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The Influence of the University Laboratory Safety Climate on Students' Safety Behavior: The Parallel Mediating Effects of Ability and Motivation

Yuan Liu, Wei Feng *, Guirong Zhang and Ying Zhang

School of Public Administration, Central South University, Changsha 410017, China;
yuanliu710@csu.edu.cn (Y.L.); zhangguirong@csu.edu.cn (G.Z.); 210211139@csu.edu.cn (Y.Z.)
* Correspondence: 210201017@csu.edu.cn

Abstract: Students' unsafe behavior is the main factor related to accidents in university laboratories. The safety climate is an important factor that affects individual safety behavior on the organizational level. Therefore, to improve the effect of university laboratory safety management, based on the theoretical framework of AMO and the SEM method, the influence of the laboratory safety climate on the safety compliance behavior and safety participation behavior of 500 university students in China was investigated and analyzed. The results show that safety ability and safety motivation play parallel mediating roles, and their synergistic effect promotes the generation of safety behavior: the safety climate in the laboratory has a direct positive effect on both safety compliance behavior and safety participation behavior; safety knowledge and safety skills have significant mediating effects on both safety compliance behavior and safety participation behavior in the laboratory safety climate; external safety motivation has a significant mediating effect on safety compliance behavior and safety participation behavior in the laboratory safety climate; and internal safety motivation does not have a mediating effect on safety compliance behavior and safety participation behavior in the laboratory safety climate. To improve students' safety behavior performance, measures such as strengthening the construction of the dynamic improvement mechanism of the laboratory safety climate, optimizing the laboratory safety access system, and taking comprehensive measures to ensure the continuous positive influence of the safety climate on students' safety behavior can be adopted.

Keywords: university laboratory safety; safety climate; students' safety behavior

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1. Introduction

Safety is the basic guarantee for the sustainable development of higher education. In recent years, in China's education system, the concept of safety development has been established, carrying forward the idea of "life first and safety first", and the safety work of university laboratories has led to positive results. However, university laboratory accidents still occur from time to time, showing that there are still weak links in laboratory safety management. According to the results of an analysis of the causes of university laboratory accidents in the past 20 years, students' unsafe behavior accounted for 40% of the direct factors related to laboratory accidents [1]. In particular, in the context of the increasing number of undergraduates and postgraduates in countries like China, the question of how to improve the management effect of university laboratory students' safety behavior is an important problem that needs to be solved urgently.

Cognitive psychology regards human behavior as the external manifestation of internal mental processes [2]. This means the primary task of safety behavior management is to optimize the human psychological process, which is affected by organizational factors, environmental factors, and personal factors [3]. Among them, the safety climate is an important dimension that affects employees' subjective psychology on the organizational level [4]. Behavioral science theory posits that if an organization requires employees to perform a certain behavior that is beneficial to the organization, it will need to create an organizational climate suitable for that behavior to improve the possibility of the behavior [5]. The safety climate was defined by Zohar as employees' shared perception of safety policies, procedures, and practices and is also understood as employees' shared awareness of their risk environment [4]. Since the safety climate concept was proposed, a large number of empirical studies have been produced in the field of safety science, and the positive impact of the safety climate on safety behavior has been fully verified [6,7].

Current research on the safety climate mostly focuses on industrial systems such as coal mines [8], aviation [9], and construction [10,11], and corresponding research is also undertaken in university laboratory systems. The influencing factors and measurement of laboratory safety climates in universities have become the focus of scholars' attention. For example, Wu et al. investigated the organizational factors, individual factors, and their interactions in the safety climates of university laboratories by taking employees in universities and colleges in Taiwan as their investigation objects [12]. Marin et al. developed a safety climate scale for university chemistry laboratories by taking college students attending chemistry classes as investigation objects [13]. Salazar et al. investigated students in the academic laboratories of several public schools in Mexico to determine the factor structure of the safety climate [14]. However, there is a lack of empirical research on how the safety climate of university laboratories affects students' safety behavior.

2. Theoretical Basis and Research Hypothesis

2.1. Theoretical Basis

The Ability–Motivation–Opportunity framework ("AMO" framework) was originally proposed by Appelbaum and Bailey, who believed that three components are required to ensure employees' autonomous efforts: that employees have the necessary skills, that they need appropriate motivation, and that employers must provide opportunities for them to participate [15]. In the discipline of human resource management, the AMO framework is widely adopted to explain the complex relationship between people management and performance outcomes. A generally accepted view is that some combination of individual abilities, motivations, and opportunities can offer us a measure of individual performance, and it can also be used to understand the behavioral processes between people management initiatives and potential performance improvements [16]. In summary, individual behavior is affected by the synergistic influences of ability, motivation, and opportunity, while ability and motivation are the proximal internal factors that affect individual behavior. Therefore, this framework provides an important theoretical support for this paper to study the mediating effect of laboratory safety climate on students' safety behavior. Specifically, the theoretical model was established and verified by taking the safety climate as an independent variable, safety behavior as a dependent variable, and ability and motivation in the AMO framework as intermediary variables.

2.2. Research Hypothesis

2.2.1. University Laboratory Safety Climate and Student Safety Behavior

As the core of the socio-technical system, human behavior has a fundamental impact on the safety state of the whole system. Almost all accidents are directly or indirectly related to human behavior [17]. Safety behavior is closely related to performance and is defined as the sum of all behavioral activities that affect organizational safety performance [18], including two types of safety compliance behavior and safety participation behavior [19]. Among them, safety compliance behavior refers to the behavior where employees insist on working with the correct safety operation process, which reflects employees' compliance with safety rules and regulations; safety participation behavior is the behavior of actively helping others, promoting the implementation of safety programs, and actively improving safety measures in specific situations.

The effect of organizational climate on individual behavior can be explained according to the two aspects of process and mechanism. On the process level, individuals often observe their work environment and the behavior of colleagues and leaders and use their observations as a basis for constructing safety cognitive models that adjust their behavior in the workplace [20]. On the mechanism level, the safety climate has the function of safety prediction [4], and the perception of the safety climate will affect behavioral expectations, change behavioral trends, and ultimately affect organizational safety performance [4]. Based on the mechanism of safety climate affecting safety behavior, the following hypotheses are proposed:

H1: *The university laboratory safety climate has a direct positive effect on students' safety behavior.*

H1-1: *The laboratory safety climate in universities has a direct positive effect on students' safety compliance behavior.*

H1-2: *The university laboratory safety climate has a direct positive effect on students' safety participation behavior.*

2.2.2. The Mediating Role of Safety Ability

Human's unsafe behavior is the embodiment of insufficient individual safety ability [21]. In the past, scholars have had different views on what constitutes an employee's or an individual's safety capabilities. For example, the two dimensions of safety knowledge and safety skill can determine an individual's safety ability [22]. The formation of employees' safety ability includes not only personal skills and physical conditions (such as physical strength and reaction time) but also the accumulation of training and relevant experience [23]; the safety ability of construction personnel is defined as the use and integration of knowledge, skills, attitudes, and other inherent characteristics of construction personnel in a construction site [24]. Through the extraction of common factors, safety ability is regarded as the synthesis of safety knowledge and safety skill.

Knowledge is divided into explicit knowledge and tacit knowledge [25]. Among them, tacit knowledge is difficult to express clearly and has the characteristics of individuality and contingency; explicit knowledge refers to a system that can be fully represented by a code system. In the past, scholars emphasized that both of them have an important impact on the formation of safe behavior [26,27]. In view of the dominant role of explicit knowledge in laboratory safety management in China, the safety knowledge explored in this study refers to the knowledge reserve that an individual uses to cope with various safety conditions during work [28], such as safety regulations, safety procedures, and possible safety risks. Safety skills include safety operation skills and emergency handling skills; this takes into account the importance of both safety management and emergency management [29]. Under the influence of the school's safety training and the instructor's safety behavior, when students perceive that their behavior expectations are not good, they will improve their laboratory safety knowledge and skills through learning, information searching, communication with classmates and teachers, and practical exercises. On this basis, students will become better able to perform an act that conforms to operating norms and processes and promote laboratory safety. Based on this, the following hypotheses are proposed:

H2: *Students' safety ability plays a mediating role in the university laboratory safety climate and students' safety behavior.*

H2-1: *Safety knowledge plays a mediating role in the university laboratory safety climate and students' safety compliance behavior.*

H2-2: *Safety skills play a mediating role in the university laboratory safety climate and students' safety compliance behavior.*

H2-3: *Safety knowledge plays a mediating role in the university laboratory safety climate and students' safety participation behavior.*

H2-4: *Safety skills play a mediating role in the university laboratory safety climate and students' safety climate behavior.*

2.2.3. The Mediating Role of Safety Motivation

In addition to the two dimensions of safety knowledge and safety skill, safety motivation is also considered to be a key factor affecting personal safety behavior [15]. Safety motivation reflects an individual's willingness to make efforts to carry out safety behavior [30], which is a proximal determinant of personal safety behavior, and a remote factor such as the safety climate has an indirect impact on the safety behavior related to a specific safety motivation [19]. Due to the proposal of self-determination theory, safety motivation has been further expanded into intrinsic motivation and extrinsic motivation [31]. Extrinsic motivation arises under the premise of behavioral expectation, embodied in the individual's expectation to obtain tangible rewards or avoid undesired results. Internal motivation refers to factors such as self-achievement, satisfaction, a sense of responsibility, and security within individuals [32].

A safety climate formed by laboratory safety norms, supervision, and regulation will prompt college students to have the desire to avoid punishment and cause accidents, thus generating external safety motivation and affecting college students' enthusiasm for laboratory safety work. In the past, there have been many understandings about the relationship between intrinsic motivation and extrinsic motivation, and scholars generally believe that they coexist. The main viewpoint is that the dominance of external motivation can either weaken or promote internal motivation [33]. Specifically, external rewards or punishments work well for predictive or executive work but can be destructive for exploratory or creative work, ultimately undermining intrinsic motivation [34]. In this executive work, when employees are subject to internal pressure or help others to gain a sense of self-worth, they are more likely to comply with safety rules and increase their motivation to participate in safety [35]. In other words, in the process of generating an individual's external motivation, it may be further transformed into an internal motivation such as their own sense of security, a sense of responsibility, and a sense of accomplishment, thus enhancing the enthusiasm for, and sustainability of, safety participation and safety compliance behaviors. Based on this, the following hypotheses are proposed:

H3: *Safety motivation plays a mediating role in the university laboratory safety climate and students' safety behavior.*

H3-1: *Intrinsic safety motivation plays a mediating role in the university laboratory safety climate and students' safety compliance behavior.*

H3-2: *Intrinsic safety motivation plays a mediating role in the university laboratory safety climate and students' safety participation behavior.*

H3-3: *Extrinsic safety motivation plays a mediating role in the university laboratory safety climate and students' safety compliance behavior.*

H3-4: *External safety motivation plays a mediating role in the university laboratory safety climate and students' safety participation behavior.*

According to the above assumptions, the theoretical hypothesis model of this research is proposed, as shown in Figure 1.

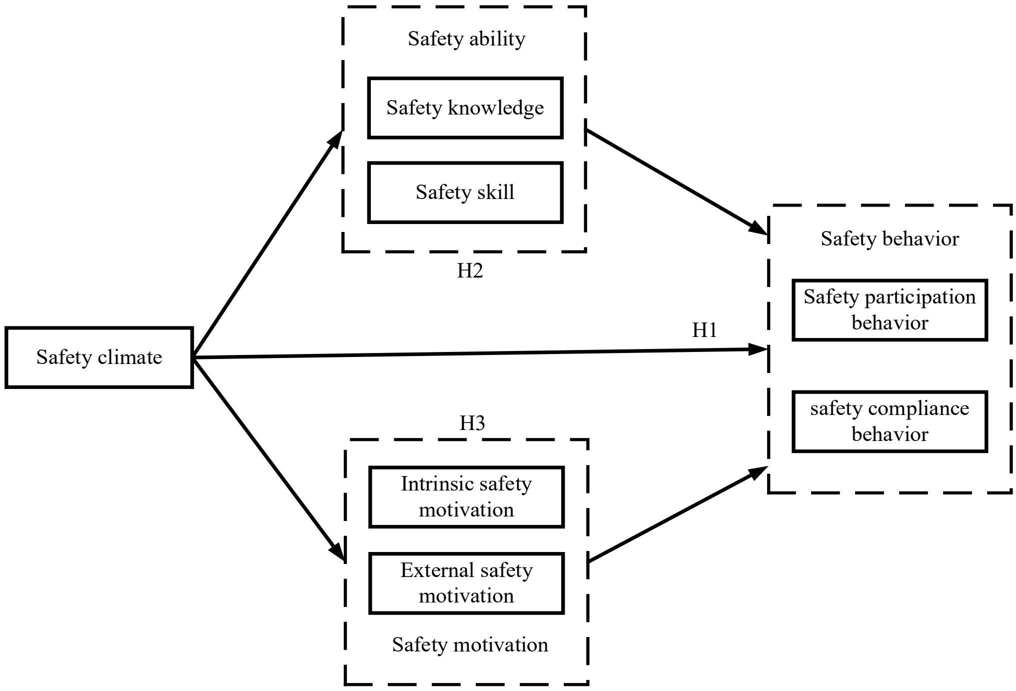

Figure 1. Theoretical hypothesis model.

3. Research Design

3.1. Sample and Data Source

In this study, we took students who performed experiments or took lab courses in Chinese universities as our survey objects, including undergraduate and graduate students from different universities. The questionnaire was issued on the questionnaire platform, and the survey participants were invited to fill out the questionnaire through QQ, Wechat, and other means. Based on the principle that the larger the sample size is, the smaller the error will be, and considering the possibility of insufficient efficiency in retrieving the questionnaires, the method of expanding the sample size and eliminating invalid questionnaires was adopted to determine the final sample. After the survey, 901 questionnaires were collected. The collected questionnaires were screened according to three criteria: first, whether the response time was less than two minutes; second, whether the results were arranged regularly; and third, whether there were questionnaires with identical answers. In the end, 401 invalid questionnaires were eliminated and 500 valid questionnaires were obtained, with an effective rate of 55%. The descriptive statistics of the basic information of the respondents are shown in Table 1.

Table 1. Statistical table of basic information of survey participants.

Personal Feature	Options	Frequency (Person)	Percentage (%)
Gender	Man	252	50.40
	Woman	248	49.60
Education level	Undergraduate student	346	69.20
	Postgraduate student	115	23.00
	PhD student	39	7.80

3.2. Variable Measurement

All scales were scored using the Likert 5-level scoring method. A scale of 1 to 5 means “strongly disagree—strongly agree” or five levels of “degree”. For example, the degree of effectiveness in the question was divided into “ineffective—strongly effective”. Based on the chemical laboratory safety climate scale developed by Marin et al. [13], two measurement dimensions of the laboratory safety climate in universities were finally determined through translation, screening, adaptation, and testing, including the safety behavior of instructors and school safety training. The measurement scales of safety knowledge, safety participation behavior, and safety compliance behavior were adapted based on the scales developed by Neal and Griffin and based on the laboratory safety situation and the students' safety perspective [36]. The measurement scale of safety motivation was adapted from the scale developed by Fleming [37]. Safety skills were defined as three items according to the requirements of laboratory safety operation and emergency response.

3.3. Analytical Method

In this study, a Structural Equation Model (SEM) was used for data analysis. The SEM is a method used to build, estimate, and test causal relationship models [38]. Social science researchers usually use some measurement questions to reflect the research dimension, and a SEM can be used to deconstruct whether the measurement questions of the surface are representative. It can also handle complex path models, measurement models, and structural models [38]. Based on this model, SPSS 23.0 and AMOS 26.0 statistical software were used to complete data processing. The data analysis procedure was as follows: (1) Cronbach's α coefficient of internal consistency was used to evaluate the reliability of the scale; (2) the confirmatory factor was used to analyze the scale's structure validity; (3) correlation analysis was used to investigate the correlation coefficient between variables; (4) and hypothesis testing was carried out using the direct effect test and mediating effect test.

4. Data Inspection and Analysis

4.1. Reliability and Validity Analysis

Before data processing, to ensure the robustness of the results, the reliability and the validity test were carried out first. In terms of reliability, Cronbach's α coefficient of internal consistency was used to evaluate the reliability of the scale. It was found that the overall validity of the scale is 0.939 (>0.9), indicating a high reliability quality of the research data. Meanwhile, the Cronbach's α values of all the latent variables are greater than 0.7, which passes the reliability test.

Validity mainly includes content validity, structure validity, convergence validity, and discriminant validity. The scale of this study is designed around university laboratory safety, and the measurement items of potential variables involved are all adapted from existing mature scales and have been pretested and verified by experts. Therefore, this scale has a high content validity. Exploratory factor analysis and confirmatory factor analysis are used to test the structural validity, and confirmatory factor analysis is used to test the convergence validity and discriminant validity. The KMO value of the overall scale is 0.923 (>0.8), and the p-values of Bartlett's sphericity test are all less than 0.05, indicating that the data of the scale are highly suitable for factor analysis. According to the principle that the eigenvalue is greater than 1, a total of four common factors are extracted, and the cumulative variance contribution rate is 69.65%, indicating that the interpretation of the four factors extracted in this study is almost ideal for the original data. In addition, the factor load coefficient of each observed variable is greater than 0.6, except for variable that "the instructor strictly requires students to abide by the laboratory safety system". Considering that the AVE value and CR value of the dimension where the item is located are good, the test is passed comprehensively, which further indicates that the overall structural validity of the scale is good. When the CR value of each variable is greater than 0.7 and the AVE value is greater than 0.5, the convergence validity of the scale is high. It can be seen from Table 2 that the CR value and AVE value of each variable are very good, indicating that the convergence validity of the scale is very good. At the same time, it can be seen from Table 3 that the AVE square root values of all the variables are greater than their correlation coefficients with other variables, indicating that the scale has a good discriminant validity.

Table 2. Reliability and validity of the scale.

Variable	Measurement Item	Standardized Factor Load	Cronbach's α	CR	AVE
Safety climate	The instructor often supervises students' safety behavior in the laboratory.	0.641	0.883	0.874	0.543
	The instructor strictly requires students to abide by the laboratory safety system.	0.587			
	The instructor follows laboratory safety procedures and policies by example.	0.608			
	The school provides students with adequate laboratory safety training.	0.778			
	The effectiveness of the school's laboratory safety training to improve their own safety operation ability.	0.884			
	The effectiveness of the school's laboratory safety training in improving its emergency response ability.	0.863			
Safety knowledge	I know what risk points and risk factors exist in the lab.	0.719	0.834	0.839	0.635
	My proficiency in safety operating practices for laboratory equipment.	0.831			
	My familiarity with various laboratory safety management systems.	0.836			
Safety skill	My proficiency in using safety facilities (e.g., fire extinguishers, fire hydrants).	0.823	0.881	0.883	0.716
	My proficiency in using and handling hazardous substances in the laboratory.	0.875			
	My ability to handle dangerous situations in the lab.	0.839			
Intrinsic safety motivation	Following the lab safety rules make me feel more secure in my experiments.	0.739	0.864	0.87	0.692
	I consider it my duty to keep the laboratory safety.	0.880			
	Exerting my ability to keep the laboratory safe and effectively deal with dangerous situations makes me feel more fulfilled.	0.869			
Extrinsic safety motivation	I try to keep the lab safe so as not to endanger myself or others.	0.902	0.890	0.89	0.802
	I try to keep the laboratory safe to avoid accidents.	0.889			
Safety compliance behavior	I strictly abide by the safety system of the laboratory to complete the experimental work.	0.921	0.839	0.870	0.696
	I strictly abide by the operating procedures and norms of all laboratory instruments and equipment.	0.911			
	I have all the knowledge and skills required to ensure the experiment's safety.	0.64			
Safety participation behavior	I often take the initiative to correct classmates' wrong operations or ideas.	0.795	0.847	0.850	0.655
	I actively advise laboratory managers or instructors on how to improve laboratory safety.	0.851			
	I do some work on my own to improve laboratory safety.	0.780			

Table 3. Correlation coefficient matrix and AVE square root value.

	Safety Climate	Safety Knowledge	Safety Skill	Intrinsic Safety Motivation	Extrinsic Safety Motivation	Safety Compliance Behavior	Safety Participation Behavior
Safety climate	0.737						
Safety knowledge	0.524	0.797					
Safety skill	0.425	0.741	0.846				
Intrinsic safety motivation	0.468	0.339	0.248	0.832			
Extrinsic safety motivation	0.451	0.372	0.273	0.808	0.896		
Safety compliance behavior	0.543	0.565	0.469	0.625	0.776	0.834	
Safety participation behavior	0.516	0.534	0.490	0.390	0.393	0.606	0.809

4.2. Confirmatory Factor Analysis

Confirmatory factor analysis is an important part of a SEM, mainly dealing with the relationship between the observed indicators and latent variables, also known as the measurement model, the analysis results of which are used to obtain model fitting indicators [38]. The relevant indicators and the criteria for judging the degree of fitting are as follows: $\chi 2/\mathrm{df}$ (1−3), RMSEA (<0.08), GFI (>0.9), CFI (>0.9), and NFI (>0.9). Based on this, AMOS 26.0 is used to perform a confirmatory factor analysis of the model. The fitting index values of the four-factor model composed of all the variables explored in this study are within the acceptable range ($\chi 2/\mathrm{df} = 2.704 < 3$; RMSEA = 0.012 < 0.08; GFI = 0.922 > 0.9; CFI = 0.963 > 0.9; NFI = 0.943 > 0.9), which again proves the validity of the scale.

4.3. Common Method Deviation Test

Since there may be a common method bias in data collected through questionnaires, which may affect the reliability of the hypothesis test results, in this study, we adopted the Harman single-factor method to test for common method bias. As the results show, in the absence of a rotation factor, exploratory factor analysis was carried out on all the measurement items in this study, and four principal component factors with eigenvalues greater than 1 were extracted. Among them, the variance explanation percentage of the initial eigenvalues of the largest common factor is 22.91%, lower than the judgment standard of 50%, indicating that the explanatory power of this factor is not strong. It is confirmed that the common method bias in the samples is minimal and does not have a serious impact on the model analysis results.

4.4. Correlation Analysis of Each Variable

Pearson correlation analysis was used to explore the degree of correlation among the safety climate, safety ability, safety motivation, and safety behavior. The results show that all three are significantly correlated at the level of 0.01, as shown in Table 4. There is a significant positive correlation of the safety climate with safety ability, safety motivation, and safety behavior, and the correlation coefficients are 0.558, 0.568, and 0.604, respectively. Safety ability also has a positive correlation with safety motivation and safety behavior. The correlation coefficient with safety motivation is 0.37, and the correlation coefficient with safety behavior is 0.623. There is a positive correlation between safety motivation and safety behavior. The stronger the safety motivation is, the safer the laboratory operation behavior will be, and the correlation coefficient is 0.654. It can be seen that the correlation analysis results are consistent with the theoretical hypothesis, which provides support for further analysis.

Table 4. Variable correlation analysis.

	Safety Climate	Safety Ability	Safety Motivation	Safety Behavior
Safety climate	1			
Safety ability	0.558 **	1		
Safety motivation	0.568 **	0.370 **	1	
Safety behavior	0.604 **	0.623 **	0.654 **	1

** $p < 0.01$.

4.5. Hypothesis Test

4.5.1. Direct Effect Test

In this study, AMOS 26.0 software was used for the direct effect test. The direct effect test results of the structural model are shown in Table 5, including the path coefficients β of the structural model, the corresponding critical ratio C.R. value, *p*-value, etc. When judging causality between variables, the C.R. is usually the critical ratio of the regression coefficient and the standard error of the estimated value, which is used as the judging index. If the absolute value of the C.R. is greater than 1.96, it can be considered that the variable relationship is significant at the significance level of 0.05, and the significance of each path is judged based on the *p*-value.

Table 5. Direct effect test results.

Structural Model Path	Standardized Path Coefficient β	Standard Error S.E.	C.R.	*p*
Safety climate→Safety compliance behavior	0.131	0.037	3.526	***
Safety climate→Safety participation behavior	0.311	0.063	4.943	***

*** $p < 0.001$.

According to the analysis results, the safety climate has a significant positive impact on safety participation behavior (β = 0.311, C.R. = 4.943, $p < 0.001$) and on safety compliance behavior (β = 0.131, C.R. = 3.526, $p < 0.001$). Therefore, hypotheses H1-1 and H1-2 are supported.

4.5.2. Mediating Effect Test

In this study, the bootstrap test was used to test the mediating effect, and the mediating effect under the 95% confidence interval was estimated using the bias-corrected percentile method and non-parametric percentile method. If the confidence interval does not contain 0, then there is a mediating effect. The results of the mediation effect hypothesis test are shown in Table 6. The results are as follows:

(1) The total effect value of "safety climate→safety knowledge→safety compliance behavior" is 0.569. The direct effect value is 0.102, and the indirect effect value is 0.107, accounting for 18.80% of the total effect. The 95% confidence interval is [0.056, 0.164], the confidence interval does not contain 0, and the indirect effect is significant, indicating that the mediating effect is significant, and the direct effect is significant, so it is a partial mediating effect. Therefore, hypothesis H2-1 is supported. The total effect value of "safety climate→safety skills→safety compliance behavior" is 0.569. The direct effect value is 0.102, and the indirect effect value is 0.050, accounting for 8.79% of the total effect. The confidence interval of 95% is [0.012, 0.085], and the confidence interval does not contain 0. The indirect effect is significant, indicating that the mediating effect is significant, and the direct effect is significant, so it is a partial mediating effect. Therefore, hypothesis H2-2 is supported.

(2) The total effect value of "safety climate→safety knowledge→safety participation behavior" is 0.639. The direct effect value is 0.285, and the indirect effect value is 0.119, accounting for 18.62% of the total effect. The 95% confidence interval is [0.041, 0.202], the confidence interval does not contain 0, and the indirect effect is significant, indicating that the mediating effect is significant, and the direct effect is significant, so it is a partial mediating effect. Therefore, hypothesis H2-3 is supported. The total effect value of "safety climate→safety skill→safety participation behavior" is 0.639. The direct effect value is 0.285, and the indirect effect value is 0.102, accounting for 15.96% of the total effect. The 95% confidence interval is [0.034, 0.191], and the confidence interval does not contain 0. The indirect effect is significant, indicating that the mediating effect is significant, and the direct effect is significant, so it is a partial mediating effect. Therefore, hypothesis H2-4 is supported.

(3) The total effect value of "safety climate→intrinsic safety motivation→safety compliance behavior" is 0.569. The direct effect size is 0.102, the indirect effect size is 0.042, the 95% confidence interval is [−0.032–0.116], the confidence interval contains 0, and the indirect effect is not significant, and so hypothesis H3-1 is not supported. The total effect value of "safety climate→intrinsic safety motivation→safety participation behavior" is 0.639. The direct effect size is 0.085, the indirect effect size is 0.007, the 95% confidence interval is [−0.076, 0.081], the confidence interval contains 0, and the indirect effect is not significant, so hypothesis H3-2 is not supported.

(4) The total effect value of "safety climate→external safety motivation→safety compliance behavior" is 0.569. The direct effect value is 0.102, and the indirect effect value is 0.267, accounting for 46.92% of the total effect. The 95% confidence interval is [0.178, 0.369], and the confidence interval does not contain 0. The indirect effect is significant, indicating that the mediating effect is significant, and the direct effect is significant, so it is a partial mediating effect. Therefore, hypothesis H3-3 is supported. The total effect value of "safety climate →external safety motivation→safety participation behavior" is 0.639. The direct effect value is 0.285, and the indirect effect value is 0.127, accounting for 19.87% of the total effect. The 95% confidence interval is [0.046, 0.227], and the confidence interval does not contain 0. The indirect effect is significant, indicating that the mediating effect is significant, and the direct effect is significant, so it is a partial mediating effect. Therefore, hypothesis H3-4 is supported.

Table 6. Results of mediation effect test.

Latent Variable	Safety Knowledge				Safety Skill			
	Direct Path	**Indirect Path**	**Total Path**	**Bias-Corrected 95% CI**	**Direct Path**	**Indirect Path**	**Total Path**	**Bias-Corrected 95% CI**
Safety compliance behavior	0.102	0.107	0.569	0.056–0.164	0.102	0.050	0.569	0.012–0.085
Safety participation behavior	0.285	0.119	0.639	0.041–0.202	0.285	0.102	0.639	0.034–0.191
Latent variable	**Intrinsic safety motivation**				**Extrinsic safety motivation**			
	Direct path	**Indirect path**	**Total path**	**Bias-Corrected 95% CI**	**Direct path**	**Indirect path**	**Total path**	**Bias-Corrected 95% CI**
Safety compliance behavior	0.102	0.042	0.569	−0.032–0.116	0.102	0.267	0.569	0.178–0.369
Safety participation behavior	0.085	0.007	0.639	−0.076–0.081	0.285	0.127	0.639	0.046–0.227

On the whole, all hypotheses are supported, except for H3-1 and H3-2. To further explore the reasons why the above hypotheses are not valid, a path analysis was carried out. From the path analysis results, we can see that the safety climate has a significant positive impact on intrinsic safety motivation ($\beta = 0.457$, $p < 0.001$) and external safety motivation ($\beta = 0.436$, $p < 0.001$). Extrinsic safety motivation has significant effects on safety compliance behavior (β = 0.56, $p < 0.001$) and safety participation behavior (β = 0.267, $p < 0.001$). However, the direct effect between intrinsic safety motivation and safety compliance behavior, on the one hand, and safety participation behavior, on the other, is not significant; its standardized path coefficients β are −0.077 and 0.122, $p > 0.001$, respectively. Therefore, it can be inferred that after receiving laboratory safety training and teacher safety guidance, college students will experience extrinsic safety motivation, which will promote safety compliance behavior and safety participation behavior, and extrinsic safety motivation will also be further internalized into intrinsic safety motivation. However, the generation of safe behaviors is still mainly caused by external safety motivation, such as violation punishment, teacher criticism, and the consequences of accidents. This provides an important basis for subsequent laboratory safety management.

5. Conclusions and Discussion

5.1. Research Conclusions

To verify the influence mechanism of safety climate on students' safety behavior, based on the AMO framework and SEM, in this study, we took 500 students in universities as the investigation objects, constructed a parallel mediating model including the laboratory safety climate, safety ability, safety motivation, and safety behavior, and drew the following conclusions through empirical research: (1) The laboratory safety climate in universities has a direct positive effect on students' safety compliance behavior and safety participation behavior. (2) Safety knowledge plays a mediating role in the university laboratory safety climate and students' safety compliance behavior and safety participation behavior. (3) Safety skills play a mediating role in the university laboratory safety climate and in students' safety compliance behavior and safety participation behavior. (4) External safety motivation plays a mediating role in the laboratory safety climate, students' safety compliance behavior, and students' safety participation behavior. (5) Intrinsic safety motivation has no mediating effect on the university laboratory safety climate, students' safety compliance behavior, or students' safety participation behavior. Therefore, Figure 1 was eventually revised to the theoretical model shown in Figure 2.

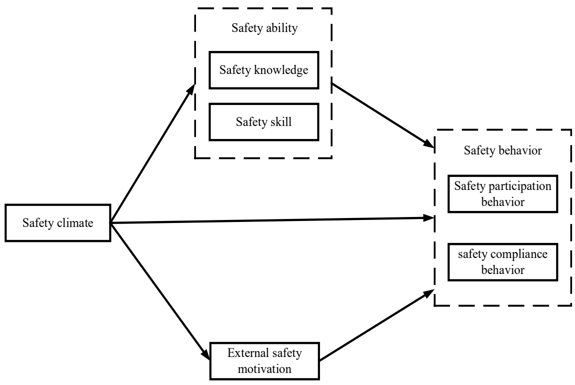

Figure 2. Revised theoretical model.

5.2. Theoretical Contribution

Based on the above research conclusions, this study makes the following contributions to the current theory:

(1) This study promotes on the mechanism of safety climates on students' safety behavior and complements the mediating effect of safety ability between the laboratory safety climate and students' safety behavior. In the past, Neal and Griffin's research verified the mediating effect of safety knowledge on the safety climate and safety behavior [36]. Safety ability is also an important prerequisite for safety behavior. However, the mediating effect of safety ability between the laboratory safety climate, safety compliance behavior, and safety participation behavior is still unclear. As

safety ability, in particular, includes multiple dimensions, it is necessary to clarify the mediating effect of safety knowledge and safety skills. The results show that safety ability is characterized by safety knowledge and safety skills and plays a mediating role between the safety climate, safety compliance behavior, and safety participation behavior.

(2) This study clarifies the mediating effect of safety motivation between the laboratory safety climate and students' safety behavior. Safety motivation is the proximal factor influencing safety behavior. Scholars have paid more attention to the influence of external safety motivation on safety behavior [31]. The mediating effect of intrinsic safety motivation on safety climate, safety compliance behavior, and safety participation behavior has not been verified. The results show that extrinsic safety motivation plays an intermediary role between the safety climate, safety compliance behavior, and safety participation behavior. There is a significant relationship between intrinsic safety motivation and the laboratory safety climate but not between safety compliance behavior and safety participation behavior. From this viewpoint, the main safety motivation in university laboratory safety work is still external safety motivation.

5.3. Future Applications

Based on the above research conclusions and theoretical contributions, the possibilities for future applications are as follows:

(1) Strengthen the construction of the dynamic improvement mechanism for the university laboratory safety climate. The safety climate is a snapshot of a system's safety culture at a certain time [39]. Therefore, the safety climate dynamically affects the reliability of individual safety compliance behavior and safety participation behavior in the system. Based on the establishment of the laboratory safety climate element system, on the one hand, we should strengthen the construction of laboratory safety training systems and promote the improvement of laboratory safety supervision systems; on the other hand, the laboratory safety climate should be dynamically evaluated and the deficiencies in the laboratory safety climate should be analyzed to improve the laboratory safety climate. In addition, it is necessary to dynamically monitor the periodic changes in the safety climates in university laboratories and strengthen the utilization of the prediction function of safety climates.

(2) Optimize the laboratory safety access system. At present, universities adopt the form of entrance laboratory safety examination to implement laboratory safety access systems, which not only ignores the differences in necessary safety knowledge and safety skills among students in different laboratories but also ignores the adaptability of students' safety ability under the dynamic changes in the system. Therefore, we should pay attention to students' necessary laboratory safety ability, establish safety access rules, and dynamically master students' safety knowledge and safety skills, thus implementing a dynamic laboratory safety access system.

(3) Comprehensive measures should be taken to ensure the continuous positive impact of safety climates on students' safety behavior and strengthen the external motivations for students' safety behavior. From past practice, it can be seen that the climate of university laboratories is generally the safest after an accident, and then this gradually reduces. Therefore, schools should regularly carry out laboratory safety supervision, inspection, safety education, and self-inspection to ensure that the safety climate has a continuous positive effect on students' safety behavior. In the daily management of university laboratories, external incentive measures should be taken to promote external safety motivation. For example, for undergraduate laboratory courses, laboratory safety behavior performance could be included in the assessment of laboratory safety courses. For laboratories that carry out scientific research, university laboratory management departments could carry out school-wide laboratory safety competitions every month and reward laboratories with a good performance.

5.4. Research Prospect

In this study, we found that safety ability and safety motivation played parallel mediating roles in the process in which the laboratory safety climate affects students' safety behavior. However, there are still many problems to be solved:

(1) The distribution of the safety climate has not been assessed, which is also an important basis for the further analysis of more factors affecting the safety climate of university laboratories.
(2) More mediating variables and moderating variables influencing how the laboratory safety climate affects students' safety behavior need to be discovered and verified, such as tacit safety knowledge. The determination of the antecedent variables of a laboratory safety climate is also an important way to further improve the efficiency of laboratory safety management.
(3) The laboratory safety climate is dynamically changing, and to determine the law of this dynamic change in the safety climate in university laboratories, we need to carry out follow-up diachronic research.

To sum up, the research program could be further optimized in the future, the scope of empirical research on safety climates could be expanded, and the scientific value and effectiveness of laboratory safety climate research could be further improved.

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