how this threat dynamically shapes the formation of Turnover Intention, require more comprehensive exploration.

The Conservation of Resources Theory (COR) posits that individuals strive to acquire, maintain, cultivate, and protect valued resources, and the introduction of robotics may trigger fluctuations in employees' perceived resource states(Hobfoll, 1989; Wu *et al.*, 2022). In contemporary workplaces, employees' perceptions of robot threat are most directly reflected in job insecurity(Li *et al.*, 2023). Thus, this study selects job insecurity as a mediator to examine its role in the relationship between perceived robot threat and Turnover Intention. Simultaneously, in human-robot collaborative environments, factors such as perceived organizational support (POS) can mitigate job insecurity(Yam *et al.*, 2023). Employees' perceptions of organizational support influence the acquisition and depletion of their resource states, thereby moderating the relationship between perceived robot threat and Turnover Intention. Consequently, this research incorporates POS as a moderator to investigate its role in the relationships among perceived robot threat, job insecurity, and Turnover Intention. These efforts not only deepen the understanding of the mechanisms linking perceived robot threat to Turnover Intention but also provide theoretical foundations and practical guidance for organizations to develop strategies aimed at reducing employee turnover.

Theoretical Foundation and Research Hypotheses

Perceived Robot Threat and Employee Turnover Intention

Perceived threat refers to individuals' perceptions of fictional or real dangers(Witte, 1992), encompassing realistic threats and identity threats. Realistic threats involve tangible harms to a group's material resources, safety, or physical well-being, posing substantive risks to survival and development. Identity threats, conversely, relate to challenges to a group's uniqueness, values, or social prominence—core components of collective identity(Złotowski *et al.*, 2015). Psychological research indicates that humans are motivated to maintain distinctions between their own group and others(Złotowski *et al.*, 2017). The proliferation of robots poses dual threats: realistic threats to human safety, employment opportunities, and material resources, and identity threats arising from blurred boundaries between humans and increasingly intelligent robots(Liao *et al.*, 2023). These dual threats activate behavioral inhibition mechanisms, triggering vigilance and anxiety, which may weaken individuals' willingness to adopt technology or engage in skill development(Nomura *et al.*, 2006).

The widespread application of robotics is reshaping organizational and labor market dynamics. At the macro level, robots' displacement of mid- to low-skilled jobs exacerbates structural imbalances in the labor market, reducing employment opportunities and widening economic disparities for certain groups(Wu *et al.*, 2024). At the meso level, enterprises adopting robots to enhance efficiency simultaneously disrupt traditional workflows, requiring employees to adapt to new human-robot

collaboration models(Cheng *et al.*, 2019). At the micro level, employees face dual pressures: (1) investing additional resources (e.g., time, effort) to acquire robotics skills—a daunting task for frontline workers that amplifies job stress(Nam, 2019); and (2) confronting risks to occupational stability(Koo *et al.*, 2021). Under the COR framework, such pressures are particularly salient: employees continuously deplete personal resources (e.g., cognitive capacity, emotional energy) to adapt to technological changes. Insufficient resource replenishment triggers self-protective mechanisms, manifesting as heightened Turnover Intention(Hobfoll *et al.*, 2018). Thus, we propose:

Hypothesis 1: Perceived robot threat is positively correlated with Turnover Intention among manufacturing employees.

Mediating Role of Job Insecurity

Job insecurity reflects employees' subjective perceptions of threats to the future stability of their current roles, signaling potential resource depletion(Cuyper *et al.*, 2008). This perception encompasses both material resource fluctuations (e.g., income loss) and intangible resource erosion (e.g., professional capital, experience, skills). As robotics adoption expands, employees increasingly fear job marginalization or replacement due to automation, intensifying psychological strain. Potential role adjustments and reduced labor demand heighten workplace competition, threatening employees' professional status and career longevity. Such insecurity stems not only from actual job changes but also from uncertainty about future stability, amplifying anxiety(Koo *et al.*, 2021).

According to COR, employees strive to protect and retain valued resources. When perceived threats (e.g., role disruptions) trigger resource loss, job insecurity escalates(Hobfoll, 1989). This undermines employees' sense of control, professional value, and confidence in their skills. To mitigate resource depletion, employees may seek alternative employment, elevating Turnover Intention(Mauno *et al.*, 2014). Hence, we propose:

Hypothesis 2: Job insecurity mediates the relationship between perceived robot threat and Turnover Intention among manufacturing employees.

Moderating Role of POS

POS refers to employees' perceptions of how much the organization values their contributions and cares about their well-being(Armeli *et al.*, 1998). It encompasses emotional support (e.g., respect, empathy) and instrumental support (e.g., training, resources), serving as a critical buffer against stress and work-life imbalances. Studies show that high POS reduces psychological strain and burnout(Arogundade *et al.*, 2015). Effective organizational support systems—including fair working conditions, skill development opportunities, and job autonomy—enhance employees' sense of control and mitigate job-related stress(Duke *et al.*, 2009). Thus, when facing robot-induced threats, POS may moderate the impact of perceived robot threat on job insecurity. Specifically, employees with strong POS can leverage organizational resources to alleviate job security concerns, maintaining proactive attitudes despite technological disruptions. Prior theories suggest that if the first half of a mediation pathway is moderated, the mediation effect itself becomes conditional(Wen and Ye, 2014). In this study, employees with weaker POS are more likely to experience heightened job insecurity and subsequent Turnover Intention when perceiving robot threats.

From the COR perspective, Turnover Intention represents a protective strategy against resource depletion when replenishment is insufficient. Extensive research confirms a negative correlation between POS and Turnover Intention(Allen *et al.*, 2003). Employees who perceive strong organizational support exhibit greater job commitment, emotional attachment, and retention intentions. When confronting robotics challenges, robust POS helps offset resource depletion, encouraging adaptive responses rather

than withdrawal. Conversely, low POS exacerbates vulnerability to robot threats, increasing Turnover Intention. Therefore, we propose:

Hypothesis 3: POS moderates both the direct effect of perceived robot threat on Turnover Intention and the indirect effect mediated by job insecurity among manufacturing employees. Specifically, the direct predictive effect of perceived robot threat on Turnover Intention and the mediating role of job insecurity are both contingent on POS.

The research model is illustrated in Figure 1.

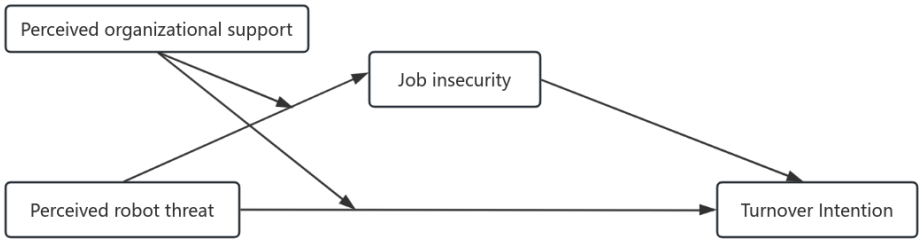

Fig. 1. Research Model

Research Design

Sample

This study collected data through a questionnaire survey targeting manufacturing employees in selected provinces of China. A total of 374 questionnaires were distributed, and after excluding invalid responses, 356 valid questionnaires were retained, yielding an effective response rate of 95.2%. The statistical characteristics of the sample (N = 356) were as follows: in terms of gender, 41.6% were male and 58.4% female; regarding age distribution, 19.9% were 18–25 years old, 36.8% were 26–35, 23.9% were 36–45, and 19.4% were over 45; for education levels, 9.8% had junior high school education or below, 13.5% held a high school/vocational diploma, 21.9% had a college diploma, 43.8% held a bachelor's degree, and 11.0% had a postgraduate degree or higher; in terms of work tenure, 8.1% had less than 1 year of experience, 30.3% had 1–3 years, 26.7% had 3–5 years, 22.2% had 5–10 years, and 12.6% had over 10 years.

Variable Measurement

The scales used in this study were derived from well-established tools in their respective research fields, with widely recognized reliability and validity. All scales adopted a 7-point Likert scoring method (1 = "strongly disagree," 7 = "strongly agree"). Specifically, perceived robot threat was measured using the 10-item questionnaire developed by Yogeeswaran et al.(Yogeeswaran *et al.*, 2016), which includes two dimensions and items such as "The increasing use of robots in daily life is causing human unemployment" (Cronbach's $\alpha = 0.940$); job insecurity was assessed with Hellgren et al.'s 3-item scale(Hellgren *et al.*, 1999), exemplified by "I worry about being forced to leave my job" ($\alpha = 0.786$); POS was evaluated using Eisenberger et al.'s 8-item scale(Eisenberger *et al.*, 2016), including statements like "The organization values my opinions" ($\alpha = 0.938$); and turnover intention was measured via Mobley et al.'s 4-item scale(Mobley *et al.*, 1978), featuring items such as "I plan to pursue long-term career development in this organization" ($\alpha = 0.874$). Additionally, gender, age, education level, and work tenure were included as control variables in the analysis.

Analysis of Empirical Results

Common Method Variance Analysis

To control for common method bias, data were collected using anonymous questionnaires, and the "latent single method factor control approach" proposed by Xiong et al. (2012) was applied for validation. A baseline model (M1) without a method factor and a comparative model (M2) incorporating a method factor were constructed to assess differences in fit indices: ΔCFI=0.012, ΔTLI=0.008, ΔIFI=0.012, ΔSRMR=0.0038, and ΔRMSEA=0.004. The changes in all fit indices were below the threshold of 0.02, indicating that common method bias had no significant impact on the results.

Discriminant Validity and Model Fit Tests

This study utilized Amos 26.0 software to examine model fit and discriminant validity of variables using key indices (e.g., χ^2, df, χ^2/df, TLI, CFI, RMSEA). As shown in Table 1, confirmatory factor analysis results indicated that the five-factor model exhibited significantly better fit than alternative models (χ^2/df = 2.209 < 3, TLI = 0.940 > 0.90, CFI = 0.946 > 0.90, RMSEA = 0.058 < 0.08), with all fit indices meeting acceptable thresholds. These findings confirm strong discriminant validity among the variables in the five-factor model.

Table Ⅰ. Results of Confirmatory Factor Analysis

Model	χ^2	df	χ^2/df	TLI	CFI	RMSEA	$\Delta\chi^2$
4-Factor: PRT、JI、POS、TI	594.16	269.00	2.21	0.94	0.95	0.06	
3-Factor1: PRT+TI、JI、POS	1043.14	272.00	3.84	0.86	0.87	0.09	448.99***
3-Factor2: PRT、JI、POS+TI	1375.86	272.00	5.06	0.80	0.82	0.11	781.70***
2-Factor: PRT+POS、JI+TI	2507.20	274.00	9.15	0.60	0.63	0.15	1913.05***
Singer-Factor: PRT+JI+POS+TI	2983.75	275.00	10.85	0.51	0.55	0.17	2389.60***

Note: PRT = perceived robot threat; JI = job insecurity; POS = perceived organizational support; TI = turnover intention; "+" indicates the combination of two factors into one variable; ***p < 0.001, **p < 0.01, *p < 0.05 (hereinafter the same).

Descriptive Statistics and Correlation Analysis Results

The means, standard deviations, and correlation coefficients of the main variables in this study are detailed in Table 2. The results show that perceived robot threat was significantly positively correlated with turnover intention (r = 0.58, p < 0.01) and job insecurity (r = 0.45, p < 0.01). Job insecurity was significantly positively correlated with turnover intention (r = 0.56, p < 0.01). Perceived organizational support (POS) exhibited significant negative correlations with perceived robot threat (r = -0.32, p < 0.01), job insecurity (r = -0.25, p < 0.01), and turnover intention (r = -0.31, p < 0.01).

Table Ⅱ. Means, Standard Deviations, and Correlation Coefficients

	M	SD	1	2	3	4
1.perceived robot threat	4.28	1.37	1.00			
2.job insecurity	4.36	1.40	0.45**	1.00		
3.Turnover Intention	4.36	1.48	0.58**	0.56**	1.00	
4.Perceived organizational support	3.87	1.44	-0.32**	-0.25**	-0.31**	1.00

Moderated Mediation Model Test

First, the study employed Model 4 (simple mediation model) from Hayes' (2012) SPSS macro to examine the mediating role of job insecurity in the relationship between perceived robot threat and turnover intention, controlling for gender, age, education level, and work tenure. As shown in Table 3, perceived robot threat had a significant positive predictive effect on turnover intention ($B = 0.63$, $t = 13.26$, $p < 0.001$). After introducing the mediator (job insecurity), the direct effect of perceived robot threat on turnover intention remained significant ($B = 0.44$, $t = 9.20$, $p < 0.001$). Perceived robot threat significantly positively predicted job insecurity ($B = 0.46$, $t = 9.43$, $p < 0.001$), and job insecurity also significantly positively predicted turnover intention ($B = 0.40$, $t = 8.33$, $p < 0.001$). Additionally, Table 4 indicates that the bootstrap 95% confidence intervals for both the direct effect of perceived robot threat on turnover intention and the mediating effect of job insecurity excluded zero, confirming that perceived robot threat not only directly predicts turnover intention but also does so indirectly through job insecurity. Specifically, the direct effect was 0.44, accounting for 71.05% of the total effect (0.63), while the mediating effect was 0.18, accounting for 28.95% of the total effect.

Table Ⅲ. Tests of the Mediation Model for Job Insecurity (N = 356)

	JI		TI		TI	
Predictor variable	B	t	B	t	B	t
Gender	-0.36	-2.67**	-0.17	-1.30	-0.03	-0.23
Age	-0.14	-1.82	-0.09	-1.28	-0.04	-0.58
Education	-0.03	-0.44	0.02	0.25	0.03	0.47
Year	0.09	1.41	-0.04	-0.58	-0.07	-1.25
PRT	0.46	9.43***	0.63	13.26***	0.44	9.20***
JI					0.40	8.33***
R^2	0.23		0.34		0.45	
F	20.37		36.13		47.56	

Table Ⅳ. Decomposition of Total, Direct, and Mediating Effects

	Effect	Boot SE	Boot LLCI	Boot ULCI	Effect Proportion
Total effect	0.63	0.06	0.51	0.73	
Direct effect	0.44	0.07	0.31	0.58	71.05%
Indirect effect	0.18	0.04	0.12	0.26	28.95%

Next, the study applied Model 8 from Hayes' SPSS macro to validate the moderated mediation model, which assumes that both the first half of the mediation process and the direct path are moderated—a framework consistent with this study's theoretical design. The model was tested while controlling for gender, age, education level, and work tenure. Results (see Tables 5 and 6) revealed that the interaction term between perceived robot threat and POS significantly predicted both turnover

intention (B = -0.10, t = -3.88, p < 0.001) and job insecurity (B = -0.12, t = -4.21, p < 0.001). This indicates that POS moderates not only the direct effect of perceived robot threat on turnover intention but also its effect on job insecurity. Further simple slope analyses (see Figures 2 and 3) demonstrated that for employees with low POS (mean minus one standard deviation, M−1SD), perceived robot threat exerted a stronger positive predictive effect on turnover intention (Figure 2) and job insecurity (Figure 3). For those with high POS (M+1SD), the predictive effects remained positive but were attenuated. Additionally, as POS increased, the mediating effect of job insecurity in the relationship between perceived robot threat and turnover intention showed a declining trend (see Table 6). Specifically, the mediating effect was stronger at low POS levels but weakened at high POS levels. These findings suggest that POS not only directly mitigates the negative impact of perceived robot threat on turnover intention but also further reduces turnover intention by diminishing the mediating role of job insecurity.

Table Ⅴ. Tests of the Moderated Mediation Model

	BA		LZ	
Predictor variable	B	t	B	t
Gender	-0.41	-3.12***	-0.09	-0.77
Age	-0.16	-2.20*	-0.07	-1.05
Education	0.00	-0.08	0.04	0.81
Year	0.08	1.39	-0.07	-1.25
PRT	0.45	8.96***	0.47	9.34***
JI			0.33	6.98***
POS	-0.14	-3.01***	-0.12	-2.87***
PRT×POS	-0.12	-4.21***	-0.10	-3.88***
R^2	0.28		0.48	
F	19.46		40.65	

Table Ⅵ. Direct and Mediating Effects at Different Levels of POS

	POS	Effect	Boot SE	Boot LLCI	Boot ULCI
Direct effect	-1.44	0.62	0.07	0.48	0.76
	0.00	0.47	0.05	0.37	0.57
	1.44	0.32	0.05	0.21	0.42
Mediating effect	-1.44	0.21	0.05	0.12	0.30
	0.00	0.15	0.03	0.09	0.22
	1.44	0.09	0.03	0.04	0.16

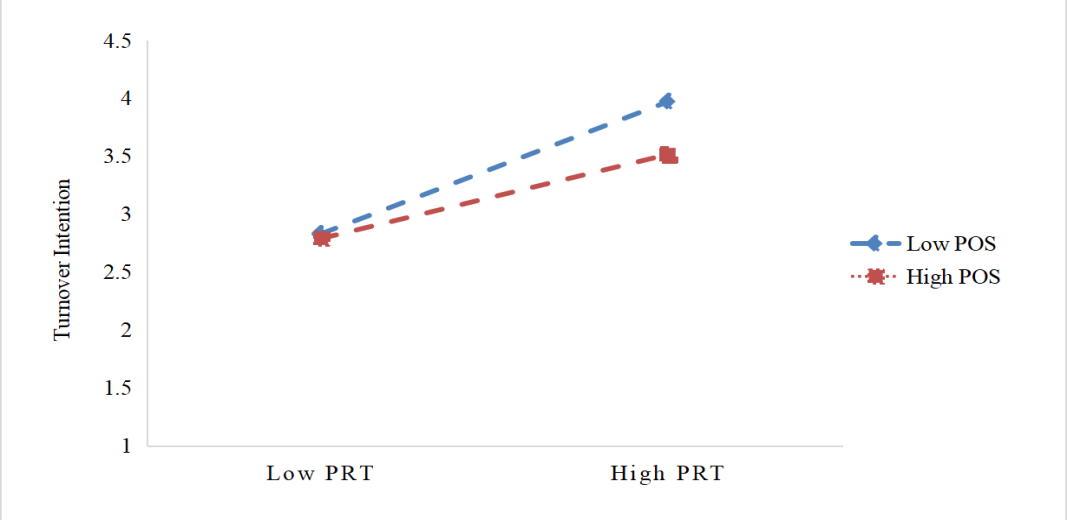

Fig. 2. Moderating Role of POS in the Relationship between Perceived Robot Threat and Turnover Intention

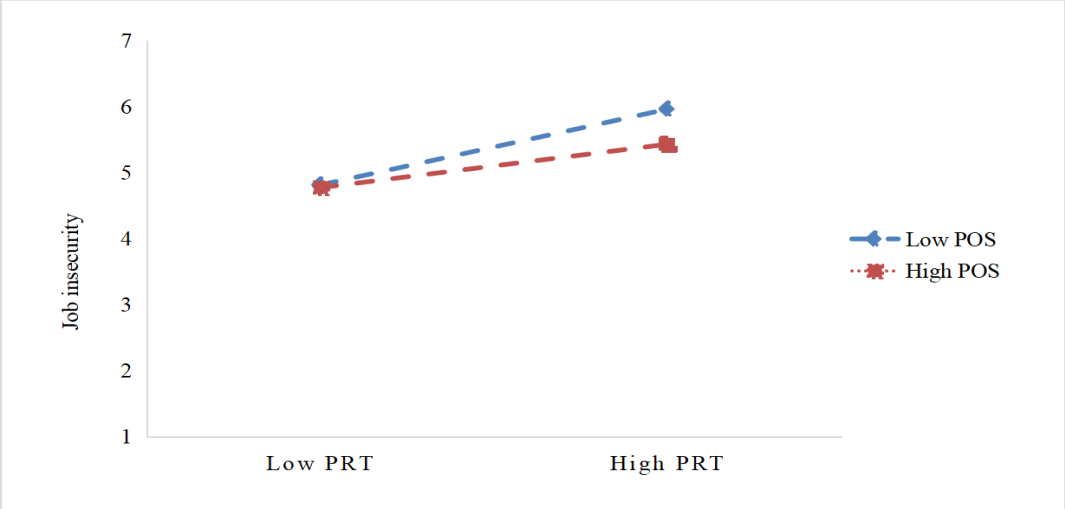

Fig. 3. Moderating Role of POS in the Relationship between Perceived Robot Threat and Job Insecurity

Discussion

Research Conclusions

Guided by the COR, this study systematically investigated the mechanism through which perceived robot threat influences turnover intention among manufacturing employees, while validating the mediating role of job insecurity and the moderating role of POS. The results supported all hypotheses, with the following key conclusions: First, perceived robot threat significantly and positively predicts turnover intention among manufacturing employees. This finding aligns with COR, indicating that when employees perceive robots as threatening their job security and career development, psychological stress arising from resource loss (e.g., skill devaluation, reduced professional capital) amplifies their inclination to leave. Second, job insecurity mediates the relationship between perceived robot threat and turnover intention. The findings demonstrate that perceived robot threat indirectly increases turnover intention by exacerbating job insecurity, highlighting job insecurity's role as a critical manifestation of resource depletion and a bridge between technological change and employee behavior. Third, POS significantly

moderates the relationships between perceived robot threat and both turnover intention and job insecurity. Specifically, high POS not only directly mitigates the negative impact of perceived robot threat on turnover intention but also indirectly reduces turnover intention by weakening the mediating effect of job insecurity.

Theoretical Contributions

First, this study extends the application of COR to the context of robotics. By integrating COR into the analysis of robot-related threats, it reveals how perceived robot threat affects employee psychology and behavior through resource depletion, offering a novel perspective for understanding the impact of technological change on employees' resource states. Second, the identification of job insecurity's mediating mechanism enriches research on job insecurity and provides a new theoretical framework for analyzing how technological transformations influence employee psychology and behavior. Third, the elucidation of POS's dual moderating role expands discussions on strategies to manage employees' psychological challenges in the face of technological disruption, emphasizing the importance of organizational-level interventions.

Managerial Implications

First, organizations should prioritize employees' psychological well-being. Proactive measures, such as regular communication and mental health support (e.g., workshops, counseling services), can help alleviate anxiety triggered by perceived robot threats. Second, enhancing POS is critical. Organizations should provide emotional support (e.g., empathy, respect) and instrumental support (e.g., training, resources) to empower employees to adapt to technological changes. Third, optimizing human-robot collaboration is essential. Clear role definitions between employees and robots can reduce ambiguity and skill devaluation. For instance, designing workflows that emphasize employees' unique contributions in human-robot teams can reinforce their value and mitigate insecurity.

Limitations and Future Directions

This study has limitations that warrant attention. First, the focus on manufacturing employees limits generalizability. Future research could extend to sectors like services or finance to test the universality of findings. Second, the cross-sectional design constrains causal inferences. Longitudinal studies are needed to explore the dynamic effects of perceived robot threat on turnover intention. Third, while POS was examined as a moderator, additional variables (e.g., psychological resilience, professional identity) could further elucidate the mechanisms linking perceived robot threat to employee outcomes.

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