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The Impact of Platform Algorithm Pressure on the Psychological Vulnerability of Digital Gig Workers Internal Mechanisms and Regulatory Strategies

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Abstract: With platform algorithms evolving from managerial tools into core regulatory mechanisms of labor processes, the novel stressors confronting digital gig workers and their psychological consequences demand urgent scholarly attention. Existing research lacks systematic exploration of the internal transmission mechanisms between algorithmic pressure and psychological vulnerability. Integrating the Job Demands-Resources theory, Psychological Capital theory, and Stress Cognitive Appraisal theory, this study conducts in-depth interviews with 30 food delivery riders, ride-hailing drivers, and couriers, supplemented by 581 questionnaire responses, to systematically dissect the internal mechanisms through which the three-dimensional structure of algorithmic pressure transforms into psychological vulnerability. Findings reveal that algorithmic pressure influences psychological vulnerability through dual mediating pathways of "challenge appraisal" and "hindrance appraisal," constituting a double-edged sword effect. Psychological capital functions as a downstream buffer; individuals with higher psychological capital can block vulnerability conversion through self-efficacy and resilience even under equivalent algorithmic pressure. Group comparisons indicate that food delivery riders exhibit significantly higher algorithmic pressure perception and belongingness deprivation than ride-hailing drivers. Accordingly, this paper constructs a four-dimensional regulatory framework encompassing algorithmic transparency, institutional reinforcement, ecological complementation, and psychological empowerment, advocating a shift from efficiency-first to balanced efficiency-fairness algorithmic governance, thereby providing theoretical support and practical pathways for digital gig worker protection.

Keywords: Algorithmic Management; Psychological Capital; Cognitive Appraisal; Collaborative Governance; Platform Labor; Stress Transmission Mechanism

1. Research Background

Currently, the internet economy is profoundly reshaping China's social relations and labor practices; the sharing economy leverages digital technology to tightly interconnect elements such as consumption, services, platforms, and labor, forming a new type of relational network unique to the information society [1]. Meanwhile, the evolution of the digital platform economy has propelled algorithms from "behind-the-scenes tools" to "central actors," making them a key entry point for understanding the interaction between technological logic and social relations.

Current research indicates that platform algorithms have a dual nature in the context of digital gig work. On the one hand, through precise scheduling and task allocation, platform algorithms can effectively improve work efficiency and help gig workers secure more job opportunities; on the other hand, issues regarding algorithmic transparency and fairness—particularly the platform's evaluation systems, especially algorithm-driven evaluation and reward mechanisms—may subject gig workers to high levels of uncertainty and stress. This pressure stems from the "covert control" mechanisms of platform algorithms—such as unfairness in evaluation systems, instability in task allocation, and the opacity of reward and punishment mechanisms—which often leave digital gig workers in a state of psychological vulnerability.

However, existing research has not sufficiently explored the intrinsic transmission mechanisms linking algorithmic pressure and psychological

vulnerability. Therefore, this paper focuses on the core question of "how platform algorithmic pressure affects the psychological vulnerability of digital gig workers." Based on the Job Demands-Resources Theory, Psychological Capital Theory, Collaborative Governance Theory, and Stress Perception Assessment Theory, and employing an empirical method combining in-depth interviews and questionnaire surveys, this study systematically analyzes the transmission mechanisms through which three-dimensional algorithmic pressure transforms into psychological vulnerability, and proposes optimized strategies for algorithmic regulation and the cultivation of psychological resilience.

2. Literature Review

2.1 Review of Research on Platform Algorithms

The mechanisms by which platform algorithms reshape and control the labor process have become a focal point in academic circles. Regarding domestic research, Liu Shanshi points out that algorithms construct a "data-driven" model of fine-grained management through real-time data monitoring, dynamic task allocation, and performance evaluation; while this enhances efficiency, it also leads to issues such as the loss of labor autonomy and income instability [2]; Feng and Zhan found that algorithms incorporate workers into high-intensity work environments through mechanisms such as "time constraints" and "linkage between rewards and punishments," thereby forming "algorithmic discipline" [3]; Zhang reveals that pressure from platform algorithms influences the behavior of digital gig workers through dual pathways of "challenging cognition" and "blocking cognition," with perceived algorithmic transparency and fairness serving as key moderating variables [4]; Gao et al. focus on the mechanisms underlying gig work stress, proposing that algorithmic mechanisms such as "dynamic pricing" and "real-time ranking" exacerbate income uncertainty and competitive anxiety [5]. In international research, German scholar Marek argues that the essence of algorithmic governance lies in the implicit regulation of the labor process through a digital rule system, while workers' acts of meaning-making regarding algorithms are, in fact, adaptive responses to this control system: specifically, the three dimensions of "focused execution," "selection patterns," and "source retention" [6]; Other scholars, drawing on the theory of moral disengagement, have highlighted that under the negative stimuli of intense algorithmic surveillance, the moral self-regulation mechanisms of gig workers on platforms will fail, leading to higher levels of unethical behavior and exacerbating labor alienation [7]. Overall, existing research still falls short in exploring specific pathways for algorithmic governance.

2.2 A Review of Research on the Mental Health of Digital Gig Workers

Mental health issues among digital gig workers are becoming increasingly prominent. In domestic research, Chen et al. found that real-time algorithmic monitoring, performance rankings, and uncertainty regarding rewards and punishments increase gig workers' occupational burnout and tendency to resign [8]; Yan pointed out that digital gig workers, due to a lack of traditional labor protections, are trapped in a vicious cycle of "high anxiety and low sense of belonging" [9]. In international research, British scholar Adam found that the heightened sense of loneliness and more severe economic instability experienced by gig workers are the core driving mechanisms behind their disadvantages in mental health and life satisfaction [10]; Australian scholar Sadia points out that the inherent uncertainty and unpredictability of gig work erode the sense of boundaries and control between work and personal life, leading to intensified role conflict and potentially undermining workers' physical and mental health as well as their subjective well-being [11]. Furthermore, Malaysian scholar Sukmit focuses on the phenomenon of "digital loneliness," arguing that digital environments erode offline social support networks and exacerbate psychological vulnerability [12].

2.3 Research Review

Domestic and international research has laid the groundwork for understanding the relationship between platform algorithms and the mental health of gig workers. Overseas studies focus on the ethical controversies surrounding algorithmic control and labor alienation, while domestic research is more closely aligned with local practices, revealing the pathways through which

algorithmic pressure affects gig workers' mental health. However, existing studies often analyze platform algorithms and mental health as independent issues, failing to delve deeply into the coupling relationship between the two or the specific transmission mechanisms through which algorithms influence psychological vulnerability. Furthermore, there is insufficient attention to the differentiated impacts on various sub-groups. Therefore, this paper adopts an empirical method combining in-depth interviews and questionnaire surveys to systematically analyze the mechanisms through which three-dimensional algorithmic pressure transforms into psychological vulnerability, thereby addressing existing research gaps.

3. Research Design

3.1 Core Concepts and Theoretical Framework

3.1.1 Definition of core concepts

(1) Digital gig workers

Digital gig workers are self-employed individuals who enter the market and can independently decide their working hours, locations, and methods. They leverage digital skills and virtual platforms to provide precisely matched services to a vast number of unspecified consumers and undertake multiple temporary tasks simultaneously based on their abilities and time availability. Their collaborative boundaries have expanded from communities to cities and even national levels [13]. This group exhibits three core characteristics: highly flexible work patterns, the absence of traditional employment relationships with platforms, and remuneration typically based on piecework or service fees. Scholars consistently point out that digital gig workers face challenges such as ambiguous legal status and a lack of social security [14-17]. They also pay particular attention to the labor rights of digital gig workers, including occupational safety and health risks, inadequate social security coverage, and poor contract stability [18,19]. Due to the continuous intervention of platform algorithms and increasing work pressure, digital gig workers not only face traditional labor protection challenges but also endure technological and psychological pressures.

(2) Psychological Vulnerability

Psychological vulnerability refers to an individual's insufficient psychological adaptability and coping strategies when facing internal and external stressors; this state makes the individual more susceptible to negative emotions, inappropriate behaviors, or cognitive biases. Its implications can be analyzed from multiple perspectives: in terms of emotional responses, highly vulnerable individuals possess strong negative cognitive schemas and are highly prone to psychological imbalance when facing stress; cognitive evaluations manifest as a tendency toward negative self-perception and pessimistic expectations [20]; coping mechanisms and interpersonal relationships lean toward avoidance behaviors and unhealthy strategies, while simultaneously exhibiting a high dependence on others for support; and values and beliefs are characterized by a negative worldview, viewing life as threatening and lacking direction [21].

3.1.2 The three-dimensional structure of algorithmic stress

The gig workforce faces a new source of stress distinct from that of traditional workers—algorithmic stress [22]—which is rooted in the process by which platform companies use algorithmic systems to perform management functions such as task allocation, performance evaluation, and rule enforcement. This stress is inherently more dynamic and interactive, constantly evolving as algorithms are updated.

Algorithmic pressure consists of three dimensions: pressure from performance evaluations, pressure from time constraints, and pressure from normative control. Under the pressure of platform algorithms, the psychological vulnerability of digital gig workers is not merely a sporadic emotional reaction, but rather a systemic outcome resulting from the interweaving, permeation, and synergistic amplification of algorithmic pressure through a "three-dimensional mechanism": each dimension acts independently on the psychological system while simultaneously reinforcing the others through algorithmic logic, forming a closed loop that continuously compounds individuals' feelings of uncertainty, powerlessness, and self-doubt, ultimately condensing multidimensional pressure into deep-seated psychological vulnerability.

3.1.3 Analytical framework

This paper integrates four theories to construct a multi-level analytical framework. The Job

Demands-Resources Theory provides the foundational structure: platform algorithms generate high-intensity job demands such as labor evaluation, time constraints, and normative control, while simultaneously eroding job resources such as autonomy and social support, creating an imbalanced "high-demand, low-resource" pattern. The Theory of Stress Perception and Evaluation explains differential effects: whether gig workers interpret algorithmic pressure as a challenge or an obstacle determines whether stress activates or depletes psychological capital. Psychological Capital Theory reveals the internal transformation process: when obstacle-oriented cognition dominates, self-efficacy, hope, optimism, and resilience are continuously eroded, ultimately solidifying into structural psychological vulnerability. The theory of collaborative governance provides a holistic perspective for strategy development, emphasizing the necessity of tripartite collaboration among government, market, and society. This underpins the construction of a regulatory framework in this paper across four dimensions: institutional safeguards, platform governance, social support, and individual empowerment. These four theories are interlinked, collectively forming a complete logical chain of "stress generation—cognitive evaluation—resource depletion—collaborative governance."

3.2 Empirical Analysis of the Impact of Algorithmic Stress on Psychological Vulnerability Among Gig Workers

3.2.1 Research methods and data sources

This study employs an empirical design combining in-depth interviews with a questionnaire survey. The interviews covered three typical categories of digital gig workers—food delivery riders, ride-hailing drivers, and couriers—with a total of 30 participants, including 16 food delivery riders, 7 ride-hailing drivers, 4 couriers, and 3 platform recruiters. The cumulative interview duration exceeded 120 hours, yielding approximately 800,000 words of qualitative research text. The questionnaire survey employed random stratified sampling and was conducted in Hangzhou from July to August 2025. A total of 581 valid questionnaires were collected, yielding a response rate of 96.83%. The interview and questionnaire data corroborate one another, forming the empirical foundation of this study.

3.2.2 Transmission mechanisms of algorithmic influence on psychological vulnerability

(1) Cognitive Evaluation: The Differentiation of Vulnerability from "Challenge" to "Blockage"

Digital gig workers' cognitive evaluations of algorithmic pressure exhibit a distinct pattern of differentiation: some gig workers develop a "challenge" mindset, viewing algorithmic pressure as a means to enhance efficiency and increase income, thereby activating psychological capital; others develop a "blockage" mindset, perceiving algorithms as obstacles to their personal development, leading to the continuous depletion of psychological resources.

Table1. Correlation Analysis Table

	Platform Algorithm Pressure	Challenging Perception	Blocking Cognition	Psychological Capital	Psychological Vulnerability
Platform algorithm pressure	1				
Challenging Cognition	.210**	1			
Blocking Cognition	.299**	.178**	1		
Psychological Capital	.395**	.181**	.190**	1	
Psychological Vulnerability	.263**	.280**	.164**	.455**	1

Note: *p<0.05, **p<0.01, ***p<0.001; same applies below.

From the Table 1: Data analysis results show that blocking cognition is significantly positively correlated with psychological vulnerability ($r = 0.164$, $p < 0.01$), while challenging cognition is significantly negatively correlated with psychological vulnerability ($r = -0.280$, $p < 0.01$), indicating that cognitive evaluation plays a key mediating role between algorithmic stress and psychological vulnerability.

(2) Depletion of Psychological Resources: The Dual Erosion of Psychological and Social Capital

Algorithmic pressure continuously erodes the dual resources of gig workers through the blocking cognitive pathway. At the level of psychological capital, frequent rule changes and uncontrollable performance feedback undermine self-efficacy, leading individuals to gradually develop learned helplessness—the belief that "no matter how hard I try, it's useless."

Consequently, hope and optimism decline, giving rise to the psychological paradox that "the harder one tries, the more vulnerable one becomes." At the level of social capital, algorithm-driven competitive mechanisms suppress mutual aid within gig worker communities, while the instability of working hours alienates family and community ties. This leaves gig workers lacking external buffers when facing psychological crises, further entrenching structural vulnerability.

(3) The triggering and entrenchment of psychological vulnerability: From emotional fluctuations to structural vulnerability

As psychological capital and social support are continuously eroded by algorithmic pressures, gig workers fall into a vicious cycle of "high vulnerability and low resilience." Emotionally, they experience frequent anxiety, irritability, and sleep disorders; cognitively, they exhibit self-denial, pessimism about the future, and "imposter syndrome"-style doubts about their abilities; behaviorally, they present a contradictory state where social avoidance, a tendency to voluntarily quit, and overwork coexist; On the physiological level, cross-validation of medical examination data reveals that individuals under prolonged high stress exhibit significantly higher rates of gastric disorders, abnormal heart rates, and weakened immunity. Questionnaire surveys corroborate this trend: food delivery riders scored significantly higher on "worrying about receiving bad reviews for minor mistakes" and "frequently feeling tense and anxious" compared to ride-hailing drivers, indicating that algorithmic pressure has caused some gig workers to slide from transient emotional fluctuations into structural psychological vulnerability.

The above qualitative findings reveal the transmission pathway through which algorithmic pressure transforms into psychological vulnerability. To further test this mechanism, this study constructed a moderated mediation model to quantitatively analyze the mediating effect of cognitive evaluation and the moderating role of psychological capital.

3.2.3 The double-edged sword effect of algorithmic pressure: quantitative model testing

(1) Scale Design and Reliability-Validity Testing

All core variables in this study were measured using a 7-point Likert scale (1 = "Strongly Disagree," 7 = "Strongly Agree"). The independent variable, platform algorithmic pressure, consisted of 10 items adapted from Cohen et al.'s (1983) Perceived Stress Scale, with a Cronbach's α coefficient of 0.898 in the pilot study. The dependent variable, psychological vulnerability, comprises 12 items across four dimensions: sense of belonging, fear of evaluation, imposter syndrome, and negative emotions. It was adapted from Muenks et al.'s Psychological Vulnerability Questionnaire, with a pilot study Cronbach's α of 0.818. The mediating variables, challenge-oriented cognition and blocking-oriented cognition, each consist of 3 items. They were developed based on the theory of stress cognition and had preliminary Cronbach's α coefficients of 0.832 and 0.845, respectively. The moderating variable, psychological capital, comprises four dimensions—self-efficacy, hope, resilience, and optimism—with a total of 24 items. It was adapted from the Psychological Capital Questionnaire (PCQ-24), with a pilot study alpha coefficient of 0.953.

Table 2. Reliability Analysis Table

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
.861	.896	52

Table 3. Validity Analysis Table

KMO Sampling Adequacy Coefficient		.877
Bartlett's Test of Sphericity	Approximate Chi-Square	4290.717
	Degrees of freedom	1326
	Significance	.000

The overall reliability and validity tests for the questionnaire are shown in the Table2 and Table 3 above: The overall Cronbach's α coefficient is 0.896 (0.861 based on standardized items), exceeding the critical threshold of 0.8, indicating good internal consistency of the questionnaire. Regarding validity testing, the KMO value was 0.877, and the significance of the Bartlett's sphericity test result was 0.000 (less than 0.05), indicating suitability for factor analysis. Exploratory factor analysis was conducted using principal component analysis, with a cumulative

variance explained of 78.628%. The factor loadings for all measurement variables were greater than 0.7, indicating ideal structural validity for the questionnaire. Specifically, the common factor F1 (Challenging Cognition), composed of the three measurement items Q1, Q2, and Q3, reflects gig workers' positive perceptions of and adaptability to platform algorithms; the common factor F2 (Blocking Cognition), composed of the three measurement items Q4, Q5, and Q6, reflects gig workers' negative perceptions of and evaluations of platform algorithms as obstacles.

(2) Analysis of Group Differences

Using food delivery riders and ride-hailing drivers as comparison groups, independent samples t-tests were conducted across four dimensions—emotional reactions, cognitive evaluations, coping strategies, and lack of belonging—to examine differences among different gig worker groups regarding the core variables.

Table 4. T-Test Results for Each Dimension

Dimension	Variable	Job Type		t-value	p-value
		Food delivery drivers (n=393)	Ride-hailing drivers (n=102)		
Perceived pressure from platform algorithms	/	5.09 ± 0.54	4.89 ± 0.56	3.266	0.001
Perceived Stress Assessment	Challenging Cognition	5.58 ± 0.96	5.46 ± 0.85	1.181	0.238
	Blocking Cognition	3.87 ± 1.51	4.01 ± 1.51	-1.258	0.209
Psychological Capital Scale	Self-Efficacy	5.52 ± 0.92	5.43 ± 0.89	0.872	0.384
	Hope	5.43 ± 0.97	5.33 ± 0.96	0.853	0.394
	Toughness	5.25 ± 0.82	5.06 ± 0.75	2.105	0.036
	Optimism	5.61 ± 0.84	5.49 ± 0.91	1.355	0.176
Psychological Vulnerability	Sense of Belonging	5.78 ± 0.93	5.50 ± 1.01	2.576	0.010
	Evaluation Concerns	3.92 ± 1.56	3.81 ± 1.42	0.611	0.541
	Imposter feelings	2.95 ± 1.43	2.73 ± 1.30	1.415	0.158
	Negative emotions	3.07 ± 1.59	2.87 ± 1.47	1.173	0.241

As shown in Table 4, food delivery riders reported significantly higher levels of perceived algorithmic pressure than ride-hailing drivers, indicating that riders are subject to greater algorithmic constraints. From the perspective of work-resource theory, "immediacy of work demands" further amplified the perception of pressure. Regarding the assessment of stress cognition, there were no significant differences in either challenge-oriented or blocking-oriented cognition, suggesting that the cognitive patterns regarding algorithmic pressure are relatively consistent across the two groups. Regarding the Psychological Capital Scale, no significant statistical differences were observed in the three dimensions of self-efficacy, hope, and optimism; only the resilience dimension showed a significant difference ($p=0.036<0.05$). The small-scale social networks formed by riders around their stations may have enhanced their psychological resilience. Regarding psychological vulnerability, no significant statistical differences were observed in the dimensions of evaluation anxiety, imposter feelings, or negative emotions; only the sense of belonging dimension showed a significant difference ($p=0.010<0.05$), which is related to the organizational ties formed by riders through their base stations.

Overall, the two groups were relatively consistent in their core cognitive patterns, both facing survival dilemmas dominated by algorithmic pressure, with only partial differences in the intensity of perceived stress, levels of resilience, and experiences of belonging.

(3) Testing the Mediating Effects of Challenging and Blocking Cognitions

This study utilized the PROCESS 4.1 plugin in SPSS 26.0 and employed the Bootstrap method (5,000 samples) to test the mediating effects of challenge-oriented cognition and blocking-oriented cognition separately.

Mediating Effect of Challenging Cognition. As shown in the Table 5, platform algorithmic pressure has a significant positive effect on challenging cognition ($\beta = 0.2225$, $p < 0.001$) and a significant positive effect on psychological vulnerability ($\beta = 0.2669$, $p < 0.001$ when platform algorithmic pressure acts independently in the model).After including challenging cognition in the model, the effect of platform algorithm pressure on psychological vulnerability remained significant ($\beta = 0.2167$, p

< 0.001), and the positive effect of challenging cognition on psychological vulnerability was also significant (β = 0.2257, p < 0.001).Bootstrap test results show that the mediation effect size is 0.0502, with a 95% confidence interval of [0.0272, 0.0779] that does not include zero, and the effect accounts for 18.81% of the total effect. In summary, challenging cognition partially mediates the relationship between algorithmic pressure and psychological fragility. Furthermore, psychological capital positively moderates the relationship between algorithmic pressure and challenging cognition: the higher the level of psychological capital (e.g., 6.50), the more pronounced the enhancing effect of algorithmic pressure on challenging cognition; the lower the level of psychological capital (e.g., 3.23), the weaker this positive relationship becomes.

Table 5. Mediation Effect Test for Table

Dependent Variable	Independent Variables	β	t	P	R	R^2	F
Challenging Cognition	Platform Algorithm Pressure	0.2225	5.1718	0.000***	0.2101	0.0422	26.7473
Psychological Vulnerability	Platform algorithm pressure	0.2669	6.5561	0.000***	0.2629	0.0691	42.9823
Psychological Vulnerability	Platform algorithm pressure	0.2167	5.3535	0.000***	0.3494	0.1221	40.1893
	Challenging Cognition	0.2257	5.9060	0.000***			

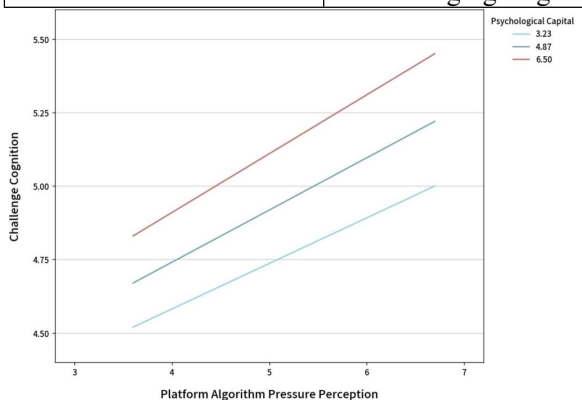

Figure 1. Moderation Effect of Psychological Capital

Mediating effect of blocking cognition. From the Table 6: Platform algorithm stress has a significant positive effect on blocking cognition (β=0.3179, p<0.001) and a significant positive effect on psychological vulnerability (β=0.2669, p<0.001). When both platform algorithm stress and blocking cognition are included, the former still significantly influences psychological vulnerability (β=0.2386,p < 0.001), and the latter also remained significant (β = 0.0890, p = 0.0264).From the Table 7 Bootstrap test results indicate that the mediation effect size is 0.0283, with a 95% confidence interval of [0.0048, 0.0529] that does not include zero, accounting for 10.60% of the total effect. In summary, blocking cognition also plays a partial mediating role. Furthermore, psychological capital also strengthens the positive relationship between platform algorithm stress and blocking cognition; the higher the level of psychological capital, the more pronounced the reinforcing effect of algorithm stress on blocking cognition.

Table 6. Mediation Effect Test Table

Dependent Variable	Independent Variables	β	t	P	R	R2	F
Blocking Cognition	Platform Algorithm Pressure	0.3179	7.5436	0.000***	0.2991	0.0895	56.9061
Psychological Vulnerability	Platform algorithm pressure	0.2669	6.5561	0.000***	0.2629	0.0691	42.9823
Psychological Vulnerability	Platform algorithm pressure	0.2386	5.6113	0.000***	0.2775	0.0770	40.1893
	Blocking Cognition	0.0890	2.2259	0.0264			

Table 7. Summary Table of Dual Mediation Effect Tests

Path	Effect Size	95% Confidence Interval		Effect Size
		LLCI	ULCI	
Algorithmic stress → Challenging cognition → Psychological vulnerability	0.0502	0.0272	0.0779	18.81%
Algorithmic pressure → Blocking cognition → Psychological vulnerability	0.0283	0.0048	0.0529	10.60%

Combining the test results from both pathways from the Figure 1 and Figure 2, platform algorithm pressure influences psychological vulnerability through dual mediating pathways of challenge-oriented cognition and blocking cognition, creating a "double-edged sword" effect: The activation pathway stems from the support of work resources; high psychological capital prompts gig workers to view algorithm pressure as a "challenge to increase income," indirectly alleviating psychological vulnerability by reinforcing challenge-oriented cognition; The blocking pathway, however, stems from a lack of resources; when social capital is weak, high

psychological capital actually reinforces blocking cognition, thereby exacerbating psychological vulnerability.

The buffering effect of psychological capital and hierarchical regression

To examine the moderating role of psychological capital in the relationship between perceived algorithmic pressure on platforms and cognitive evaluation, this study conducted moderation tests using challenge-oriented cognition and obstruction-oriented cognition as dependent variables, respectively.

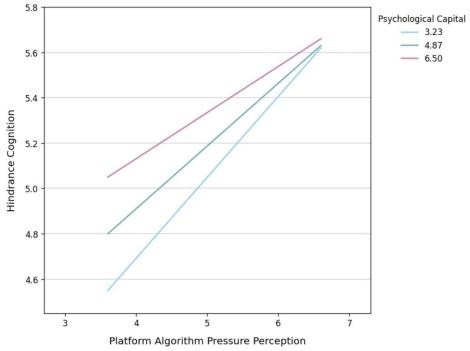

Figure 2. Moderation Effect Diagram for Psychological Capital

Table 8. Moderating Effect of Psychological Capital on Challenging Cognition

	Model 1	Model 2	Model 3
Constant	4.961**(74.392)	4.961**(74.769)	4.947**(69.208)
X	0.222**(5.169)	0.174**(3.734)	0.177**(3.765)
W		0.116**(2.624)	0.117**(2.645)
X*W			0.013(0.495)
N	581	581	581
R^2	0.044	0.055	0.056
Adjusted R^2	0.042	0.052	0.051
F-value	F(1,579)=26.722, p=0.000	F(2,578)=16.941, p=0.000	F(3,577)=11.361, p=0.000
△R^2	0.044	0.011	0.000
△F-value	F(1,579)=26.722, p=0.000	F(1,578)=6.887, p=0.009	F(1,577)=0.245, p=0.621
Note: Dependent variable = Y1 * p < 0.05, ** p < 0.01; values in parentheses are t-values			

Table 9. Moderation Effect of Psychological Capital on Interruptive Cognition

	Model 1	Model 2	Model 3
Constant	5.163**(79.060)	5.163**(79.258)	5.209**(74.396)
X	0.318**(7.544)	0.282**(6.165)	0.271**(5.883)
W		0.086*(1.975)	0.082(1.884)
X*W			-0.046(-1.767)
N	581	581	581
R^2	0.089	0.096	0.100
Adjusted R^2	0.088	0.092	0.096
F-value	F(1,579)=56.910, p=0.000	F(2,578)=30.548, p=0.000	F(3,577)=21.481, p=0.000
△R^2	0.089	0.006	0.005
△F-value	F(1,579)=56.910, p=0.000	F(1,578)=3.902, p=0.049	F(1,577)=3.123, p=0.078
Note: Dependent variable = Y2 * p<0.05, **p<0.01; values in parentheses are t-values			

From the Table 8 and Table 9 the results show that psychological capital (W) has a significant positive effect on challenge-oriented cognition (Y1) when considered alone (the coefficient of W in Model 2 is 0.116**, $p < 0.01$), and the model's explanatory power significantly improved after including W ($\Delta R^2 = 0.011$, p for $\Delta F = 0.009 < 0.01$). However, the interaction term between platform algorithm stress and psychological capital (X*W) did not reach significance ($\beta = 0.013$, $p = 0.621$), and the moderating effect was not established (see Table 10).In the blocking cognitive model, psychological capital also had a positive effect (the coefficient of W in Model 2 was 0.086*, $p < 0.05$), and the model's explanatory power significantly increased after including W ($\Delta R^2 = 0.006$, p for $\Delta F = 0.049 < 0.05$).However, the interaction term was also not significant ($\beta = -0.046$, $p = 0.078$). This indicates that psychological capital did not play a significant buffering role in the direct relationship between perceived algorithmic pressure and cognitive evaluation.

We further employed hierarchical regression to examine the independent predictive power of

each core variable on psychological vulnerability (see Table 11).

The results show that the model's explanatory power increased significantly as variables were sequentially included. The final model explains 15.4% of the variance in psychological vulnerability, validating the overall explanatory power of the "stress perception–resource depletion" transmission chain.

First, algorithmic pressure from the platform constitutes a direct driver of psychological vulnerability. Model 2 shows that, after controlling for demographic variables, algorithmic pressure has a significant positive predictive effect on psychological vulnerability ($\beta = 0.186$, $p < 0.001$), explaining an additional 3.4% of the variance. This corroborates the widespread sentiment among gig workers in qualitative research that they feel "chased by the system"—algorithmic pressure itself constitutes a source of psychological resource depletion and can directly elevate vulnerability levels without requiring mediation.

Second, the mediating effect of cognitive evaluation was verified through stratification. After incorporating challenging and blocking cognitions into Model 3, explanatory power increased by an additional 3.2%, but the regression coefficients for both were not significant. This does not negate the mediating effect; rather, it reveals that the role of cognitive evaluation is primarily realized through the indirect pathway of "algorithmic pressure—cognitive restructuring—resource depletion." Combined with the previous test results—where the effect sizes of the two mediating pathways were 18.81% and 10.60%, respectively—this confirms that cognitive evaluation serves as a critical hub in the transmission chain rather than an independent predictor.

Table 10. Summary of Regression Models

Model	R	R^2	Adjusted R^2	Standard Error of Estimate
1	.173a	0.03	0.021	10.658
2	.252b	0.064	0.054	10.481
3	.310c	0.096	0.083	10.317
4	.392d	0.154	0.14	9.99

Table 11. Regression Coefficients Table

Model		Unstandardized Coefficients		Standardized Coefficients Beta	Significance
		B	Standard error		
1	(constant)	46.96	3.087		0
	Gender	2.749	0.998	0.117	0.006
	Age	-0.322	0.58	-0.025	0.579
	Digital gig work type	-1.303	0.792	-0.069	0.101
	Hours Worked	-1.108	0.594	-0.086	0.063
	Average daily working hours	0.423	0.716	0.026	0.555
2	(constant)	32.027	4.479		0
	Gender	2.656	0.982	0.113	0.007
	Age	-0.343	0.571	-0.026	0.548
	Digital gig work type	-0.769	0.788	-0.041	0.329
	Hours Worked	-1.16	0.584	-0.09	0.048
	Average daily working hours	0.38	0.704	0.023	0.59
	Platform algorithm pressure detection	0.336	0.074	0.186	0
3	(Constant)	36.547	15.299		0.017
	Gender	2.676	0.966	0.114	0.006
	Age	-0.371	0.562	-0.028	0.51
	Digital gig work type	-1.049	0.779	-0.055	0.179
	Hours Worked	-0.829	0.58	-0.064	0.153
	Average daily working hours	0.202	0.695	0.012	0.771
	Platform algorithm pressure sensitivity	0.507	0.082	0.28	0
	Challenging Cognition	-0.699	0.581	-0.241	0.23
	Blocking Cognition	-0.145	0.809	-0.035	0.858
4	(Constant)	44.017	14.862		0.003
	Gender	1.996	0.942	0.085	0.034

	Age	-0.217	0.545	-0.017	0.691
	Digital gig work type	-1.058	0.754	-0.056	0.161
	Hours Worked	-0.337	0.567	-0.026	0.553
	Average daily working hours	0.097	0.673	0.006	0.886
	Platform algorithm pressure detection	0.637	0.082	0.352	0
	Challenging Cognition	0.18	0.58	0.062	0.757
	Blocking Cognition	-0.322	0.784	-0.078	0.682
	Psychological Capital Scale	-0.211	0.034	-0.459	0

Third, psychological capital functions as a "buffer" rather than a "filter." After incorporating psychological capital into Model 4, explanatory power increased by 5.8 percentage points, and psychological capital exhibited the strongest negative predictive effect on psychological vulnerability ($\beta = -0.459$, $p < 0.001$). Notably, the standardized coefficient for algorithmic stress increased rather than decreased. Combined with the non-significant interaction term in the moderation analysis, this leads to the conclusion that the protective mechanism of psychological capital does not diminish the perception of stress itself, but rather functions as a "stress immunity" downstream in the stress transmission pathway—individuals with high psychological capital can buffer the transformation of vulnerability through self-efficacy and resilience even when exposed to the same level of algorithmic stress.

Fourth, the non-significance of control variables reveals the structural roots of algorithmic stress. Across the four models, demographic variables such as age, type of digital gig work, and hours worked did not reach the level of significance; only gender remained marginally significant in the models. This suggests that the impact of algorithmic pressure on psychological vulnerability is cross-group in nature: regardless of tenure or working hours, the risk of psychological vulnerability is systematically present as long as workers are incorporated into algorithmic management systems. The root cause of stress lies not in individual differences but in the institutional flaws of algorithmic governance structures.

In summary, the hierarchical regression and mediation analysis complement and corroborate each other: algorithmic stress, mediated by cognitive evaluation and buffered by psychological capital, jointly shapes the differentiated patterns of psychological vulnerability among digital gig workers, laying an empirical foundation for the four-dimensional regulatory strategies discussed below.

3.3 Algorithmic Black Boxes, Institutional Voids, and the Reconstruction of Psychological Resilience: The Real-World Dilemmas and Optimization Pathways of Algorithmic Regulation for Digital Gig Workers

3.3.1 The absence of standardized algorithm governance and the deconstruction of the algorithmic black box

As the core regulatory mechanism in the digital gig economy, platform algorithms are inherently opaque. This lack of transparency leaves gig workers with unclear understanding of key processes—such as task allocation, performance evaluations, and reward/punishment rules—fostering a strong sense of psychological uncertainty. Research indicates that algorithm rules are frequently adjusted without prior notice, forcing gig workers to passively accept tasks. Some riders reported that "the system assigns nearby orders to riders who are farther away," resulting in unnecessary waste of time and energy. Survey data further confirms this: the average level of pressure from platform algorithms is 5.14 (on a scale of 1–7); 76% of riders are constrained by time pressures, and 69% of respondents cite "pressure from customer reviews" as their primary source of anxiety. Platforms monopolize the power to interpret rules, rendering appeal channels virtually non-existent—with riders stating, "We cannot appeal negative reviews, and the platform will not listen to our explanations"—which continuously exacerbates their sense of powerlessness.

To address this, the algorithmic "black box" must be deconstructed to block the transmission of pressure to the front end: Platforms must establish a comprehensive algorithm disclosure system, proactively publishing information such as task-assignment logic, performance evaluation metrics, and the trigger conditions and quantitative standards for rewards and penalties. Visualizing this information will eliminate cognitive confusion. Simultaneously, platforms should implement targeted algorithm

literacy training tailored to different types of gig workers. Through online courses, live Q&A sessions, and in-person workshops, they should facilitate a shift from passively accepting rules to actively understanding and applying them, thereby reducing the psychological burden caused by uncertainty.

3.3.2 Lagging algorithm constraints on the regulatory side and strengthening institutional support

Current government regulation of platform algorithms remains in its preliminary stages. Only a few normative documents, such as the "Guiding Opinions on Safeguarding the Labor Rights and Interests of Workers in New Forms of Employment," address algorithm governance. There is a lack of specialized legislation and mandatory regulations. Although the government advocates for "safeguarding the rights of gig workers," it lacks specific enforcement mechanisms and penalty measures. Platforms independently set income standards and reward/punishment rules, rendering complaint and appeal mechanisms largely ineffective.

In response, efforts should focus on safeguarding rights and strengthening institutional support: Accelerate the enactment of specialized legislation such as the "Regulations on Platform Algorithm Governance," explicitly prohibiting discriminatory decisions based on factors unrelated to work performance, and defining the joint liability and compensation standards for platforms resulting from algorithmic design flaws or non-compliant applications; Integrate departments such as human resources and social security, market regulation, and cyberspace administration to establish a comprehensive oversight mechanism; regularly investigate violations such as unreasonable task quotas and excessive compression of working hours; ensure unimpeded access to rights protection channels; and enforce penalties such as fines, suspension of operations for rectification, and public exposure in accordance with the law to establish institutional deterrence.

3.3.3 Addressing gaps in public service standards and building a mutual aid ecosystem

Currently, some Party-Mass Service Centers and trade union stations only provide basic services such as temporary rest and charging facilities, while core needs like psychological support, legal consultation, and vocational training remain scarce and fragmented. Only 12% of riders are aware of flexible employment protection policies, psychological counseling is often merely a formality, and 54.70% of gig workers "only vent their stress by complaining to peers," indicating a lack of a systematic social support network.

In response, a mutual aid ecosystem should be established to supplement public safeguards: Taking food delivery and ride-hailing as entry points, systematically advance the development of gig worker unions and industry associations. Organizational representatives should engage in equal negotiations with platforms on issues such as algorithmic rules, compensation calculations, and rest guarantees, promoting industry conventions and regular dialogue; Collaborate with companies, mental health counseling agencies, and non-profit organizations to establish a comprehensive service support platform that integrates mental health hotlines, emotional support workshops, legal aid, and customized skills training, thereby comprehensively enhancing risk management capabilities.

3.3.4 The shortage of mental health resources and the enhancement of individual psychological resilience

Information asymmetry between platforms and gig workers can lead to a sense of dehumanization, as communication between the two is indirect and one-sided [23]. Survey results indicate that 77.62% of riders do not understand the rules governing order priority. Their average psychological capital score is 4.87, with only 47.33% exceeding the baseline. This makes them susceptible to being "domesticated" by algorithms, gradually leading them to adopt a passive coping strategy at work and feel that the platform disregards their agency in the work process [24]; The mean psychological vulnerability score reached 4.96, with 54.70% expressing "concerns about career development" and 62.10% frequently feeling "anxious and exhausted." This vulnerability was particularly pronounced among younger riders, those with lower educational attainment, and those with shorter tenure. Meanwhile, existing psychological support services—such as links pushed by the platform—are largely superficial interventions. Riders report, "Working 12 hours a day, I simply have no time to use them," highlighting a lack of professionalism and continuity.

In response, psychological capital should be enhanced to strengthen self-protection capabilities: design a three-stage progressive psychological training program covering "stress identification—emotional regulation—resilience building," and develop lightweight "algorithm awareness micro-courses," that break down the underlying logic of algorithms and task-matching rules in accessible terms, guiding gig workers to shift from a "victim mentality" to a "participant mindset." Additionally, we should collaborate with vocational schools to establish specialized skill training programs to broaden career pathways, strengthen a sense of control over work and adaptability, systematically block the transmission of stress, and effectively enhance the psychological resilience of the digital gig workforce.

4. Conclusion

This paper explores the "internal mechanisms and regulatory strategies regarding how algorithmic stress impacts the psychological vulnerability of digital gig workers." Through in-depth interviews and questionnaire surveys, this paper clearly defines the three-dimensional form of algorithmic pressure, empirically tests the dual mediating mechanisms of challenge-oriented and blocking cognition, and examines the buffering effect of psychological capital in the downstream transformation of stress. It reveals the complete logic ranging from cognitive differentiation and depletion of psychological resources to the solidification of structural vulnerability. Based on these findings, this paper constructs a four-pronged regulatory framework comprising "algorithmic transparency—institutional reinforcement—ecological supplementation—psychological empowerment."

The implications of this study are as follows: the healthy development of the platform economy must not come at the expense of the legitimate rights and interests of the gig workforce. Algorithms are not merely technical tools; the value orientations behind them directly relate to labor equity. Promoting a shift in algorithms from "efficiency-first" to "balancing efficiency and equity" essentially involves seeking a dynamic equilibrium between commercial interests and the rights of gig workers.

Due to research constraints, there remains room for expansion in terms of research perspective and depth. Future research could further adopt empirical methods to quantitatively analyze the extent to which different types of algorithmic pressure affect the psychological vulnerability of gig workers and to verify the actual effectiveness of various coping strategies. At the same time, attention could be paid to differences in algorithmic pressure across distinct segments of the gig workforce, with targeted studies conducted. It is hoped that this paper will stimulate greater academic attention to labor protection issues in the algorithmic era and provide useful references for policymakers, platform companies, gig workers, and all sectors of society. Together, we can promote the development of the gig economy toward a more equitable, inclusive, and sustainable direction, ensuring that digital technology truly empowers every worker.

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