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The Impact of Improving Employee Psychological Empowerment and Job Performance Based on Deep Learning and Artificial Intelligence

Xiaoxue Fan, Semyung University, South Korea
Shulang Zhao, Beijing University of Technology, China
Xuan Zhang, Monroe College, USA
Lingchai Meng, Qingdao Hengxing University of Science and Technology, China*

ABSTRACT

In order to improve the management mode of the human resources system and enhance the work efficiency of employees, this paper uses artificial intelligence (AI) technology to enhance the psychological empowerment of employees. It affects employees' work performance from a psychological perspective with the help of psychological empowerment. The questionnaire survey method collects data on the influencing factors of employees' psychological empowerment. The statistical data are analyzed by regression. Back propagation neural network (BPNN) algorithm based on deep learning is used to establish the work condition evaluation model. The job satisfaction, pressure, and performance of employees based on psychological empowerment are analyzed.

KEYWORDS

Artificial Intelligence, Back Propagation Neural Network, Deep Learning, Psychological Empowerment, Work Performance

INTRODUCTION

With the development of Internet technology and globalization, the structure of many enterprises is changing, and the pressure of competition between enterprises is also increasing. Employee satisfaction with work, work-life balance, and occupational stress are related. Work stress has a negative impact on efficiency and performance (Piao et al., 2022). Psychological empowerment can mediate the positive correlation between structures. Job involvement and job empowerment are positively correlated with task performance. Therefore, psychological empowerment is crucial to job performance (Amor et al., 2021). Artificial Intelligence (AI) technology is used to improve workplace flexibility, professional

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*Corresponding Author

autonomy, independent learning of knowledge, and leadership, which can significantly motivate employees to enter and exit the workplace and improve work performance (H. Zhang et al., 2022). Therefore, to enhance the development of enterprises and promote employees' enthusiasm, it is necessary to explore employees' work performance based on AI technology and psychology.

Coun et al. (2022) pointed out a positive correlation between psychological empowerment and workplace initiative. Yao et al. (2022) pointed out that AI technology could impact future work. The strategic foresight generated by AI promotes the change of career research and practice from passive to active, which can positively promote employees' work safety, mental health, and other aspects (Howard, 2019). AI and employee service quality can explain the significant differences in overall service quality assessment, customer satisfaction, and customer loyalty. This will help enterprises optimize resource allocation and improve employee performance (Prentice et al., 2020a, 2020b). Tong et al. (2021) researched the factors affecting employee performance and, based on deep learning, improved the ability to collect and analyze information, which played a certain role in improving employees' working conditions. Deep learning can be used to diagnose, analyze, and judge employees' work behavior (Liu et al., 2019). Zhang & Qi (2022) collected data through questionnaires to analyze employees' working conditions. They used deep learning to predict employees' pressure to improve the enterprise's human resource management and to prevent and improve employees' work pressure and performance. BPNN is a supervised learning algorithm in deep learning, a multilayer feed forward network trained by the error back propagation algorithm, and one of the most widely used neural network models (Cui & Jing, 2019; Feng & Chen, 2022). Based on BPNN, the human resource management system is constructed to conduct statistical analysis on the relevant data of employees' work. The system can play a role in improving work performance (Bao et al., 2021; Wei & Jin, 2021). AI technology can improve employees' psychological empowerment, health, and satisfaction. Based on the BPNN of deep learning, employees' working state under psychological empowerment was evaluated. To prove that psychological empowerment under the influence of AI technology can improve employees' work performance, adding a deep learning algorithm is essential.

First, AI technology is used to enhance employees' psychological empowerment. Psychological empowerment can affect employees' work performance from a psychological perspective. The questionnaire survey method was used in this study to collect data on the influencing factors of employees' psychological empowerment. The statistical data were used for regression analysis to verify the reliability of the data. Second, the BPNN algorithm based on deep learning establishes the employee working condition and evaluation model. Employees' job satisfaction, pressure, and performance were analyzed based on psychological empowerment. The main innovation lies in combining deep learning, AI technology, and psychological empowerment, and in establishing a work situation evaluation model (Chen & Du, 2022; Deng et al., 2021; Hu & Chen, 2022) . Based on psychology, employees' work conditions were analyzed and their satisfaction was improved. This model can play a role in improving employee performance.

In the first two sections, the topic is introduced and a literature review is presented. The first section introduces the current situation of enterprise development and the difficulties of competition and puts forward that enterprise development should attach importance to employee development. The background and purpose of the study are also discussed. The literature review shows that psychological empowerment and AI technology greatly promotes staff performance and reduces stress. The research objective of this paper is to establish a psychological empowerment and job performance model for employees through the combination of deep learning and AI technology, and to analyze the job satisfaction, pressure, and performance of employees based on psychological empowerment. The results can improve the human resources system's management mode and enhance employees' enthusiasm.

The materials and methods section starts with the theoretical part and analyzes the role of AI technology, deep learning, and BPNN algorithm in improving employees' working conditions. The experiment shows the evaluation model based on the BPNN algorithm and psychological

empowerment. The questionnaire survey method was used to collect sample data to analyze and predict employees' work status.

The result and discussion section introduces the reliability analysis results of the questionnaire data and the prediction results of employees' work conditions based on the BPNN optimization model. The results show the sample data's reliability and confirmed a correlation between job satisfaction, stress, performance, and psychological empowerment. Psychological empowerment can improve the working conditions of employees.

The conclusion presents the authors' conclusion and puts forward the shortcomings of the research and the prospects for the future.

LITERATURE REVIEW

Employee performance refers to the efforts and contributions made by employees within an organization to the organization, which can be divided into two aspects: employee behavior and work results (Niati et al., 2021). Wahyudi (2022) proposed that employees' work performance depended on seven factors, namely: goals, standards, feedback, opportunities, conditions, abilities, and motivations. Among them, goals and motivation were the determinants of work performance, which provided ideas for studying ways to improve employees' work performance. The core concepts of psychological empowerment theory mainly included four points: empowerment, power, empowerment, and social stratification. Among them, empowerment was the synthesis of processes and results, including the empowerment of individuals, communities, and society. These confirmed that psychological empowerment would affect employees from a psychological perspective (Liu & Chen, 2021; Malik et al., 2021). The psychological empowerment theory has been applied to education, community, family, society, and other aspects. Community psychology is one of the fields with the most research and empowerment. There is relatively little research in enterprise work (Zhang, & Qi, 2022). Servant leadership mediated by knowledge sharing and psychological empowerment significantly affects employees' work performance. Therefore, leaders' psychological empowerment of employees can enable them to gain self-recognition and positively affect their work performance (Tripathi et al., 2020). Khan et al. (2020) pointed out that psychological empowerment could positively impact the enthusiasm of employees and the completion of project objectives. AI is one of the fields of computer science, which can imitate cognitive functions and build learning and thinking systems like human beings. This is also known as machine intelligence (Holzinger et al., 2019). There is an important relationship between psychological empowerment and work engagement. Psychological empowerment can affect employees' perceived well-being and work performance. Decentralization helps to improve management and organizational efficiency (Karimi et al., 2021). Arefin et al. (2019) pointed out that the high-performance work system and psychological empowerment positively impacted employee engagement. Psychological empowerment dominates the impact of high-performance work systems on job engagement. The organizational human resources system can influence employees' work participation through psychological empowerment and improve work performance (Arefin et al., 2019; Liu et al., 2021). Prentice et al. (2020a, 2020b) pointed out that AI can affect employees' work from an emotional level, improve employees' internal performance, and positively promote efficiency (Prentice et al., 2020a, 2020b). AI can analyze employees' emotions through natural language processing technology, improve employees' business ability, and enable employees to obtain psychological empowerment (Ahmed et al., 2022; Chang & Chen, 2021; Liu & Chen, 2023; R. Zhang et al., 2022).

The psychological empowerment theory is a vital evaluation standard of employees' work performance, and its development in China is relatively slow. AI technology has been widely studied in influencing employees' psychological empowerment, but there are few direct studies on employees' job performance. Based on the enterprise's development and employees' working conditions, the research on psychological empowerment, AI, and the deep learning algorithm is basically at the

primary stage (Ye & Chen, 2021). The research on psychological empowerment and employee job performance in China adopts a questionnaire and regression analysis method.

RESEARCH METHODOLOGY

AI and Deep Learning Technology

AI was put forward in the early 1960s. There are six main technologies: machine learning, human-computer interaction, natural language processing, biometrics, computer vision, and knowledge mapping (Minh et al., 2022).

Deep learning belongs to machine learning. It mainly extracts relevant information through hierarchical feature recombination to represent the rules and levels of learning sample data. Typical deep learning models include convolutional neural networks, stack self-coding networks, and deep confidence networks (Mater & Coote, 2019). Deep learning is an advanced big data analysis technology widely used in classification, regression analysis, image processing, speech recognition, target detection, etc. (Feng et al., 2021; Zhao et al., 2022; Zhou et al., 2019).

BPNN Algorithm

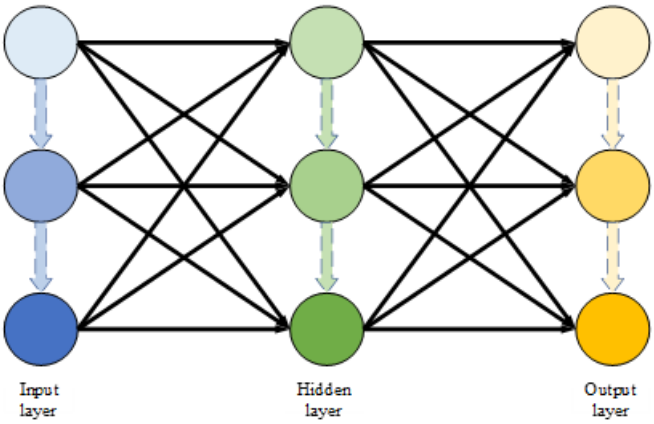
The main applied method is the BPNN algorithm. As a kind of deep learning, this algorithm is widely used. For example, it can improve greenhouse control technology in agriculture (Escamilla-García et al., 2020). In industry, the BPNN model can be used to analyze the wear of machine components and the employees' work efficiency (Huang et al., 2021; Wang et al., 2019). BPNN can improve the impact of psychological empowerment on employees' psychology and work performance through data learning, and is a good prediction and evaluation model.

The topology of the BPNN model is mainly divided into three layers: input, hidden, and output. The hidden layer is the model's core part (Jiang et al., 2019). The specific structure is shown in Figure 1.

Assumption: in the BPNN model, the number of neurons in the hidden layer is X, the number of neurons in the input layer is Y, and the number of neurons in the output layer is N. Therefore, the number of hidden layer neurons is calculated as shown in Equation (1):

$$X = \sqrt{Y + N} + \alpha \tag{1}$$

Figure 1.
BPNN model



In Equation (1), α is a constant, and the value range is 1 to 10. The relationship between the number of hidden layer neurons and the number of input layer neurons is shown in Equation (2):

$$X = \log_2 Y \tag{2}$$

BPNN model can be divided into forward and error back propagation. In the process of forward propagation, there is a neuron s. The activation function input of neuron s can produce induced local domain $X_s\left(n\right)$. $w_{si}\left(n\right)$ is the synaptic weight of a neuron s. $N_s\left(n\right)$ is the output of neurons. φ_s is the activation function. The calculation of input and output neurons is shown in Equations (3) and (4):

$$X_s\left(n\right) = \sum_{i=0}^{m} w_{si}\left(n\right) N_i\left(n\right) \tag{3}$$

$$N_s\left(n\right) = \varphi_s\left(X_s\left(n\right)\right) \tag{4}$$

In the process of error back propagation, set $N_s\left(n\right)$ is the actual output of neuron s; $d_s\left(n\right)$ is the expected output of neuron s. The calculation of the error signal $E_s\left(n\right)$ generated by the output of neuron s is shown in Equation (5):

$$E_s\left(n\right) = d_s\left(n\right) - N_s\left(n\right) \tag{5}$$

In Equation (5), $d_s\left(n\right)$ is the s-th element of the expected response vector $d\left(n\right)$. To make the function continuously derivable, the error signal $E_s\left(n\right)$ is minimized. Instantaneous error energy of neuron $e_s\left(n\right)$ is shown in Equation (6):

$$e_s\left(n\right) = \frac{1}{2} E_s^2\left(n\right) \tag{6}$$

Suppose: There is a set h. The set includes all neurons in the output layer. The calculation of all instantaneous error energy of neuron s is shown in Equation (7):

$$E_n = \sum_{s\in h} e_s\left(n\right) = \frac{1}{2}\sum_{s\in h} E_s^2\left(n\right) \tag{7}$$

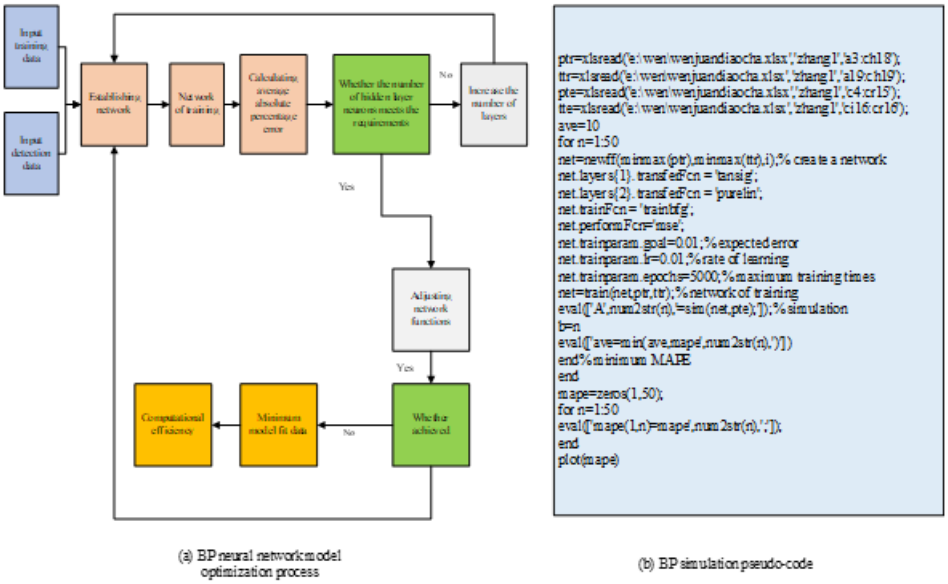
The BPNN model should be optimized to calculate different cases' actual and predicted values. The specific optimization situation is shown in Figure 2.

Psychological Empowerment

The research focuses on the impact of psychological empowerment on employees. In Western societies, empowerment is often used to enhance employees' job satisfaction and self-identity. Psychological empowerment can be measured at four levels: meaning, competence, self-determination, and influence (Abbasi et al., 2021). The specific process of empowerment is shown in Figure 3.

Psychological empowerment is a core concept in community psychology. According to the different survey factors, the factors that affect individual psychological empowerment are divided

Figure 2.
BPNN model optimization: (a) BPNN model optimization process, (b) BPNN model simulation pseudocode



(a) BP neural network model optimization process

(b) BP simulation pseudo-code

into three categories, namely, the characteristics of individuals, work groups, and organizations. The specific structure of the psychological empowerment research model is shown in Figure 4.

Based on the psychological aspect of empowerment, employees' meaning, ability, self-determination, and influence are positively correlated with organizational commitment. The significance and influence of psychological empowerment are important research factors of employees' organizational commitment (Ibrahim, 2020). The main influencing factors of psychological empowerment are shown in Figure 5.

Questionnaire Survey Method

The data were collected by questionnaire. This method is widely used in social surveys. First, the closed questionnaire is set up. The specific questionnaire setting is shown in Table 1.

The collected data were analyzed for reliability and validity. Statistical Product and Service Solutions (SPSS) 22.0 software was used to process the questionnaire data.

Figure 3. Specific process of empowerment

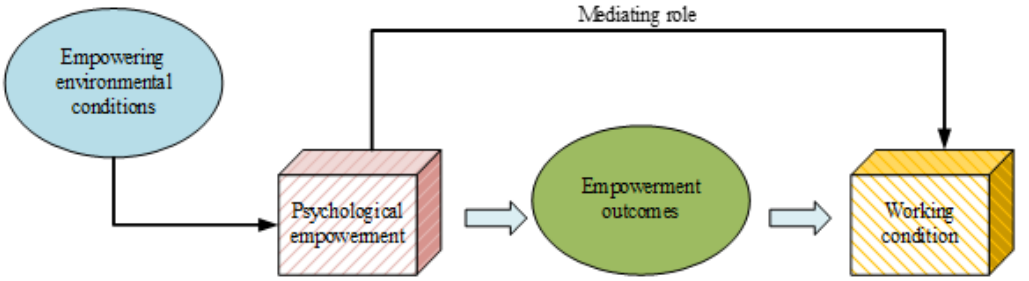


Figure 4. M
odel structure of psychological empowerment

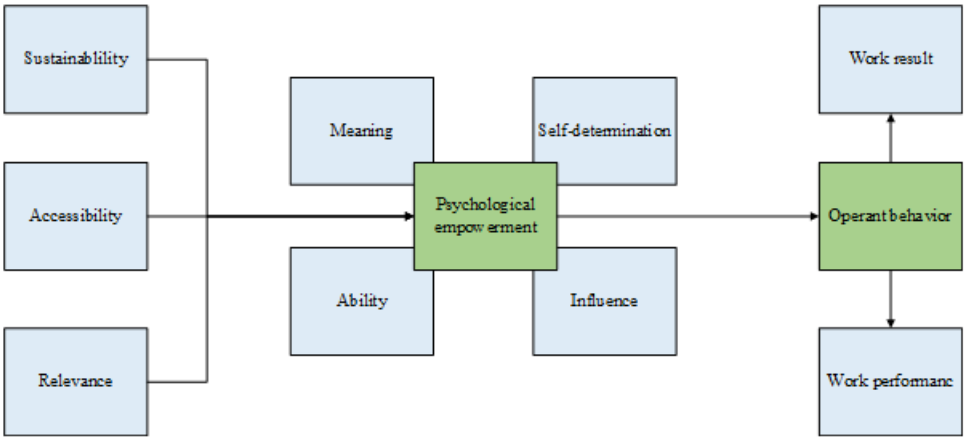


Figure 5.
Main influencing factors of psychological empowerment

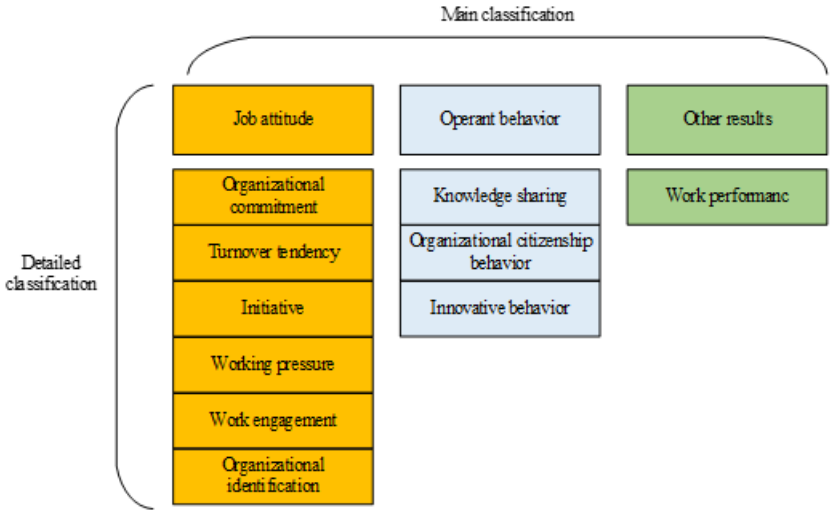


Table 1.
Setting of questionnaire questions

Category	Option
Gender	Male or female
Age	Under 25, 26 to 30, 31 to 35, 36 to 40, over 41
Record of formal schooling	High school and below, college, undergraduate, master, and above
Operating time	1 to 2 years, 2 to 3 years, 3 to 4 years, 4 to 5 years, and more than five years
Income	Under three thousand Yuan, three thousand to six thousand Yuan, six thousand to nine thousand Yuan, nine thousand to twelve thousand Yuan, more than twelve thousand Yuan
Duty	General staff, grassroots managers, middle managers

Table 2. Measurement of psychological empowerment

Psychological Empowerment Dimension Classification	Question
Meaning	My work is very important to me.
	My work activities are meaningful to me personally.
	My work is meaningful to me.
Capacity	I have confidence in my ability to complete the work.
	I believe I have the ability to do a good job.
	I have the ability to finish the work.
Self-determination	In the work, I can deal with problems well.
	I can decide how to finish my work.
	I have autonomy and decision-making power in deciding how to do my job.
Influence	In the work, my leader attaches great importance to my opinion.
	I have a great influence on what happens at the company.
	In my work, my research or manufacturing of improved products can be praised by leaders and users.

EXPERIMENTAL DESIGN AND PERFORMANCE EVALUATION

Datasets Collection

The wjx.cn platform was used to build online questionnaires. This online platform can automatically anonymize participants to protect the information security of the respondents. To improve the effectiveness of questionnaire data, questionnaire collection and screening questions were set in the sub-nodes to screen out personnel who met the basic requirements. After the questionnaire data was collected, it was inputted into Excel for processing, and the data was normalized dimensionless to eliminate the differences between the data. The missing data was filled with "NA." The survey object of the questionnaire was enterprise employees. Data were collected from working years, income, and learning. Of questionnaires distributed, the 359 questionnaires were collected, and the effective rate was 87%. Seven questionnaires were removed due to incorrect answers or missing questions, and the number of questionnaires obtained was 352. The question setting of the questionnaire was improved according to the employee innovation performance scale and the setting of Spreitzer's research.

Psychological empowerment and job performance were taken as research variables, and measurement items were set from the four dimensions of psychological empowerment. The specific psychological empowerment measurement questions are shown in Table 2.

Experimental Environment

The computer used in the experiment was Windows 10 (Windows Experience) system. The data source was questionnaire survey data. SPSS 25.0 software was used for data processing. According to Cronbach's α standard and data, reliability was analyzed. The Cronbach's α standard is shown in Table 3.

Matrix Laboratory (MATLAB) 2022b was used to establish a three-layer BPNN optimization model to analyze and predict employees' working state. MATLAB's MathWorks is software developed in the United States that can be used in data analysis, wireless communication, deep learning, image processing and computer vision, signal processing and simulation, and other fields.

Table 3. Coefficient standard of Cronbach's alpha

Cronbach's Alpha	Judgment Result
Less than 0.5	Reject
0.5 to 0.6	Non-ideal
0.6 to 0.7	Reluctantly accepted
0.7 to 0.8	Acceptable
0.8 to 0.9	Good
More than 0.9	Very good

Parameters Setting

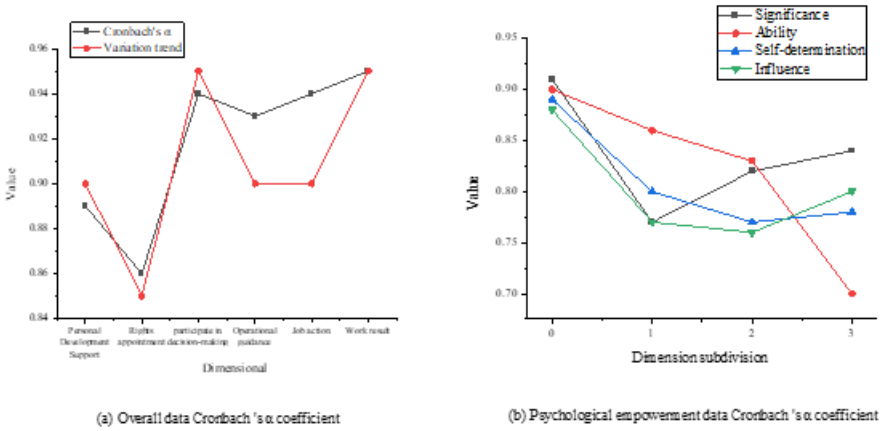
The BPNN optimization model was set. The work state of employees based on psychological empowerment was selected as the input and output value of the neural network. Employee work status was divided into satisfaction, stress, and performance. The three variables took turns as the output values of the model. The expected error of the BPNN optimization model was set to 0.05, the maximum training times were 5000, and the number of hidden layer neurons was 1 to 50. The hidden layer neurons of the model whose job satisfaction was output was set to 14. The model hidden layer neurons whose work pressure was output was set to 13, and the model hidden layer neurons whose work performance was output was set to 23.

Performance Evaluation

The reliability analysis results of the questionnaire data are shown in Figure 6.

In Figure 6, Cronbach's α is 0.89 in the dimension of personal development support under psychological empowerment. The Cronbach's α of the dimension of power appointment is 0.86. The Cronbach's α of the dimension of participation decision-making is 0.94. The Cronbach's α of the job guidance dimension is 0.93. In the action dimension under job performance, Cronbach's α is 0.94. The Cronbach's α of the work effect is 0.95. Among the refined variables of psychological empowerment, Cronbach's α of the meaning dimension is 0.91, the ability coefficient is 0.9, the self-determination

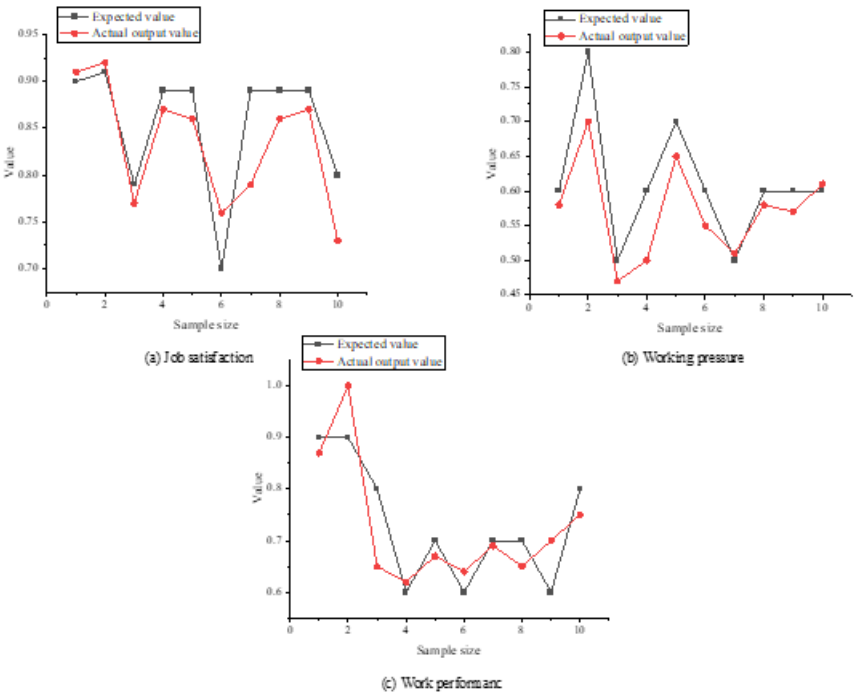
Figure 6. Reliability analysis results of questionnaire data



(a) Overall data Cronbach 's α coefficient

(b) Psychological empowerment data Cronbach 's α coefficient

Figure 7. Forecast results of employees' working conditions



coefficient is 0.89, and the influence coefficient is 0.88. According to Cronbach's α criterion, the overall data reliability is between good and very good, and the data validity is good and available.

The prediction results of employee working conditions based on the BPNN algorithm optimization model are shown in Figure 7.

In Figure 7, employee job satisfaction is taken as the output value. When the number of test samples is 1 to 4, the predicted expected value of the BPNN optimization model fits well with the actual output value. When the number of test samples is six, the anticipated expected value of the BPNN optimization model drops significantly, considerably different from the actual output value. When the number of test samples is between seven and nine, the real output value shows an upward trend, and the expected value remains unchanged. The employee's work pressure is taken as the output value, the overall expected value of the model is close to the actual output value, and the fitting is good. The work performance is taken as the output value. When the number of test samples is two, the expected, and the actual output value are poorly matched. When the number of pieces is between one and four, the changing trend of the expected value curve decreases first, and then increases. The changing direction of the actual output value curve raises first and then decreases. When the number of samples is between four and seven, the expected and actual output values fit well, and the curve coincides well. The error of the overall average absolute percentage of the BPNN optimization model is less than one. The model can realize the prediction of employees' working conditions based on psychological empowerment.

The results showed the correlation between job satisfaction, stress, performance, and psychological empowerment, and confirmed the role of psychological empowerment in improving employees' working conditions. The fitting results of the expected and the actual output values of the model show that the prediction is consistent with the survey results of the actual questionnaire, and the model's accuracy is good.

Discussion

The analysis of psychological empowerment in China is still in a relatively basic stage. It is generally believed that psychological empowerment positively affects employees, but the research is relatively simple. Questionnaires are used to collect the personal characteristics of employees in relevant enterprises based on psychological empowerment. The collected sample data are used for analysis and learning to implement psychological empowerment and employee work status evaluation models based on deep learning and AI technology. This model realizes the analysis of the employee working state based on psychological empowerment. This model realizes the analysis of employees' working state based on psychological empowerment. Based on the model's prediction, psychological empowerment will influence employee job satisfaction, pressure, and performance. Psychological empowerment will improve employees' work performance and satisfaction, and better enable employees to obtain work significance and ability. Psychological empowerment can realize the decentralization of work power, strengthen employees' self-determination perception ability and influence, improve employees' work enthusiasm, and reduce work pressure. This paper proves that deep learning and AI technology will affect psychological empowerment compared with previous studies. The intermediary role of psychological empowerment can improve employees' work performance and provide a new way to enhance enterprise management and employees' psychological status in the future.

CONCLUSION

AI technology is used to improve the psychological empowerment of employees. Through psychological empowerment, employees' work performance is affected psychologically. A questionnaire survey was used to make data statistics on the relevant influencing factors of employees' psychological empowerment, and regression analysis was conducted on the statistical data to calculate the credibility of the data. With the help of the BPNN algorithm based on deep learning, an evaluation model of employees' work conditions was established to analyze employees' job satisfaction, pressure, and performance based on psychological empowerment. The results show that: (1). In the overall variables, the reliability of the data is between good and very good, and the data are available and effective; (2). For model prediction, the output value is job satisfaction.

The number of samples tested was between one and four. The expected value of the BPNN optimization model fits well with the actual output value. The model can predict employees' work status based on psychological empowerment, indicating the correlation between job satisfaction, stress, performance, and psychological empowerment. The results confirm that psychological empowerment can improve job performance and the BPNN model has a better predictive role in studying psychological empowerment.

The disadvantage is that the online questionnaire survey was adopted for data collection, which cannot guarantee the authenticity and reliability of the questionnaire. The survey object was set as enterprise employees, which may cause the data to be affected by subjective factors, reducing the validity and reliability of the data. Secondly, the number of samples is too small. The results are limited when the BPNN model is established. Other factors may also affect employees' working conditions, such as environment, welfare, etc. In the future, the online survey will be assisted by way of on-site questionnaires. This combination of online and offline methods can increase the effectiveness of data and prevent the occurrence of questionnaire fraud and other problems. BPNN increases the number of training to make the model more accurate. The factors affecting the functional status of employees have been increased, and psychological empowerment research has been carried out from the perspective of organizational group characteristics to improve the credibility and reliability of the results.

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Xiaoxue Fan went to Graduate School at Semyung University, Jecheon-Si, South Korea.

Xuan Zhang is a student at Monroe College in the United States.