



The Influence and Classification of Unsafe Psychology on the Safety Behavior of Miners

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Abstract. In order to improve the psychological state of miners, improve the safety behavior of miners, and effectively prevent and control coal mine accidents, the questionnaire was used to investigate the unsafe psychology of frontline employees in Shanxi a coal mine and Shaanxi B coal mine. The fluke mentality, conformity mentality and shortcut energy saving mentality of unsafe psychology was selected by reading literature, the mediating variables of safety awareness and team safety atmosphere were selected, and the correlation analysis and the K-means were carried out on the data using python. Found that miners fluke mentality has the greatest negative impact on safety behavior, followed by conformity mentality, and shortcut energy saving mentality is the least, the indirect positive influence of miners' unsafe psychology on safety behavior through team safety atmosphere is greater than safety awareness, miners classified as three types according to the clustering results, provide a reference for coal mining enterprises to improve the miners' safety behavior accurately.

Keywords: unsafe psychology · safety behaviour · safety awareness · team safety atmosphere · K-mean

1 Introduction

Coal mine accidents account for more than 90% of the total number of coal mine accidents. At the same time, the quality of coal mine workers is uneven, the work is boring, there is a certain risk, employees are under higher pressure than other industries, resulting in unsafe psychology. Miners' safety behavior refers to the behavior that will not be infringed, dangerous, harmful and the probability of loss. Xia Runhe et al. [1], Yao Mingliang et al. [2], Lian Minjie et al. [3], Tian Shuicheng et al. [4] and Li Yan et al. [5] respectively studied the influence of unsafe psychology on unsafe behavior of subway construction workers, construction workers and coal miners, ML Fraser [6] emphasized that most of the unsafe incidents involving non-professional group riders were the fault of the driver and involved reckless behavior. The driver is an individual, and the driver's unsafe psychology leads to the occurrence of unsafe behavior. C Atombo [7] investigated and studied the attitude and behavior of drivers when driving on the road, and found that control belief had the strongest predictive effect on driving intention under the influence

of speeding and overtaking motivation. Pizarro [8] described and analyzed scientific literature on the mental health of coal miners through scope review, and found that harsh working atmosphere, unsafe experience, work pressure and job dissatisfaction would cause some miners to face serious mental health problems. It can be seen that individual factors affect people's safety behavior, and psychological state is particularly important. Zhang Yaping et al. [9] established structural equation model through questionnaire and found that insecurity psychology significantly led to the generation of unsafe behavior intention of miners. Bridget [10] found that workers' behaviors are affected by various comprehensive factors. Based on the above studies, fluke psychology, conformity psychology and shortcut psychology directly negatively affect miners' safety behavior, it can be found that unsafe psychology will improve workers' unsafe behavior, but few scholars have studied the interaction between specific types of unsafe psychology and their direct and indirect influences on miners' safety behavior. Therefore, this paper selects three direct influencing factors (lucky, conformity, shortcut energy saving psychology) and two indirect influencing factors (safety awareness, safety atmosphere of team and group). In order to effectively reduce the coal mine accidents caused by unsafe psychology, improve safety practices for miners.

1.1 Miners Are not Safe Psychological Division

The boring and monotonous work of miners for a long time is easy to produce unsafe psychology. Tian Shuicheng et al. [11] investigated the relationship between miners' psychological factors, work pressure and unsafe behaviors through questionnaires and found that psychological quality influenced miners' unsafe behaviors in various ways. Through questionnaire analysis. In view of the fact that there is no in-depth analysis of miners' unsafe psychology in the current relevant research, this paper selects three dimensions from coal mine workers' unsafe psychology: fluke psychology, conformity psychology and shortcut psychology. Based on this, the following hypothesis is proposed:

H_{1a}: The luck mentality of coal miners has negative influence on safety behavior.

H_{1b}: The conformity psychology of coal mine workers has negative influence on safety behavior.

H_{1c}: The shortcut saving psychology of coal miners has negative influence on safety behavior.

1.2 Mediating Variable

(1) safety awareness

Safety awareness represents miners' cognitive ability to the environment and their own risks. Chen Tiehua et al. [12] built a structural equation model of factors affecting the safety consciousness of mine managers and found that individual factors affected the safety consciousness of mine managers. Based on this, the following hypothesis is proposed:

H_{2a}: The lucky mind of coal mine workers has negative influence on safety consciousness.

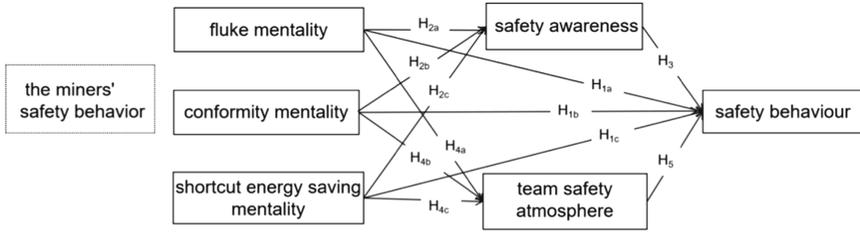


Fig. 1. A theoretical model of the influence of miners’ unsafe psychology on safety Behavior

H_{2b}: The conformity psychology of coal mine workers has negative influence on safety consciousness.

H_{2c}: The short-cut energy saving mentality of coal miners has negative influence on safety consciousness.

H₃: Safety consciousness has positive influence on safety behavior.
team safety atmosphere

Team safety atmosphere reflects whether the safety culture is rich and effective in an enterprise, and can reduce the effect of unsafe behaviors by enhancing the trust between team members. Arslan [13] studied 401 hotel employees and found that the safety culture atmosphere in the enterprise has a significant and negative impact on employees’ unsafe behaviors. Based on this, the following hypothesis is proposed:

H_{4a}: Coal mine workers’ fluke mentality has negative influence on the safety atmosphere of the team.

H_{4b}: The conformity mentality of coal miners has a negative influence on the safety atmosphere of the team.

H_{4c}: Coal mine workers shortcut energy saving psychology has a negative impact on the safety atmosphere of the team.

H₅: Safety atmosphere has positive influence on safety behavior.

1.3 Theoretical Model Construction

Based on the above research assumptions, the theoretical model of the influence of coal mine workers’ insecurity psychology on safety behavior is constructed, as shown in Fig. 1.

2 Scale Selection and Questionnaire Survey

2.1 Scale Selection

Li Naiwen et al. [14] obtained the data through the open questionnaire of interviews, conducted exploratory factor analysis and found that the miners’ psychological insecurity questionnaire can be an effective measuring tool to study the miners’ psychological insecurity in our country. In combination with other mature psychological scales [15] and with reference to the opinions of relevant professionals in the industry and the functional characteristics of operators, the measurement scale is designed. All scales are applicable to Likert scale 5, with a scale of 1 to 5 indicating very inconsistent - very consistent.

2.2 Questionnaire Survey

In the formal questionnaire survey, 310 questionnaires were issued and 300 questionnaires were collected for front-line employees in A coal mine in Shanxi Province and B coal mine in Shaanxi Province, with an effective rate of 97.3%. The statistics of basic characteristics of the research samples are shown in Fig. 2. According to the data obtained, it is found that the four basic characteristics of the respondents, such as age, working years, educational level and marital status, are consistent with the characteristics of the miners group, as shown in Table 1.

3 Data Analysis

3.1 Reliability and Validity of Questionnaire

Python was used to analyze the reliability and validity of the collected data. The results were shown in Table 2. The Cronbach- α value of the overall Klonbach coefficient of the questionnaire was greater than 0.7, indicating that the reliability of the questionnaire was acceptable. The combined reliability CR values of all latent variables meet the reliability judgment requirements of 0.7 critical value, and the average variance sampling AVE values are all greater than 0.5, indicating good aggregation validity. The results of this questionnaire are credible, the data are valid, and the reliability is high, which can support the conclusion of subsequent analysis.

3.2 Correlation Analysis

As shown in Fig. 2, the correlation coefficient ' P ' value (Pearson coefficient value) among all latent variables fluctuates between $[-1, 1]$, which is obtained by Pearson correlation method. The correlation strength between variables is represented by the absolute value of the coefficient. The larger the absolute value is, the larger the correlation strength will be; conversely, the smaller the absolute value is, the smaller the correlation strength will be. When the value of correlation coefficient ' P ' is positive, the correlation between variables is positive; when the value is negative, the correlation is negative. According to the data results, the hypothesis relationship between variables is preliminarily supported, that is, X_1 , X_2 and X_3 are negatively correlated with Y_1 , Y_2 and Z , while Y_1 , Y_2 and Z are positively correlated, which also indicates that the data is reliable and data analysis can be continued.

3.3 Interpretation of Result

- (1) The direct influence of unsafe psychology on Safety behavior of coal mine workers. From the perspective of absolute correlation coefficient, the correlation coefficient between lucky psychology and safety behavior of miners is 0.38, herding psychology is 0.37, and shortcut psychology is 0.34. Therefore, the negative impact of lucky psychology on safety behavior is greater than that of conformity psychology and shortcut psychology.

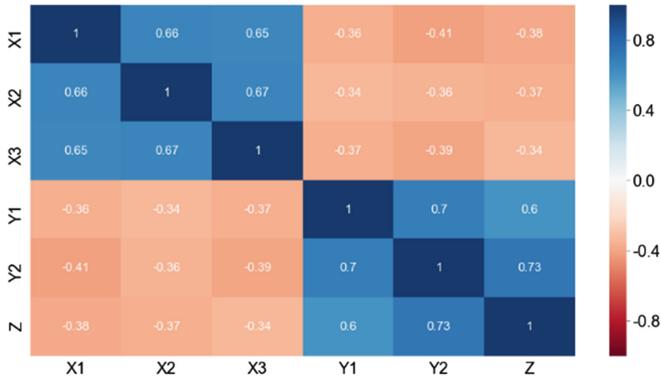
Table 1. Basic information of coal mine workers surveyed

category	scope	frequency	proportion
age	Age 25 and under	62	20.7%
	25–35 years old	48	16%
	35–45 years old	90	30%
	45–55 years old	76	25.3%
	Age 55 and above	24	8%
working age	2 years or less	76	25.3%
	3–5 years	62	20.7%
	6–9 years	73	24.3%
	10–14 years	59	19.7%
	15 years and above	30	10%
degree of education	Junior high school and below	83	27.7%
	Education Technical Secondary School or above	94	31.3%
	junior college	55	18.3%
	Bachelor and above	69	23%
marital status	married	214	71.3%
	discovery	86	28.7%

(2) Mediation effect analysis. The correlation coefficients between luck mentality and safety consciousness and safety atmosphere of the miners are -0.36 and -0.41, the conformity mentality are -0.34 and -0.36, and the shortcut energy saving mentality are -0.37 and -0.39, respectively. The absolute value of correlation coefficient of shortcut energy saving psychology on safety consciousness is greater than that of lucky psychology and shortcut energy saving psychology, and the absolute value of correlation coefficient of lucky psychology on team safety atmosphere is greater than that of herd psychology and shortcut energy saving psychology. The correlation

Table 2. Results of reliability and polymerization validity analysis

Relate index	X ₁	X ₂	X ₃	Y ₁	Y ₂	Z
α	0.793	0.762	0.775	0.808	0.828	0.825
CR	0.866	0.849	0.861	0.875	0.886	0.884
AVE	0.619	0.584	0.608	0.638	0.66	0.656

**Fig. 2.** P value of correlation coefficient between latent variables

coefficient between the safety atmosphere and safety behavior of the miners is 0.73, greater than the correlation coefficient between the safety consciousness and safety behavior of the workers. The indirect influence of team safety atmosphere is greater.

4 K-means

K-means minimizes the objective function by unsupervised and iterative means. The greater the similarity, the closer the target distance, and the smaller the similarity, the farther the target distance. As shown in Fig. 3, unsupervised cluster analysis was carried out on the data. Each category was concentrated, the difference between groups was large, and the clustering effect was obvious.

According to the sample clustering results, the samples are grouped into 5 categories, and the distribution difference of the core (center point) of each category is shown in Fig. 4. The six variables of the red line, blue line and yellow line are all in the middle value, which is the first group of people; The variable values of X₁, X₂ and X₃ in the green line are extremely low, while the variable values of Y₁, Y₂ and Z are in the middle. This group is the second group of people. The variable values of X₁, X₂ and X₃ in the dark blue line are in the middle, while the variable values of Y₁, Y₂ and Z are high. This group of people is the third group. Coal mining enterprises can put forward targeted measures for the three groups to achieve more efficient management.

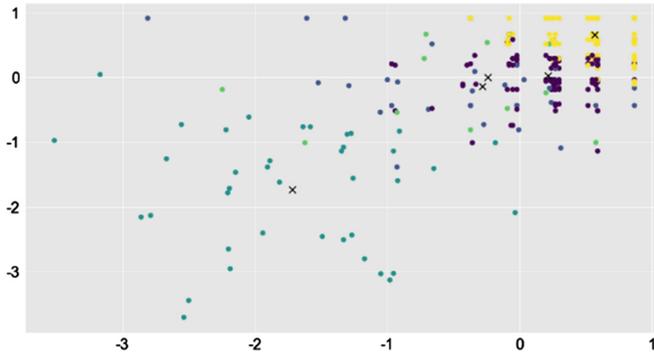


Fig. 3. Clustering result graph

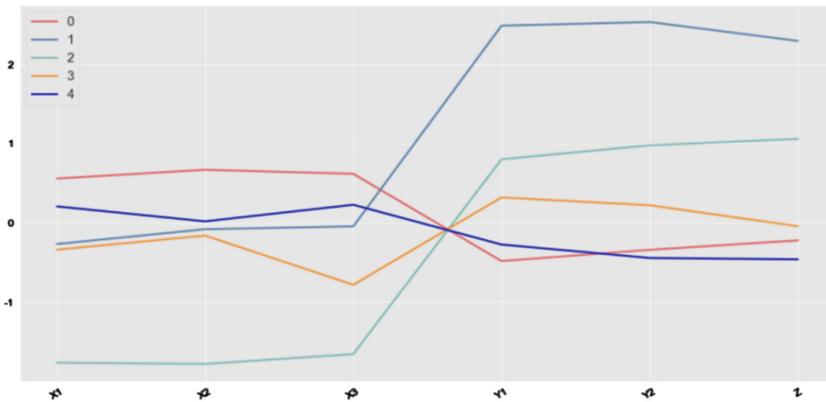


Fig. 4. Cluster center diagram

5 Conclusion

- (1) Fluke psychology, conformity psychology and shortcut psychology directly negatively affect miners' safety behavior.
- (2) Miners' unsafe psychology will indirectly affect miners' safe behavior through mediating variables.
- (3) Hierarchical control of miners is beneficial to the efficient management of coal mining enterprises. Coal mining enterprises can focus on cultivating the safety awareness of miners, put forward targeted management measures for the three types of miners, and strengthen the work to improve the safety atmosphere of the team.

References

1. Xia Runhe, Qiao Xiaoyan, Wu Hongqun. Causes and prevention of unsafe behavior of met-ro station construction workeis [J]. Tunnel Construction, 2021,41(06):1024-1031.

2. Yao Mingliang, Qi Shenjun, Cheng Jiale, et al. Research on structural relationship between workload and unsafe behavior of construction workers [J]. *Construction Economy*, 2019, 40(01):30-35.
3. Lian Minjie, Liu Ruimin, Lu Caiwu, et al. The influence mechanism and empirical study of miners' psychological safety capital on their violation behaviors [J]. *Mining Research and Development*, 2020,40(08):167-173.
4. Tian Shuicheng, Wang Xuechen, Miao Yanping, et al. Research on influencing factors of miners' unsafe state based on grounded theory [J]. *Safety in Coal Mines*, 2022,53(02):252-256.
5. Li Yan, Yu Huijin, Tian Shuicheng. Identification of cost and benefit for unsafe Behavior based on Grounded Theory [J]. *Journal of Safety Science and Technology*, 2017, 13(09): 158-162.
6. Fraser ML, Meuleners LB. Characteristics of unsafe events involving a motor vehicle for group riders in Western Australia: A naturalistic study [J]. *Transportation Research Part F Traffic Psychology and Behaviour*, 2020, 74:40-51.
7. Atombo C, Wu C, Zhong M, et al. Investigating the motivational factors influencing drivers intentions to unsafe driving behaviours: Speeding and overtaking violations[J]. *Transportation Research Part F Psychology & Behaviour*, 2016, 43(nov.):104–121.
8. Pizarro José Matamala, Fuenzalida Francisco Aguayo. Mental health in mine workers: a literature review. [J]. *Industrial health*, 2021, 59(6).
9. Zhang Yaping, Li Jizu, Feng Guorui, et al. Effects of conflict handling modes on miners' unsafe behavior intention [J]. *China Safety Science Journal*, 2016, 26(08):24-29.
10. Bridget R. D. Burdett, Nicola J. Starkey, Samuel G. Charlton. The close to home effect in road crashes [J]. *Safety Science*, 2017 (98):1–8.
11. Tian Shuicheng, Kong Weijing, Kuang Yun, et al. Research on relationship between psychological factors of miners and their work stress response and unsafe behavior [J]. *Journal of Safety Science and Technology*, 2018,14(08):106-111.
12. Chen Tiehua, Liu Jingpin, Li Hongxia, et al. Study of influential factors and paths of the mine manager's safety awareness [J]. *Mining Safety & Environmental Protection*, 2022, 49(01): 109–113+120.
13. Arslan, Siddik, Tuna, et al. The effects of the perceived external prestige of the organization on employee deviant workplace behavior The mediating role of job satisfaction[J]. *International journal of contemporary hospitality management*, 2016.
14. Li Naiwen, Jiang Qiumin. The construction and measurement of unsafety psychology inventory for miners [J]. *Psychological Exploration*, 2010,30(03):91-96.
15. Cao Lulu, Liu Yan. Research on unsafe mentality and behavior scales of workers in con-fined space [J]. *China Safety Science Journal*, 2020, 30(11):37-42.

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