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# Research on the Influence of the Safety Climate of the Construction Site on Safety Behavior of Builders ---- The Role of Safety Knowledge Transfer and Individual Differences in Influencing

Fengping luo [1]*, Anan Pongtornkulpanich [2]*, Thitinant Wareewanich [3], Hong Yan [4]

***Abstract***

*Safety casualties in the construction industry have long been a concern for scholars worldwide, particularly in developing countries where construction workers face a risk of death 3 to 6 times higher than in developed nations. An empirical survey was conducted among 563 construction site personnel in China. Data collection involved both online and offline self-administered questionnaires. The collected data underwent testing and hypothesis analysis using SPSS23 and Amos23. The study revealed that safety knowledge transfer plays a crucial role in moderating the relationship between safety climate and builders' safety behavior. Effective knowledge transfer significantly enhances the impact of safety climate on personnel safety behavior, acting as a mediating factor. Additionally, individual differences were found to moderate the relationship between the mediating variable and the dependent variable. These findings offer valuable insights for construction companies aiming to improve safety management and reduce safety accidents on construction sites. Implementing efficient safety knowledge transfer can enhance safety climate impact and prevent construction site casualties.*

**Keywords:** *Construction safety, Mediation effect, Moderating effect, Safety behavior.*

## Introduction

The construction sector experiences the highest accident rate and the most severe injuries at accident sites. (Høyland et al., 2018). The mortality rate, especially in developing countries, is notably elevated, indicating a higher risk of death (3-6 times) linked to construction work(Organization, 2015). As a result, the world's construction industry faces significant safety challenges (Lee et al., 2020). According to the Ministry of Employment and Labor, construction accounted for the highest proportion of deaths in all sectors of The South Korean industry between 2012 and 2015, and the situation improved in the United States In 2010, where 774 workers died as a result of injuries sustained on construction sites, or 16.5 percent of all industries, (Bokhari et al., 2020)according to the U.S. Bureau of Labor Statistics. Through the research of many research documents, (Jeong, 1998)found that construction safety-related accidents mainly occurred during the construction process or temporary construction. Construction activities account for 20% of industrial fatalities in countries such as Japan, the United Kingdom, the United States, and Hong Kong(Health & Executive, 2017).

[1] Chakrabongse Bhuvanarth International Institute for Interdisciplinary Studies, Rajamangala University of Technology Tawan-Ok, Bangkok, Thailand.Email: fengping.luo@rmutto.ac.th
[2]CBIS, Rajamangala University of Technology Tawan-Ok, Bangkok, Thailand. Email: anan_po@rmutto.ac.th
[3]CBIS, Rajamangala University of Technology Tawan-Ok, Bangkok, Thailand. Email: thitinant_wa@rmutto.ac.th
[4]. College of Civil Engineering, Jiujiang University, Jiujiang, China. Email: yhtj@jju.edu.cn

In China, there are also safety issues in the construction industry. The high accident rate and fatality rate are also the focus of attention in the safety field. As of the end of 2019, the total number of employed individuals in China's society was 77.471 million, with 54.2737 million employed in the construction industry, constituting 7.01% of the overall employed population (Ministry of Housing and Urban-Rural Development, 2020). Based on the statistical data from 2010 to 2019, it can be seen that for three consecutive years, from 2017 to 2019, the death rate of construction accidents has been above 2.2 per day.

The research content primarily focuses on investigating the root causes of accidents, identifying and correcting unsafe behaviors, and implementing early warning systems for accident prevention(Zhang et al., 2020; Zhou et al., 2019). Additionally, the research explores safety training methods such as virtual reality training and online courses to enhance workers' knowledge and awareness of safety protocols(Le et al., 2015). These training techniques simulate hazardous situations, enabling workers to gain practical experience and better understand how to handle safety challenges. The research also involves analyzing human behavior to identify potential safety hazards and unsafe practices(Mannering et al., 2020). Furthermore, the study explores using automation technology in construction to minimize direct worker exposure to hazardous environments(Paneru & Jeelani, 2021). Finally, the research aims to develop a comprehensive construction site safety management system to track worker activity, ensure safety compliance, and manage hazardous situations effectively.

Scholars have noted that numerous factors impact the safety behavior of builders, including personal, social, and environmental factors. These may include safety consciousness and knowledge, unique traits such as risk-taking behavior, work experience and training, self-efficacy, and the influence of colleagues, superiors, family, and other social environments(Amabile & Pillemer, 2012; He et al., 2019; Zhang et al., 2013). By studying these factors, we can better understand worker safety behavior on construction sites and implement measures to promote and improve safety practices.

Social cognitive theory posits that an individual's behavior is influenced by observation of others, self-efficacy, and outcome expectations. It proposes that people acquire and adopt behavior patterns by observing others, participating in activities, and engaging in self-reflection(Wood & Bandura, 1989). Individuals then imitate these behaviors in similar contexts, evaluating the consequences of their actions based on their personal and observed experiences. The theory of Planned Behavior asserts that individual behavior is shaped by conscious decision-making, which is informed by attitudes and intentions toward specific actions. Personal preferences and norms can significantly impact the likelihood of engaging in positive safety behaviors, with a positive attitude often serving as a strong predictor of acti(Ajzen, 1991).

With the deepening of a large number of studies, people began to pay more attention to the control of the process of safe production from the perspective of culture and behavior, such as through the culture of safety, strengthen the guidance of workers' attitudes, and to monitor safety performance by observing workers' safety behavior. National scholars have conducted a great deal of research on the relationship between safety climate, safety consciousness, safety motivation, work pressure, and safety behavior, and tried to excavate the factors of safety behavior and clarify the mechanism of action between the factors. Research shows that the guidance of workers' safety behavior, can improve the safety performance of enterprises. However, most scholars in the study of worker safety behavior, emphasizing the workers comply with the enterprise safety rules and regulations, whether the safety work and through

punishment, or correction methods to control unsafe behavior. Because of the uncertainty of the building site, the type of inconsistency, resulting in workplace safety issues is not static, and perfect regulations, cannot cover all hidden dangers control measures. If workers simply adhere to established safety systems and do not participate in the entire safety management system, then safety management will be scalding and will not improve.

Thus, only the emphasis on safety compliance behavior cannot effectively reduce the occurrence of harmful events, individuals need to actively deal with safety problems on the ground, to solve the problem from the source, through the study of this article, based on the second chapter of the literature review, to solve the following problems:

1. To Analyze the impact of a safety climate on individual safety behavior to determine whether it promotes or inhibits safety measures.
2. To Investigate the role of safety knowledge transfer as a mediator in the relationship between safety climate and individual safety behavior to understand the mechanisms behind this transfer.
3. To Evaluate the moderating effect of individual differences in the relationship between safety knowledge transfer and individual safety behavior, including work attitudes, negative emotions, and cognitive closure needs.

**Materials and Methods**

Numerous studies on safety climate have revealed significant variations across different industries and research subjects in terms of perspectives and measurement standards, which encompass various dimensions(Aktas & Kagnicioglu, 2023; Flin et al., 2000; Hon et al., 2014). Despite extensive research on the safety climate, a consensus specification still needs to be discovered, hindering practical applications. This paper draws upon past literature to investigate the correlation between safety climate and safety conduct in the construction sector, scrutinizing commonly employed dimensions of safety climate, including management's dedication to safety, safety regulations and protocols, and safety-focused training. Management Safety Commitment refers to the degree of emphasis and support given to safety production by the company's top management, which can be reflected by formulating safety policies, allocating safety resources, participating in safety activities, and supervising safety performance. Safety knowledge transfer refers to the transfer, sharing, and application of internal or external safety knowledge between different subjects, levels, or scenarios, which can be achieved through training, communication, collaboration, feedback, etc. Management Safety Commitment can promote the occurrence and quality of safety knowledge transfer by shaping a positive safety climate, enhancing employee safety trust and commitment, and stimulating employees' intrinsic motivation and self-efficacy(Fruhen et al., 2014; Saleem & Malik, 2022). Propose a hypothesis:

**H1** Management's commitment to safety has a significantly positive impact on the safety knowledge transfer.

Safety skills training refers to a method for improving employees' safety awareness and ability by teaching, imparting, and practicing safety-related knowledge, skills, and attitudes, thereby reducing the likelihood and severity of accidents. Safety skills training can promote the occurrence and improve the quality of safety skills training by improving employees' safety knowledge, enhancing their safety confidence, motivation, and attitudes, and improving their

safety behaviors(Aburumman et al., 2019; Burke et al., 2006; Metwally et al., 2019). Safety knowledge transfer can enhance the performance and effectiveness of safety skills training by providing timely and effective feedback, promoting knowledge sharing and innovation, and increasing the sustainability of training effects. Therefore, hypothesize:

**H2** Safety training significantly enhances the transfer of safety knowledge.

Safety Rules and Programs refer to a series of safety-related rules and regulations, standards, operating procedures, emergency plans, etc., formulated and implemented by enterprises to ensure safe production. They can regulate employee safety behaviors, provide sources and basis for safety knowledge, and Increase employees' awareness and attention to safety knowledge to promote safety knowledge transfer(Sverke et al., 2019; Syed-Yahya et al., 2022). Based on this, it is hypothesized that:

**H3** Safety procedures significantly positively affect the transfer of safety knowledge.

The management safety commitment exists not only at the enterprise level but also at the department level, team level, and individual level. It is believed that management safety commitment will affect employees' safety behavior by affecting their psychological state (such as safety climate, safety attitude, safety belief, etc.), will also be affected by the personal characteristics of employees (such as gender, age, education level, etc.), the higher the management safety commitment, the better the safety behavior of employees(Michael S. Christian et al., 2009; Zohar & Luria, 2005). However, Fruhen et al. (2014)found that safety commitment does not correlate with behavior.

The relationship between Safety skills training and safety behavior. It involves promoting the acquisition and application of employees' safety knowledge through practical training design and implementation to improve the organization's safety performance. Many studies have shown that Safety skills training can significantly enhance safety behavior. Level of employees and reduce the accident rate and loss. Employees' intrinsic motivation, extrinsic motivation, self-efficacy, etc., will affect their degree of learning and transfer of Safety skills training (Giannakakos et al., 2020; Trevor et al., 2021).

Generally speaking, Safety Rules and Programs should be related to employees' actual work. Safety Rules and Programs are clear and easy to understand and follow. The relationship between Safety Rules and Programs and safety behavior involves promoting the acquisition and application of employees' safety knowledge through effective design and implementation of rules and programs to improve the safety behavior of the organization(Zohar & Luria, 2005). Based on this, it is hypothesized that:

**H4** Management's commitment to safety has a significant positive effect on safety behavior.

**H5** Safety skills training has a significant positive effect on safety behavior.

**H6** Safety Rules and Programs have a significant positive effect on safety behavior.

In recent years, more and more researchers have devoted themselves to exploring the composition and evaluation of the safety climate in their respective fields, as well as the research on the safety and unsafe behavior of builders. Accurately assessing safety training as an essential component of safety climate remains a challenge. Questionnaires are typically used to ask about participation in safety training and whether safety recommendations are implemented. However, this approach ignores a series of intangible participatory behaviors and knowledge

acquisition methods(Shuang et al., 2015). For example, pass and share safety knowledge among colleagues through chat or self-made short videos. This way of safety knowledge transfer, whether this way has an impact on the safety behavior of personnel, hypotheses:

**H7:** Safety knowledge transfer has a positive impact on builders' safety behavior.

This paper explores the Impact of safety culture at different levels in the organization on employees' safety knowledge transfer and safety behavior. Partial mediation.(Zhang et al., 2002)

**H8** Safety knowledge transfer mediates the effect between management's commitment to safety and safety behavior.

**H9** Safety knowledge transfer mediates the effect between safety training and safety behavior.

**H10** Safety knowledge transfer mediates the effect between safety procedures and safety behaviors.

Individual differences refer to the differences or variations between individuals in the aspects of physiology, psychology, behavior, etc., and are an essential research topic in psychology and management. It is related to multiple dimensions, such as personality, intelligence, ability, motivation, emotion, attitude, and values(Chan & Drasgow, 2001; Gohm & Clore, 2002). Several studies have explored individual differences in human behavior and performance. Impacts and the mechanisms and conditions they are affected, such as job satisfaction, job performance, job stress, etc. Educational psychology research shows that individual differences will affect students' learning motivation, learning strategies, academic performance, learning self-efficacy, consumer behavior, etc(Semmer & Meier, 2003), which can be used to optimize human behavior and performance. Work attitude has a positive and positive impact on employees' safety knowledge transfer and safety behavior. Work attitude can affect employees' motivation and attitude towards safety knowledge transfer, thereby affecting the degree and quality of their participation in safety knowledge transfer. When employees are satisfied with their work and working environment, they are more willing to learn and share safety knowledge, and they are more able to understand and share safety knowledge. Receive safety knowledge, thereby improving their safety behavior(Li et al., 2019). Propose a hypothesis:

**H11** Work attitude has a significant positive moderating effect on the relationship between safety knowledge transfer and safety behavior.

Negative emotions can affect employees' cognition and attitude toward safety knowledge transfer. When employees feel angry, fearful, sad, or anxious, they may resist or dislike safety knowledge transfer, thinking it is a burden or threat, thereby reducing Their willingness to learn and share, affects their ability to understand and accept, and may also reduce their attention and memory, causing them to ignore or forget essential safety knowledge, thereby reducing their ability to use and innovate, and affecting their evaluation and Feedback capabilities, thereby reducing their level of safe behavior. That is, when employees' negative emotions are more substantial, the positive Impact of safety knowledge transfer on safety behavior is weaker. Based on this, it is hypothesized that:

**H12** Negative emotions have a significant negative moderating effect on the relationship between safety knowledge transfer and safety behavior.

The Need for cognitive closure refers to the psychological tendency of people to pursue quick and specific answers and avoid further information searching or thinking when faced with uncertain or ambiguous situations. When the Need for cognitive closure of employees is higher,

they may have resistance or aversion to security knowledge transfer, thinking it is an unnecessary or wasteful activity, thereby reducing their willingness to learn and share and affecting their understanding and acceptance. When employees have a high Need for cognitive closure, they may reduce their creativity and critical thinking, leading them to solidify or simplify safety knowledge, making assumptions that:

**H13** Cognitive closure needs significantly negatively affect the relationship between safety knowledge transfer and safety behavior.

Based on the research findings of scholars, social cognitive theory, and planned behavior theory, this paper proposes the research model and hypotheses shown in Figure 1 below.

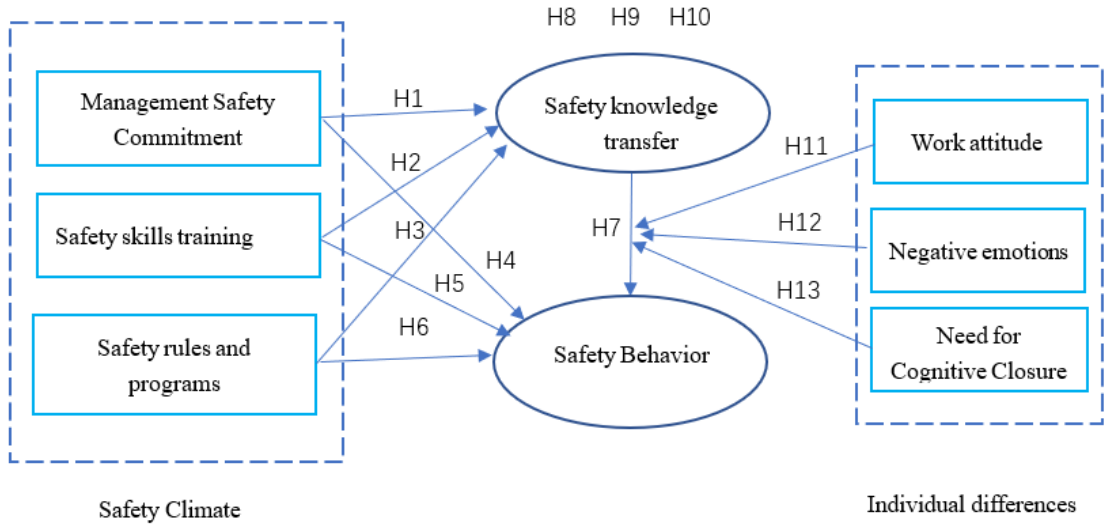


**Figure 1.** Research model

## 3. Results

### 3.1. Measurements

This study adopts a questionnaire method to collect relevant data, which is convenient and quick. Then, quantitatively test the hypotheses raised earlier. Considering the availability of survey samples and the comprehensiveness of data, convenience sampling was used to collect survey data(Etikan et al., 2016).This paper on the safety climate of the questionnaire is through the Tsinghua - Golden Gate Building Safety Center following China's specific situation, based on the British questionnaire made corresponding changes so that the questionnaire is more suitable for China's national conditions, combining safety climate measurement literature, this paper combined (Schwatka et al., 2016; Tawfik et al., 2019; Zhu et al., 2020). The safety climate of this paper consists of three parts: management of safety commitments (4 items), safety skills training (3 items), and safety rules and procedures (4 items). The safety behavior uses the definitions and components proposed by Griffin and Neal to measure(Griffin & Neal, 2000). Safety behavior consists of two sub-dimensions: safety compliance (3 items) and safety participation (4 items). According to Huang and Yang (2019), the dimensions of Safety

knowledge transfer are knowledge acceptance(5 items), safety concerns(4 items), and safety awareness(3 items).

According to the literature, among the factors affecting safety behavior, the work attitude, negative emotions, and cognitive closure needs of individual builders have a greater impact (Chen et al., 2021; Tixier et al., 2014; Webster et al., 1994). The working attitude in the safety work of builders consists of five items. (Chen & Chen, 2017).According to the(Liu et al., 2007) negative mood scale(5 items), the negative emotion survey consists mainly of being angry, upset, annoyed, and afraid of the job and the five emotions of anger. The scores representing frequency represent 1 None; 2 Rarely; 3 Sometimes; 4 Very often; 5 Extremely often, always. The NFC Closed Needs Scale is a short scale comprising 15 items; this version is a revision based on 2007, indicating that the scale has good stability and similar performance in reliability to the classic 42-item scale(Roets & Van Hiel, 2011). This scale is a 6-point Likert scale, and the specific score indicates: 1. Completely disagree 2. Mostly disagree 3. Slightly disagree 4. Slightly agree 5. I mostly agree 6. Completely agree. Due to the different levels of scales, they cannot used for content consistency testing. Therefore, according to the conversion between different levels of IBM Support, that is, 6-point scoring is converted to 5-point scoring.

The object of this questionnaire is to the builders at the construction site. The survey is carried out through online and offline self-filled questionnaires. A total of 563 useful questionnaires were obtained.According to the formula for calculating sample size, the alpha level is pre-set at 0.05, and the variable of interest is assumed to be proportional. An error range of ±5% is deemed acceptable, with a standard deviation of 0.5. Using Cochran's sub-formula, the sample size is calculated to be 384(Kotrlik & Higgins, 2001) while ensuring a questionnaire response rate of at least 70%. Factoring in the potential for invalid responses, the minimum required sample size for the questionnaire is determined to be 549. The sample size is representative of the population of builders.

Several measures were taken to ensure the validity and reliability of the questionnaire data. To minimize response bias, participants were informed of their right to withdraw from the survey anytime. Researchers assured the confidentiality and anonymity of all collected information and that the data would only be used for scientific Analysis. Additionally, it was emphasized that the research team had no affiliations with the participants' employers or superiors. Demographic data collected included age, gender, education level, years of experience in the construction industry, and occupation (refer to Table 3). Of the participants, the majority (84.70%) were over 23 years old, with the highest percentage (42.10%) in the 23-30 age group. The majority were male (90.80%), had less than eight years of experience in the industry (80.70%), and had attained a high school or technical secondary education (79.6%). Of those surveyed, 55.6% were Shelf workers or carpenters.

### 3.2. Data analysis

The study followed guidelines for establishing a structural equation model using SPSS23 and Amos23 software. Confirmatory factor analysis assessed the measurement model's reliability, discriminant, and convergent validity. Amos23 and SEM evaluated relationships between theoretical structures. The Bootstrap method examined safety knowledge transfer's mediating effect on the relationship between construction site climate and safety behavior. A multiple regression model assessed the moderating effect of individual differences. Model fit indicators ($X^2$/df, GFI, AGFI, NFI, TLI, CFI, and RMSEA) confirmed acceptable fit.

**Table 1.** Results of model fit indices for the measurement model

| Fit index | Recommended cut-off value | Scores |
|---|---|---|
| $X^2$/df | ＜5acceptable；＜3desirable | 2.447 |
| GFI | ＞0.8acceptable；＞0.9desirable | 0.953 |
| AGFI | ＞0.8acceptable；＞0.9desirable | 0.932 |
| NFI | ＞0.8acceptable；＞0.9desirable | 0.935 |
| IFI | ＞0.9 | 0.960 |
| CFI | ＞0.9 | 0.960 |
| NNFI（TLI） | ＞0.9 | 0.949 |
| RMSEA | ＜0.08 | 0.051 |

Based on the provided table, the $X^2$/df value is 2.447, lower than the ideal threshold of 3, indicating a good fit of the structural equation model. Additionally, the goodness-of-fit indicators such as GFI (0.953), AGFI (0.932), NFI (0.935), IFI (0.960), CFI (0.960), and TLI (0.949) all surpass the general standard values, further confirming the model's validity and excellent alignment with the recovered questionnaire data. Moreover, the RMSEA test result of 0.051 is below the standard level of 0.08, providing additional evidence of the model's favorable fit to the data. Overall, the goodness-of-fit results demonstrate the strong appropriateness and accuracy of the established structural equation model in this study.The research results of Fornell and Larcker (1981)suggest that the factor loading coefficient value of each structure more significant than 0.7 is an acceptable level when verifying convergent validity. In addition, the average variance (AVE) extracted by each construct must be greater than the critical requirement of 0.5(AVE corresponds to a value range of 0.514 to 0.720). The attainment of such findings provides an indicator of the measure's satisfactory convergent validity.

In summary, the measurement model has the advantages of sufficient model fitting, good internal consistency reliability, convergence, and discriminant validity, indicating that the measurement model is suitable for structural equation modeling.

## 4. Structural model

In this study, structural equation modeling (SEM), **Figure** 2 was developed using Amos23 software based on theoretical model diagrams and specific research hypotheses(Collier, 2020).

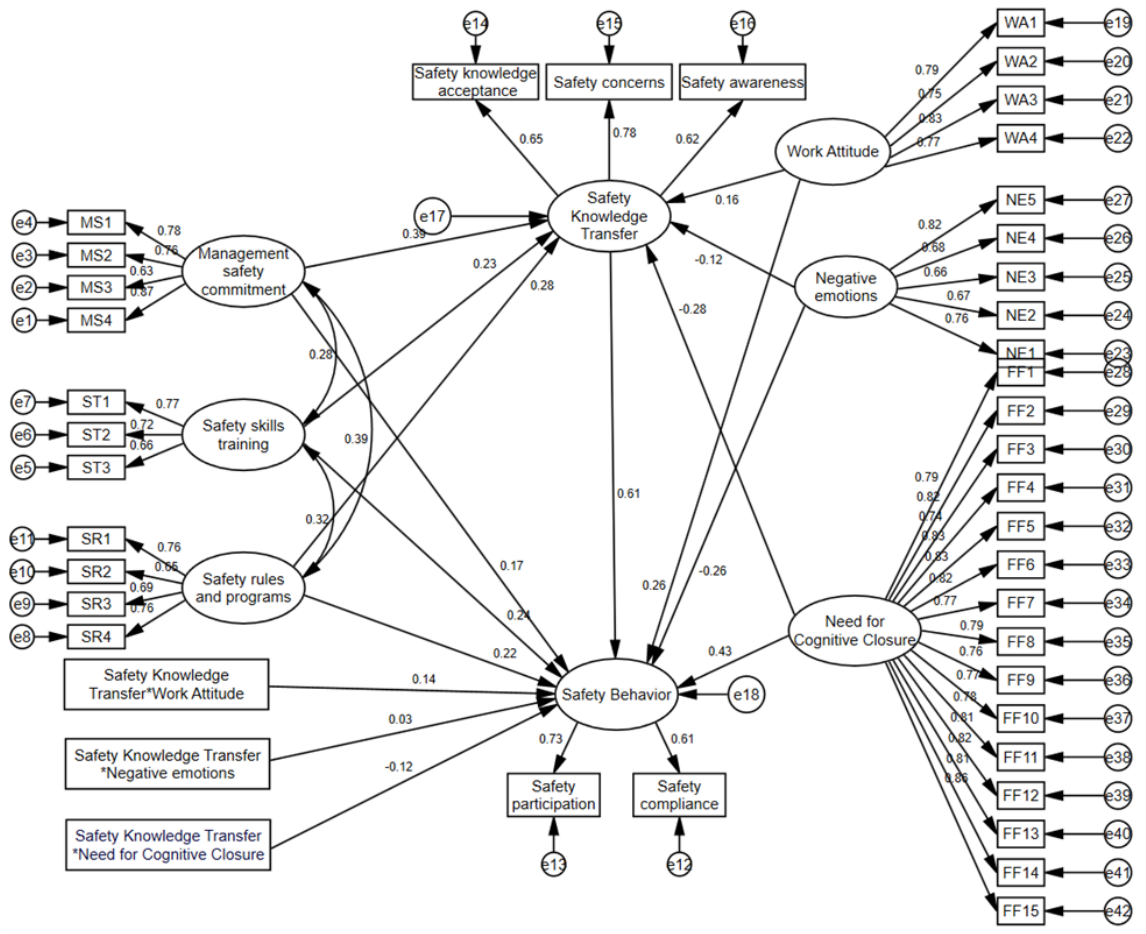


**Figure**. 2 Structural model

Path Analysis is a multivariate statistical analysis method that aims to explore the causal relationship and mutual influence among multiple variables(Heise, 1969). It is commonly used in social sciences and ecology to help researchers understand the relationship between various factors, especially the direct and indirect effects between variables. Using AMOS software path analysis, the general standard is that the critical ratio t value is at least greater than 1.96, because when the t value is more significant than 1.96, the P value is just less than the significant level of 0.05, and if the t value is less than 1.96, the significance P value did not reach the significance level(Ghasemi & Zahediasl, 2012). The analysis results are shown in Table 2.

**Table2** Hypothetical Path Coefficients

| Path | | | Standardized Factor Loadings | S.E. | C.R. | P |
|---|---|---|---|---|---|---|
| Safety Knowledge Transfer | ← | Management safety commitment | 0.389 | 0.04 | 7.11 | *** |
| Safety Knowledge Transfer | ← | Safety skills training | 0.233 | 0.054 | 4.294 | *** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Safety Knowledge Transfer | ← | Safety rules and programs | 0.278 | 0.042 | 4.981 | *** |
| Safety Behavior | ← | Management safety commitment | 0.169 | 0.031 | 3.142 | 0.002 |
| Safety Behavior | ← | Safety skills training | 0.243 | 0.04 | 4.654 | *** |
| Safety Behavior | ← | Safety rules and programs | 0.215 | 0.031 | 4.037 | *** |
| Safety Behavior | ← | Safety Knowledge Transfer | 0.613 | 0.063 | 7.538 | *** |

Note: *** represents a significance level of $p < 0.001$, C.R. stands for critical ratio (t-value), and S.E. denotes the standard error of the path coefficient.

The hypothetical path is tested by three indicators: standardized path coefficient, C.R. is the critical ratio (t value), and significance P, and the hypothesis in this paper is established. That is, management safety commitment has a significant positive effect on safety knowledge transfer; safety training has a significant positive impact on safety knowledge transfer; safety procedures have a significant positive effect on safety knowledge transfer; management safety Commitment has a significant positive effect on safety behavior; safety training has a significant positive effect on safety behavior; safety procedures have a significant positive effect on safety behavior; safety knowledge transfer has a significant positive effect on safety behavior to influence.

### 4.1. Mediation analysis

The Amos23.0 software was utilized to test and analyze the presence of a significant mediating effect among the data variables. The Bootstrap method was employed with a selection of a 95% confidence interval. The mediating effect was then calculated using 2000 rotational iterations integrated within the software, as outlined by Nevitt and Hancock (2001). The upper and lower limits of the 95% confidence interval and p-value were utilized to determine if a significant mediating effect existed according to the results presented in Table 3.

**Table 3** Bootstrap Method Mediated Effects Test

| **Parameter** | **Estimate** | **Lower** | **Upper** | **P** |
|---|---|---|---|---|
| Management safety commitment Safety Knowledge Transfer Safety Behavior | 0.239 | 0.131 | 0.393 | 0 |
| Safety skills training- Safety Knowledge Transfer Safety Behavior | 0.143 | 0.068 | 0.241 | 0 |
| afety rules and programs Safety Knowledge Transfer Safety Behavior | 0.171 | 0.087 | 0.297 | 0 |

From the table, the upper and lower 95% confidence intervals are all positive numbers, excluding 0, and the standard of the significance P value is less than the significance level of 0.05, indicating that the mediation effect is significant and thus confirms the validity of the hypothesis proposed in this study.

### 4.2 Moderating Analysis

Aiken et al. (1991) introduced building regression models, testing and interpreting interaction terms, and performing a simple slope test to test the moderating effect. This was to

demonstrate the moderating effect. Taking gender, age, education level, years of work, type of work, and safety knowledge transfer as control variables, safety knowledge transfer as an independent variable, work attitude, negative emotions, and cognitive closure needs as moderating variables, and safety behavior as the dependent variable, a multivariate model was constructed. The R square magnitude and significance of the regression coefficient reflect the significance of the adjustment variable. The test results for the model are displayed in Table 4, Table 5, and Table 6 below.

**Table 4** Work attitude moderating effect table

| **Variables** | **Dependent variable: Safety behavior** | | |
|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** |
| Gender | -0.001 | -0.004 | -0.002 |
| Age | 0.018 | -0.003 | 0 |
| Education level | -0.082 | -0.018 | -0.013 |
| Years of work | 0.042 | -0.005 | -0.01 |
| Job type | -0.037 | -0.027 | -0.025 |
| safety knowledge transfer | \ | 0.532*** | 0.552*** |
| work attitude | \ | 0.206*** | 0.257*** |
| safety knowledge transfer *work attitude | \ | \ | 0.141*** |
| $R^2$ | 0.010 | 0.427 | 0.443 |
| Adjusted $R^2$ | 0.001 | 0.420 | 0.435 |
| F | 1.103 | 59.174*** | 55.136*** |

Note: ***P < 0.001, **P < 0.01, *P < 0.05

**Table 5** Negative Emotions moderating effect table

| **Variables** | **Dependent variable: Safety behavior** | | |
|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** |
| Gender | -0.001 | 0.001 | 0.001 |
| Age | 0.018 | 0.002 | 0.001 |
| Education level | -0.082 | -0.01 | -0.01 |
| Years of work | 0.042 | -0.008 | -0.006 |
| Job type | -0.037 | -0.014 | -0.015 |
| safety knowledge transfer | \ | 0.521*** | 0.512*** |
| negative emotions | \ | -0.265*** | -0.259*** |
| safety knowledge transfer * negative emotions | \ | \ | 0.028 |
| $R^2$ | 0.010 | 0.453 | 0.453 |
| Adjusted $R^2$ | 0.001 | 0.446 | 0.446 |
| F | 1.103 | 65.607*** | 57.448*** |

Note: ***P < 0.001, **P < 0.01, *P < 0.05

**Table.6** Need for Cognitive Closure Moderating Effect table

| **Variables** | **Dependent variable: Safety behavior** | | |
|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** |
| Gender | -0.001 | 0.012 | 0.007 |
| Age | 0.018 | 0.011 | 0.003 |
| Education level | -0.082 | -0.016 | -0.015 |
| Years of work | 0.042 | -0.001 | -0.002 |
| Job type | -0.037 | -0.024 | -0.02 |

| | | | |
|---|---|---|---|
| safety knowledge transfer | \ | 0.626*** | 0.646*** |
| Need for Cognitive Closure | \ | 0.011 | -0.004 |
| safety knowledge transfer * Need for Cognitive Closure | \ | \ | -0.116** |
| $R^2$ | 0.010 | 0.394 | 0.406 |
| Adjusted $R^2$ | 0.001 | 0.386 | 0.398 |
| F | 1.103 | 51.535*** | 47.430*** |

Note: ***P < 0.001, **P < 0.01, *P < 0.05

Table 4 shows that the $R^2$ of model 2 is 0.427, and the $R^2$ of model 3 is 0.443, which is significantly improved. The regression coefficient of the interaction item in model 3 is 0.141 (P<0.001), which shows that the explanatory ability of the model is enhanced. It proves that the moderating variable work attitude has a significant positive moderating effect on the relationship between safety knowledge transfer and safety behavior. In Table 5, the regression coefficient of the interaction term in model 3 is non-significant (0.028, P>0.05), indicating that the interaction term does not have a significant impact on safety behavior. The $R^2$ of model 2 is 0.453, which remains unchanged at 0.453 in model 3. This suggests that the moderating variable "negative emotion" does not have a significant moderating effect on the relationship between safety knowledge transfer and safety behavior. In Table 6, the regression coefficient of the interaction term in model 3 is -0.116 (P<0.01), indicating a significant negative effect of the interaction term on safety behavior. Moreover, the $R^2$ value of model 2 is 0.394, whereas that of model 3 is 0.406--a significant improvement. This suggests that the model's explanatory power has increased. Importantly, it also suggests that the Need for cognitive closure plays a significant negative regulatory role in modulating the relationship between safety knowledge transfer and safety behavior.

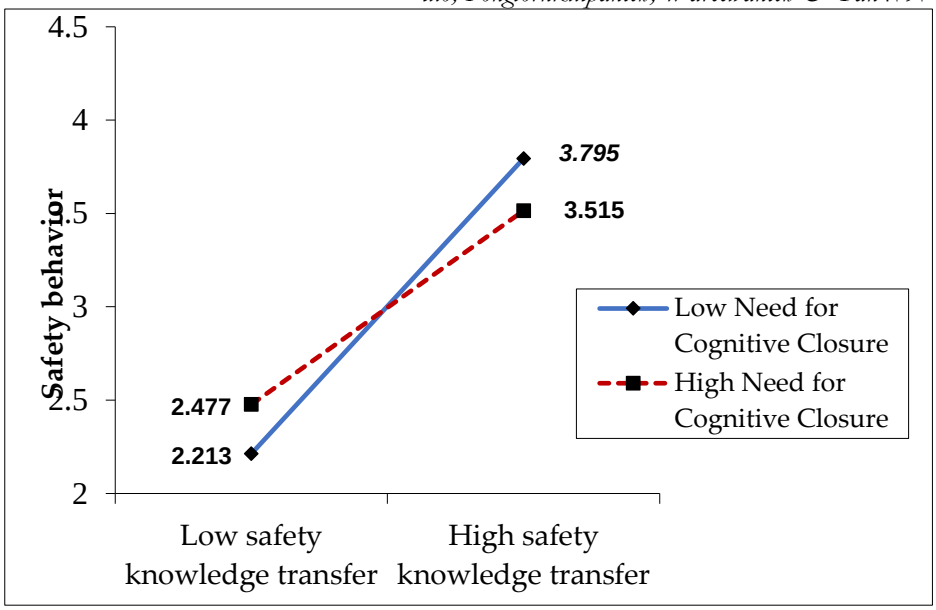


**Figure. 3** Interaction Slope diagram of safety knowledge transfer and work attitude on safety behavior

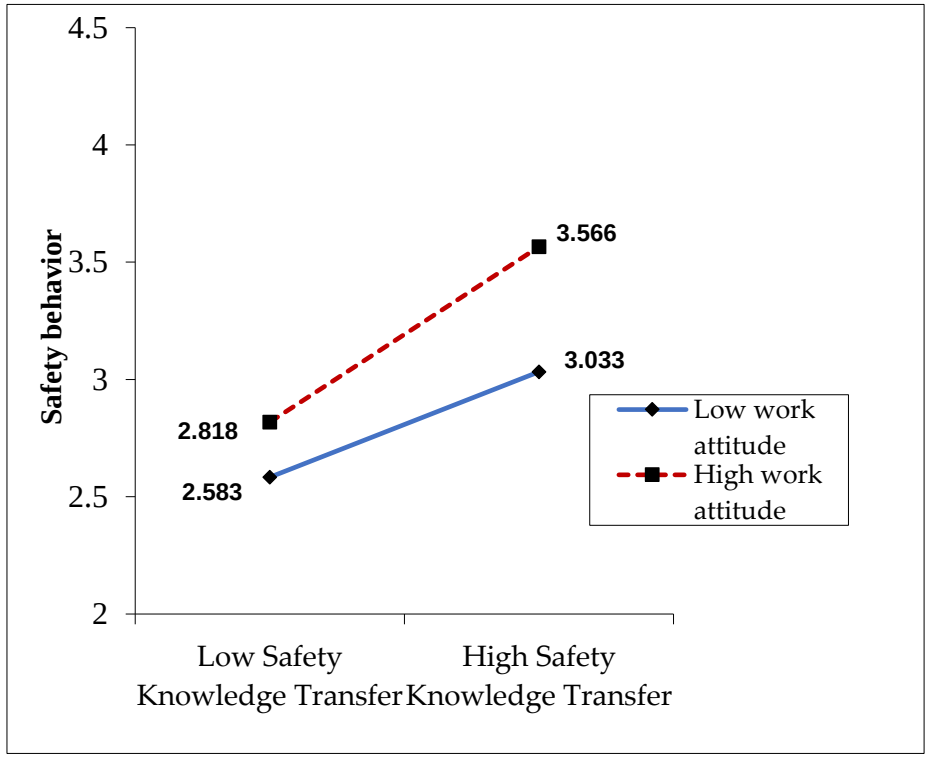


**Figure** 4. Interaction Slope diagram of safety knowledge transfer and need for cognitive closure on safety behavior

According to Dawson (2014), the slope plot of the moderating effect is further used to verify

whether the role of the moderating effect is consistent with the hypothesis of this paper. The slope plot of the moderating effect is shown in Fig.3 and Fig.4. From Figure 3, it is evident that a greater degree of seriousness in the builders' working attitude leads to a more notable enhancement in safety behavior during the process of safety knowledge transfer. Similarly, Figure 4 reveals that as the employees' cognitive closure needs decrease, the positive effect of safety knowledge transfer on safety behavior amplifies. This implies that cognitive closure needs have a negative moderating impact on the association between safety knowledge transfer and safety behavior.

## 5. Discussion

In 1980, Zohar first proposed the term "Safety climate" and pointed out that it is the common view and belief of employees in the organization on safety, and it has an impact on employees' safety behavior and accident rate(Zohar, 1980). Different scholars have studied the influence of safety climate on safety behavior in more depth from different perspectives and studied the influence of safety climate on safety behavior from different perspectives such as organizational climate, individual and environment, organizational level and individual level, and leadership style(Michael S Christian et al., 2009; Hofmann & Stetzer, 1996; Neal et al., 2000). Employees are also more likely to engage in positive safety behaviors if they see them as serving to fulfill their personal goals(Cravens et al., 2010). All these measures are from the enterprise perspective, the actions taken from the management system, management methodologies, and personnel management, that is, attempting to resolve the risky behavior of individuals through external intervention. There is a lot of research on this topic. This article aims to conduct further research from the viewpoint of individuals in enterprise management so that individuals can highlight their unique traits in this process and leverage their initiative to better utilize their abilities and reduce the incidence of insecure behavior, thereby facilitating the safety management of enterprises.

It is believed that the more committed the management is to safety at the H1 building construction site, the greater the role of safety knowledge transfer among construction workers will be. management safety commitment has a major positive effect. on safety knowledge transfer ($\beta=0.389$, $p=0.000<0.001$). H1 is confirmed, demonstrating that the enterprise management's dedication to safety is effectively implemented, which not only enhances the construction workers' trust and identification with the management, and makes them more willing to communicate and exchange with the management, and share safety issues and suggestions, thus facilitating the transfer of safety knowledge; moreover, the management, through the provision of training and educational opportunities, teaches safety knowledge and skills to the employees, to equip them with the ability to cope with the safety risks on the construction site; and it also motivates the employees to take the initiative to learn and share their safety experience, which effectively facilitates the transfer and application of safety knowledge and thus reduces the incidence of unsafe behaviors.

Hypothesis H2 is that the better the construction company does the safety training of construction workers, it will improve the safety knowledge transfer of construction workers and will effectively provide the level of safety of construction workers. safety training has Significantly enhanced safety knowledge transfer ($\beta=0.233$, $p=0.000<0.001$). Assuming H3 is supported, safety training provides construction workers with the necessary knowledge and

skills， not only to master the safety norms and operating methods but also to improve the identification and prevention of safety risks by learning the content of safety training, as well as to be able to correctly use the safety equipment and tools and comply with the safety operating procedures. Moreover, it is also able to enhance safety awareness and responsibility, cultivate safe behavioral habits, and effectively improve the level of safety behavior of construction workers on the construction site.

Hypothesis H3 posits that the more concise and intelligible the safety protocols are, the more conducive they are to facilitate knowledge transfer, resulting in the attainment of heightened safety. safety at the worksite. safety policies exert A major positive effect on safety knowledge transfer ($\beta$=0.278, p=0.000<0.001). This affirms the veracity of Hypothesis H3, which asserts that by establishing and enforcing safety guidelines, organizations establish a structured and methodical framework for disseminating and exchanging safety-related information. Elucidating the precautionary measures undertaken, the instruments and apparatus utilized, and the procedures implemented enables employees to proactively understand how to carry out safety-related duties, thereby guaranteeing the observance of consistent safety standards. The presence and enforcement of safety protocols convey to workers that the enterprise places utmost importance on safety, and fosters active participation and compliance.

Hypothesis H4 indicates that the better the management safety commitment of the construction company is done, the lower the incidence of unsafe behavior on the construction site. management safety commitment has a major positive effect on safety behavior ($\beta$=0.169, p=0.000<0.001). Hypothesis H4 supports that employees are more motivated and willing to engage in safety practices when management demonstrates commitment to safety by words, deeds, and actions. Also, the example set by management's commitment to safety is more suitable or more liable to encourage construction workers to imitate and practice safe behaviors.

Hypothesis H5 indicates the importance of safety training work in construction companies and that safety training work is properly organized to effectively improve the safety behavior of personnel. safety training exerts a considerable and positive influence ($\beta$=0.243, p=0.000<0.001). Hypothesis H5 is supported that through safety training, Firms offer their employees the essential knowledge and expertise to improve their safety awareness, develop emergency response capabilities, and create a positive corporate safety climate.

Hypothesis H6 indicates that the development of safety procedures in construction companies provides behavioral guidelines for the actions of construction workers. safety procedures have a major positive effect on the safety behavior of builders ($\beta$=0.215, p=0.000<0.001). Hypothesis H6 supports that by having clear safety rules and procedures, the organization can provide employees with clear behavioral guidelines on best practices to help them prevent accidents and keep themselves safe. Rules include proper use of PPE, following operating procedures, and reporting potential hazards.

Assuming that the results of H7 indicate that the better the knowledge transfer in safety management by the enterprise, the less unsafe behavior of the staff is now, safety knowledge transfer has a major positive effect on the safety behavior of builders ($\beta$=0.613, p=0.000<0.001). Assuming 7 is supported, companies should not only promote individual self-learning behavior, but also enhance the transfer of safety knowledge from teams and organizations to individuals, enabling the integration of safety experience from other members of the team, the safety knowledge of the entire organization, and the individual safety knowledge of that member, overcoming the limitations of individual self-learning and

effectively reducing individual unsafe behavior.

Hypothesis H8 indicates that the better the company's safety knowledge transfer is, the higher the safety behavior of builders will be. the indirect effect value of safety knowledge transfer between management safety commitment and safety behavior is 0.239, and the data reveals that there is a significant mediation effect, as evidenced by the 95% confidence interval ranging from 0.131 to 0.393, excluding 0. Additionally, the P value is less than the established significance level of 0.05.

Hypothesis H9 indicates that the better the company's safety knowledge transfer is, the better the effect of using safety training to improve the safety behavior of builders. the indirect effect of safety knowledge transfer on safety behavior through safety training is found to be 0.143. The 95% confidence interval for this indirect effect ranges from 0.068 to 0.241, excluding 0, and the P value is less than the significance level of 0.05. These results suggest a significant mediation effect.

Hypothesis H10 indicates that the better the company's safety knowledge transfer is, The more effective the utilization of safety procedures, the greater the improvement in safety behavior of builders. the indirect effect value of safety knowledge transfer between safety procedures and safety behaviors is 0.171, the 95% confidence upper and lower interval values are 0.068-0.241, excluding 0, and the significance P value is less than the significance level of 0.05, indicating that there is a significant mediation effect.

Hypothesis H11 indicates that the better the work attitude, the greater the impact of safety knowledge transfer on safety behavior. In the multivariate regression model established with safety knowledge transfer, work attitude, and the interaction item safety knowledge transfer*work attitude as the independent variable and safety behavior as the dependent variable, the interaction term between the independent variable and the moderator variable exhibits a regression coefficient of 0.141. ($P<0.001$), The results indicate that the interaction term has a statistically significant and positive impact on safety behavior. Assuming that H11 holds, it means that the better the working attitude of the moderating variable, the greater the impact on safety behavior through safety knowledge transfer, which the implementation of this method can effectively improve the safety behavior of site personnel and reduce the occurrence of unsafe accidents. It has significantly improved the safety management level of enterprises.

Hypothesis H12 indicates that the higher the negative emotion, A multiple regression model is created to examine how safety behavior is influenced by safety knowledge transfer, negative emotion, and the interaction between safety knowledge transfer and negative emotion. The impact of safety knowledge transfer on safety behavior is found to be minimal in this analysis. The regression coefficient of the interaction item is 0.028 ($P>0.05$), indicating that the interaction item has no significant impact on safety behavior, so the assumption is not valid.

Hypothesis H13 indicates that the decreased desire for cognitive closure, the greater the impact of safety knowledge transfer on safety behavior. In the multivariate regression model established with safety knowledge transfer, cognitive closure demand, and interaction item safety knowledge transfer cognitive closure demand When considering the independent variables and safety behavior as the dependent variable, the interaction term between the independent variable and the moderating variable exhibits a regression coefficient of -0.116 ($P<0.01$), indicating that the interaction term has a significant negative effect on safety behavior. Assuming that H13 holds, it means that the lower the cognitive closure requirement

of the moderator variable, The stronger the impact on safety behavior resulting from safety knowledge transfer.

This study holds significant practical implications for the safety management of construction enterprises. The safety behavior of individual builders is not only influenced by the safety climate created by the enterprise, but also by individual differences such as work attitudes, cognitive closure needs, and knowledge transfer processes that impact safety behavior. Safety knowledge transfer acts as a mediator between safety climate and safety behavior, strengthening the Impact of safety climate on safety behavior. Meanwhile, individual differences play a moderating role in the relationship between safety knowledge transfer and safety behavior. Employees who exhibit a more positive attitude towards work, have complete safety facilities, and possess stronger safety awareness are less likely to experience unsafe accidents.

## 6. Conclusion

In this study, mainly through the collection and Analysis of online and offline questionnaire data, it is found that the safety climate at the construction site affects the safety behavior of builders, and the safety knowledge transfer is between the site safety climate and individual safety behavior. There is a mediating effect; that is to say, with the improvement of the safety knowledge transfer effect, the greater the Impact of the safety climate on the construction site on the safety behavior of personnel, the better the safety behavior is improved; Safety behavior has a moderating effect, that is, depending on the individual's work attitude and cognitive closure needs, the same site environment, the same work content, and the same safety problem, different individuals will have different behaviors, which is individual differences.

The study found that satisfied builders are more likely to follow safety procedures, participate in safety training, and adopt preventive safety behaviors, and there is a positive relationship between job satisfaction and builders' safety behaviors(He et al., 2019). When builders are treated fairly, they are more likely to follow safety rules and standards. Builders who are highly engaged tend to be more safety-conscious as they take their job responsibilities more seriously, including complying with safety requirements. Builders' satisfaction, commitment, and other factors can affect their safety behavior.(Donglong et al., 2020) Studying this relationship can help organizations better understand how to improve workplace safety by changing work attitudes and promoting positive safety behavior among builders.

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