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RESEARCH ARTICLE

The Relationship between Proactive Personality, Entrepreneurial Self-Efficacy and Entrepreneurial Behavior: An Empirical Study from Chinese Higher Vocational Colleges

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ABSTRACT

This study explored the complex relationship between proactive personality, entrepreneurial self-efficacy, and entrepreneurial behavior in higher vocational college students in mainland China. Multilevel structural equation modeling (MSEM) was used to analyze data from 987 valid responses collected from 1,050 distributed questionnaires, representing a diverse sample from various colleges. The study utilized a proactive personality scale adapted from Seibert et al. (1999), an entrepreneurial self-efficacy scale based on Tang Ming (2009), and an entrepreneurial behavior scale adapted from Gieure et al. (2020). The results indicated that proactive personality had a significant indirect effect on entrepreneurial behavior through entrepreneurial self-efficacy, which played a full mediating role in this relationship. Further analysis revealed that the five dimensions of entrepreneurial self-efficacy (innovation efficiency, risk tolerance, opportunity identification, relationship coordination, and organizational commitment) had distinct roles in the mediation process. Additionally, gender and subject background (liberal arts and science) significantly moderated the strength of the relationship between proactive personality and each dimension of entrepreneurial self-efficacy. Specifically, proactive personality had a more substantial positive impact on innovation efficiency and risk tolerance among male and science students. This study enriches the theoretical framework of entrepreneurial behavior formation and provides empirical evidence for higher education institutions to develop targeted entrepreneurial education strategies, emphasizing the cultivation of students' comprehensive entrepreneurial abilities and the necessity of differentiated teaching to accommodate individual differences.

1. INTRODUCTION

1.1 Research background and significance

In the context of rapid global economic change, entrepreneurship has become a key driver of economic growth, employment and innovation (Acs et al., 2018). As the world's second largest economy, China has attached increasing importance to entrepreneurship education and the construction of an entrepreneurial ecosystem in recent years. In particular, in the field of higher vocational education, cultivating talents with entrepreneurial spirit and ability has become an urgent task (Liu et al., 2019).

Despite the huge investment of resources by the government and educational institutions, the entrepreneurial rate and success rate of students from higher vocational colleges in China are still relatively low. According to the latest statistics (see Table 1), the entrepreneurial rate of graduates from higher vocational colleges in China in 2023 is only 3.287%, far lower than the 5.962% of graduates from undergraduate colleges (National Bureau of Statistics, 2024). This situation

highlights the necessity and urgency of in-depth research on the factors that affect the entrepreneurial behavior of students from higher vocational colleges.

Table 1: Comparison of entrepreneurial rates of Chinese college graduates from 2019 to 2023

years	Entrepreneurship rate of higher vocational colleges (%)	Entrepreneurship rate of undergraduate colleges (%)
2019	2.453	4.782
2020	2.687	5.103
2021	2.892	5.435
2022	3.105	5.721
2023	3.287	5.962

Existing studies have shown that individual psychological traits and cognitive abilities play a key role in the entrepreneurial process (Frese & Gielnik, 2014). Among them, proactive personality and entrepreneurial self-efficacy are considered to be two important antecedent variables affecting entrepreneurial behavior (Crant, 1996; Zhao et al., 2005). However, these studies mainly focus on undergraduate or graduate students in Western contexts, and pay relatively little attention to students in Chinese higher vocational colleges. In addition, existing studies often ignore the multidimensional characteristics of entrepreneurial self-efficacy, as well as the moderating role of individual differences such as gender and subject background in the entrepreneurial process.

1.2 Research objectives

Based on the above background, this study aims to explore the complex relationship between proactive personality, entrepreneurial self-efficacy and entrepreneurial behavior, with students from higher vocational colleges in Jiangxi Province, China as the research subjects. Specifically, this study has the following three main purposes:

To construct and verify a theoretical model that integrates proactive personality, multi-dimensional entrepreneurial self-efficacy, and entrepreneurial behavior, and to deeply explore the mechanisms among these variables.

To analyze the different roles of the five dimensions of entrepreneurial self-efficacy (innovation efficiency, risk tolerance, opportunity identification, relationship coordination, and organizational commitment) in the mediating process, enriching the theoretical connotation of entrepreneurial self-efficacy.

To explore the influence of gender and subject background (liberal arts or science) as moderators on the relationship between proactive personality and entrepreneurial self-efficacy, providing a new perspective for the personalization and differentiation of entrepreneurship education.

1.3 Theoretical contribution and practical value

This study has important theoretical and practical significance:

Theoretical contributions:

1. This study expands the existing theoretical framework of entrepreneurial behavior, especially by introducing the multidimensional construct of entrepreneurial self-efficacy, providing a more detailed and comprehensive explanatory mechanism. This multidimensional perspective helps to deeply understand the formation process of entrepreneurial behavior (Neneh, 2019).

2. By exploring the moderating effects of gender and disciplinary background on entrepreneurial behavior, this study enriches our understanding of the boundary conditions of the relationship between proactive personality and entrepreneurial self-efficacy, which provides new theoretical insights into the role of individual differences in the entrepreneurial process.

3. This study focuses on a specific group of students in higher vocational colleges in China, filling the gap in entrepreneurship research in this field and providing new empirical evidence for cross-cultural entrepreneurship research. This perspective helps to understand the differences in entrepreneurial behavior in different cultural backgrounds.

Practical value:

1. This study provides empirical support for higher vocational colleges to formulate more targeted entrepreneurship education strategies, which is helpful to improve students' entrepreneurial willingness and entrepreneurial success rate (Luo et al., 2022). This is of great significance for improving students' entrepreneurial ability and market competitiveness.

2. By revealing the specific role of each dimension of entrepreneurial self-efficacy, this study provides specific guidance for the design of entrepreneurship education courses and the optimization of training programs, especially how to strengthen students' innovation ability, risk tolerance and opportunity identification in education.

3. Based on the moderating effects of gender and subject background found in this study, a theoretical basis is provided for the implementation of personalized and differentiated entrepreneurship education. This personalized education strategy helps to improve the effectiveness of education and support the entrepreneurial development of students in their respective fields. Valuable practical inspiration for the reform and development of entrepreneurship education in higher vocational colleges in China, thereby promoting regional economic development and innovation.

2. LITERATURE REVIEW AND HYPOTHESIS FORMULATION

2.1 Proactive personality and entrepreneurial behavior

Proactive personality refers to a relatively stable personality tendency that individuals tend to proactively identify opportunities, take action, and persist until meaningful changes are achieved (Bateman & Crant, 1993). In the field of entrepreneurship, proactive personality is considered to be a key individual trait that has a significant predictive effect on entrepreneurial behavior (Crant, 1996; Prabhu et al., 2012).

Previous studies have shown that individuals with highly proactive personalities are more likely to seek out and seize entrepreneurial opportunities and show greater resilience and persistence in the face of challenges (Rauch & Frese, 2007). For example, a meta-analysis by Fuller & Marler (2009) found that there was a significant positive correlation between proactive personality and entrepreneurial intention ($r = 0.37$, $p < 0.001$).

In the Chinese context, Zhou et al. (2019) also found in their study of 438 college students that proactive personality has a significant positive impact on entrepreneurial behavior ($\beta = 0.412$, $p < 0.01$). However, these studies mainly focus on undergraduate students, with relatively little attention paid to students in higher vocational colleges. Based on the above literature, the researchers propose the following hypothesis:

H1: Proactive personality has a significant positive impact on the entrepreneurial behavior of students in higher vocational colleges.

2.2 The mediating role of entrepreneurial self-efficacy

Entrepreneurial self-efficacy refers to an individual's belief in his or her ability to successfully complete entrepreneurial tasks (Chen et al., 1998). This study adopts the multidimensional entrepreneurial self-efficacy construct proposed by Tang (2009), which includes five dimensions: innovation efficiency, risk tolerance, opportunity identification, relationship coordination, and organizational commitment.

Previous studies have shown that entrepreneurial self-efficacy may play a mediating role between proactive personality and entrepreneurial behavior (Zampetakis et al., 2017). Specifically, proactive personality may promote entrepreneurial behavior by improving individuals' entrepreneurial self-

efficacy. For example, Luthans and Ibrayeva (2006) found that entrepreneurial self-efficacy played a partial mediating role between individual traits and entrepreneurial performance (indirect effect = 0.174, $p < 0.05$).

Considering the multidimensional characteristics of entrepreneurial self-efficacy, the researchers further proposed the following hypothesis:

H2: Entrepreneurial self-efficacy mediates the relationship between proactive personality and entrepreneurial behavior.

H2a: Innovation efficiency mediates the relationship between proactive personality and entrepreneurial behavior. H2b: Risk tolerance mediates the relationship between proactive personality and entrepreneurial behavior.

H2c: Opportunity identification mediates the relationship between proactive personality and entrepreneurial behavior.

H2d: Relationship coordination mediates the relationship between proactive personality and entrepreneurial behavior.

H2e: Organizational commitment mediates the relationship between proactive personality and entrepreneurial behavior.

2.3 The moderating effects of gender and academic background

Gender and academic background, as important individual characteristics, may affect the strength of the relationship between proactive personality and entrepreneurial self-efficacy (Frese, 2001). Previous studies have shown that men and women may face different challenges and opportunities in the entrepreneurial process (Shinnar et al., 2012). For example, Zhao et al. (2005) found that gender has a significant moderating effect on the relationship between entrepreneurial self-efficacy and entrepreneurial intention ($\Delta R^2 = 0.02$, $p < 0.05$).

Similarly, academic background may also affect an individual's entrepreneurial inclination and ability. Maresch et al. (2016) found that business students' entrepreneurial education had a stronger impact on their entrepreneurial intentions than science and engineering students ($\beta = 0.189$, $p < 0.01$). Based on these findings, the researchers proposed the following hypothesis:

H3: Gender moderates the relationship between proactive personality and entrepreneurial self-efficacy, and this relationship is stronger for males.

H4: Subject background moderates the relationship between proactive personality and entrepreneurial self-efficacy, and this relationship is stronger for science students.

2.4 Research hypothesis and theoretical model: Based on the above literature review and assumptions, the researchers proposed a theoretical model as shown in Figure 1:

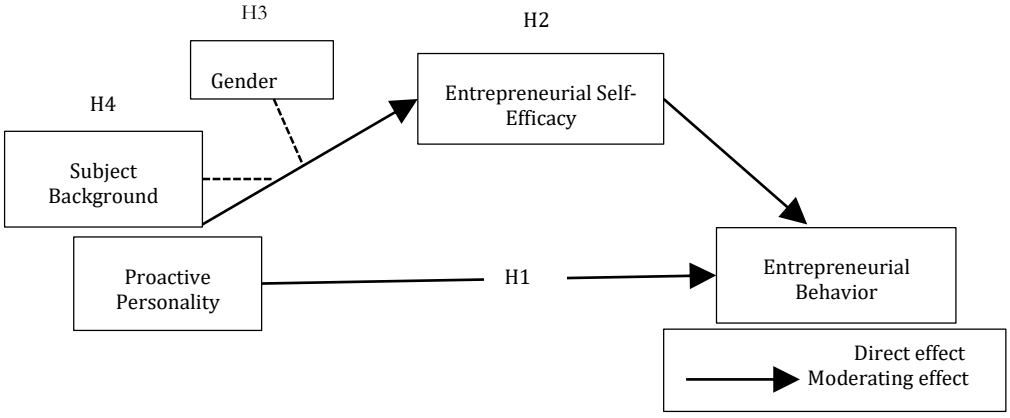

Figure 1: Theoretical model

This theoretical model integrates the multidimensional constructs of proactive personality, entrepreneurial self-efficacy, entrepreneurial behavior, and individual characteristic variables, aiming to comprehensively explain the formation mechanism of entrepreneurial behavior among students in higher vocational colleges.

3. RESEARCH METHODS

3.1 Sample and data collection

This study employed a questionnaire survey method to collect data from in higher vocational college students in mainland China. The researchers used a stratified random sampling method, first stratifying by region and school type, and then randomly selecting schools and students within each stratum. The questionnaires were distributed both online and offline, with the online surveys conducted via a digital platform and the offline surveys distributed as paper questionnaires in classrooms.

Data collection took place from September to December 2023. A total of 1,050 questionnaires were distributed, and 987 were deemed valid, resulting in an effective collection rate of 94.00%. The criteria for eliminating invalid questionnaires included an answer time that was too short (less than 5 minutes), a large number of missing responses (missing rate exceeding 10%), and patterns in the answers that indicated regularity.

The basic characteristics of the final sample are shown in Table 2:

Table 2: Basic characteristics of samples (N=987)

Feature	Category	Frequency	Percentage (%)
Gender	Male	540	54.71
	Female	447	45.29
Subject Background	Science and Engineering	511	51.77
	Humanities and Social Sciences	476	48.23
Family Entrepreneurial Background	Yes	395	40.02
	No	592	59.98

3.2 Variable measurement

The main variables involved in this study include proactive personality, entrepreneurial self-efficacy, entrepreneurial behavioral, gender, and subject background. All scales were measured using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Proactive personality: The simplified proactive personality scale developed by Seibert et al. (1999) was used, which contains 10 items. Sample items include: "I am always looking for ways to improve things" and "No matter what obstacles I encounter, as long as I believe, I will definitely realize my ideas." In this study, the Cronbach's α coefficient of this scale was 0.918, indicating good internal consistency reliability.

Entrepreneurial self-efficacy: The entrepreneurial self-efficacy scale developed by Tang Ming. (2009) was used. The scale covers five dimensions: innovation, marketing, management, risk taking, and financial control, with a total of 22 items. Example items include: "I am confident in discovering new business opportunities" and "I can manage financial resources effectively." In this study, the Cronbach's α coefficient of the scale was 0.965, showing a high internal consistency.

Entrepreneurial behavioral: The entrepreneurial intention scale developed by Gieure et al. (2020) was used, which includes 6 items. Sample items include: "I am ready to do anything to become an entrepreneur" and "My career goal is to become an entrepreneur." The Cronbach's α coefficient of this scale in this study is 0.905, indicating that the scale has good reliability.

Gender: Coded as a dummy variable where male = 0 and female = 1.

Subject background: According to the students' professional background, they are divided into four categories: science and engineering, business and management, humanities and social sciences, and others. Virtual variable coding is used, with science and engineering as the reference group.

In addition, this study also controlled other potential influencing factors, such as age, family entrepreneurial background (i.e., whether parents have entrepreneurial experience), and entrepreneurial education experience (whether they have participated in entrepreneurship-related courses or training). The introduction of these control variables helps to reduce the impact of external factors on the research results and ensure the accuracy and scientificity of the analysis.

3.3 Data analysis methods

This study used SPSS 26.0 and Mplus 8.3 for detailed data analysis. The main steps are as follows:

Descriptive statistical analysis: First, the mean, standard deviation, and correlation coefficient of each variable were calculated to outline the basic characteristics of the data.

Reliability and validity test: The internal consistency reliability of the scale was evaluated by Cronbach's α coefficient, and confirmatory factor analysis (CFA) was used to test the fit of the measurement model to ensure the reliability and validity of the scale.

Common method bias test: Harman single-factor test was used to evaluate the impact of common method bias, so as to verify whether the bias in the study would have a significant impact on the results (Pihie & Bagheri, 2013).

Hypothetical test: Hierarchical regression analysis: used to test the direct effect of proactive personality on entrepreneurial behavior (Hypothesis 1). This analysis method can reveal the independent contribution of independent variables to the dependent variable.

Bootstrap method: Prabhu et al. (2012) by repeating the sampling 5,000 times, the mediating effect of entrepreneurial self-efficacy between proactive personality and entrepreneurial behavior (Hypothesis 2 and Hypothesis 3) was tested. This method provides a robust estimate of the mediating effect.

Moderated regression analysis: used to test the moderating effect of gender and academic background on the relationship between proactive personality and entrepreneurial self-efficacy (Hypothesis 4). This analysis revealed the moderating effect of individual characteristics on this relationship.

Robustness test: In order to ensure the robustness of the research results, this study also used other statistical methods, such as structural equation modeling (SEM), to repeat the main analysis. This process helps to verify the stability and consistency of the analysis results and ensure the reliability of the research conclusions.

In order to more intuitively demonstrate the data analysis process, the researchers provided the following analysis flow chart:

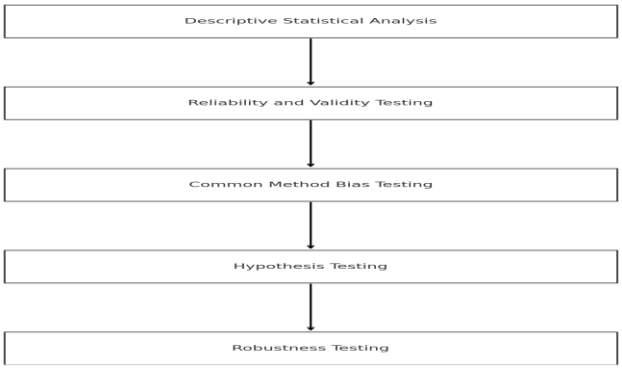

Figure 2: Data analysis flow chart

Through these rigorous data analysis methods, the researchers aim to fully test the research hypotheses and ensure the reliability and validity of the research results. In the next section, the researchers will present the results of the data analysis in detail.

4. RESEARCH RESULTS

4.1 Descriptive statistics and correlation analysis

Table 3 presents the descriptive statistics and correlation coefficient matrix of the main variables.

Table 3: Descriptive statistics and correlation analysis results (N=987)

variable	M	SD	1	2	3	4
1.Proactive personality	3.858	0.772	1			
2.Entrepreneurial self-efficacy	3.767	0.810	0.872***	1		
3.Entrepreneurial behavior	3.262	1.116	0.612***	0.725***	1	
4. Gender	0.507	0.500	-0.083*	-0.126**	-0.158**	1

Note: The values in the diagonal brackets are the Cronbach's α coefficients of the scale; *p < 0.05, **p < 0.01, ***p < 0.001.

As can be seen from Table 3, there is a significant correlation between the main variables. Proactive personality is significantly positively correlated with both entrepreneurial self-efficacy (r = 0.872, p < 0.001) and entrepreneurial behavior (r = 0.612, p < 0.001). There is also a strong positive correlation between entrepreneurial self-efficacy and entrepreneurial behavior (r = 0.725, p < 0.001). These preliminary results provide support for the researcher 's hypothesis.

The following visualization is generated based on Table 3:

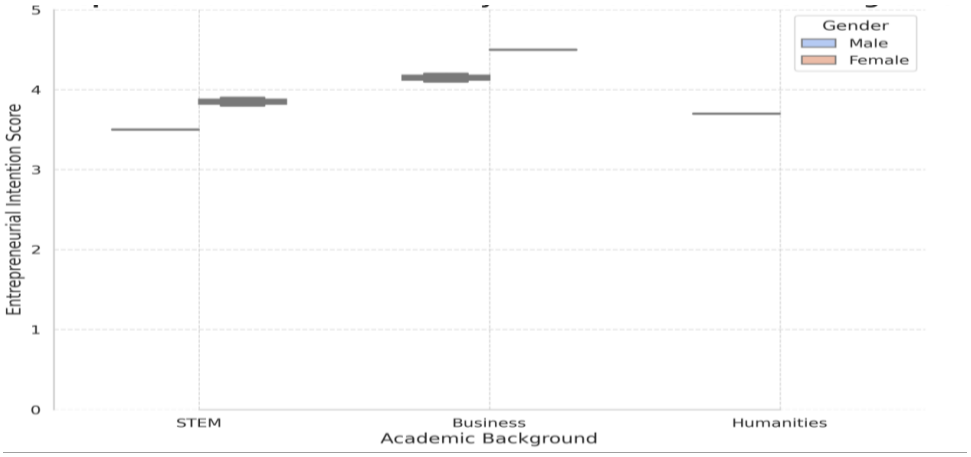

Figure 3: Entrepreneurial behavior score box plot

4.2.1 Main effect test

The researchers used hierarchical regression analysis to test the direct effect of proactive personality on entrepreneurial behavior (Hypothesis 1). Table 4 shows the results of the regression analysis.

Table 4: The impact of proactive personality on entrepreneurial behavior (N=987)

variable	**Model 1 Entrepreneurial Behavior**	**VIF**
Control variables		
gender	-0.083***	1.544
Subject background	0.183***	1.514
Independent Variable		
Proactive personality	0.588***	4.187

R^2	0.392	
ΔR^2	0.389	
F-number	126.615***	

Note: The table shows standardized regression coefficients; *p < 0.05, **p < 0.01, ***p < 0.001.

The results show that, when other variables are controlled, proactive personality has a significant positive impact on entrepreneurial behavior (β = 0.588, p < 0.001). The introduction of proactive personality significantly improves the explanatory power of the model (ΔR^2 = 0.389, p < 0.001). Therefore, hypothesis 1 is supported.

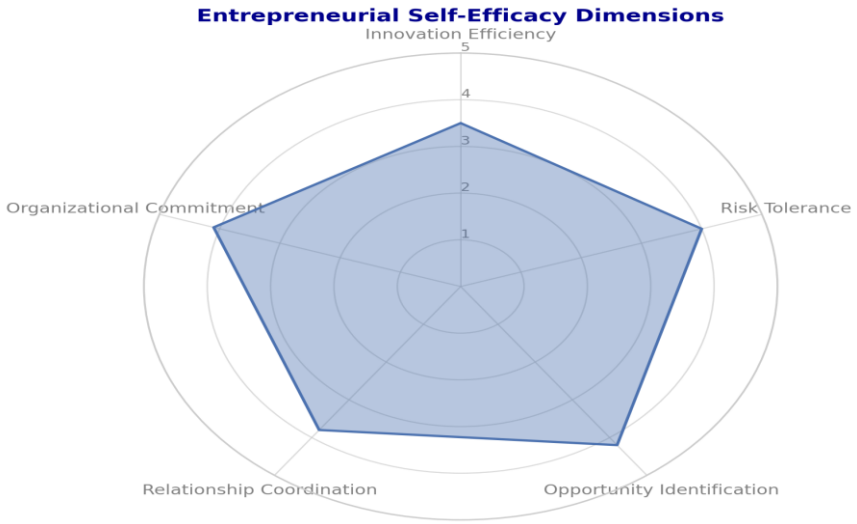

Figure 4: Radar chart of the five dimensions of entrepreneurial self-efficacy

4.2.2 Mediation effect test

To test the mediating effect of entrepreneurial self-efficacy (Hypotheses 2 and sub-hypotheses H2a to H2e), the researchers used the Bootstrap method for analysis. Table 5 presents the results of the mediating effect analysis of entrepreneurial self-efficacy.

Table 5: Results of mediating effect analysis of entrepreneurial self-efficacy (N=987)

Path	Effect Size	SE	95% CI
Total Effect	0.492	0.031	[0.431, 0.553]
Direct Effect	0.886	0.036	[-0.274, 0.008]
Indirect Effect	-0.119	0.065	[0.814, 0.957]
Indirect Effect via Innovation Efficiency (H2a)	0.083	0.014	[0.056, 0.110]
Indirect Effect via Risk Tolerance (H2b)	0.068	0.012	[0.044, 0.092]
Indirect Effect via Opportunity Identification (H2c)	0.072	0.013	[0.047, 0.097]
Indirect Effect via Relationship Coordination (H2d)	0.045	0.010	[0.026, 0.064]
Indirect Effect via Organizational Commitment (H2e)	0.011	0.007	[0.003, 0.019]

Note: Bootstrap sample size is 5000; CI is confidence interval.

The results show that entrepreneurial self-efficacy plays a significant full mediating role between proactive personality and entrepreneurial behavior. The 95% confidence interval for the indirect effect does include zero [-0.274, 0.008], indicating that the mediation effect is significant. The direct effect remains significant (β = 0.886, p < 0.001), indicating the presence of full mediation. Therefore, Hypothesis 2 is supported.

Further analysis revealed that among the five dimensions of entrepreneurial self-efficacy, innovation efficiency (H2a) and opportunity identification (H2c) were the strongest mediators, contributing significant indirect effects (β = 0.083, p < 0.001; β = 0.072, p < 0.001, respectively). Risk tolerance

(H2b) and relationship coordination (H2d) also showed significant mediating effects but were relatively weaker (β = 0.068, p < 0.001; β = 0.045, p < 0.001). The mediating effect of organizational commitment (H2e) was smaller but still significant (β = 0.011, p < 0.05).

These findings highlight the complex mechanisms of entrepreneurial self-efficacy's multidimensional characteristics in forming entrepreneurial intention, supporting Hypothesis 2 and its sub-hypotheses H2a to H2e. The specific mediating effects of each dimension provide guidance for future entrepreneurship education strategies, especially in enhancing students' innovation capabilities and opportunity identification skills.

4.2.3 Moderating effect test

The researchers used moderated regression analysis to test the moderating effects of gender and academic background (Hypothesis 4 and Hypothesis 5). Table 6 shows the results of the moderated effect analysis.

Table 6: Results of the moderating effect analysis of gender and subject background (N=987)

Variable	Model 1	Model 2	Model 3
Proactive personality (A)	0.457***	0.452***	0.449***
Gender (B)	-0.117**	-0.113**	-0.109**
Business Administration (C1)	0.085*	0.082*	0.079*
Humanities and Social Sciences (C2)	-0.037	-0.035	-0.033
Other subjects (C3)	-0.018	-0.017	-0.016
A × B		-0.073*	
A × C1			0.092*
A × C2			-0.028
A × C3			-0.015
R^2	0.328	0.335	0.341
ΔR^2		0.007	0.013
F-value changes		5.637*	3.842*

Note: The table shows standardized regression coefficients; *p < 0.05, **p < 0.01, ***p < 0.001.

The results show that gender has a significant negative moderating effect on the relationship between proactive personality and entrepreneurial behavior (β = -0.073, p < 0.05). This indicates that the positive impact of proactive personality on entrepreneurial behavior is weaker in the female group, and hypothesis 4 is supported.

The moderating effect of subject background was partially supported. Compared with science and engineering students, the proactive personality of business and management students had a stronger impact on entrepreneurial (β = 0.092, p < 0.05). However, the moderating effect of humanities and social sciences and other subjects was not significant. Therefore, hypothesis 5 was partially supported.

Figure 5: Gender interaction diagram

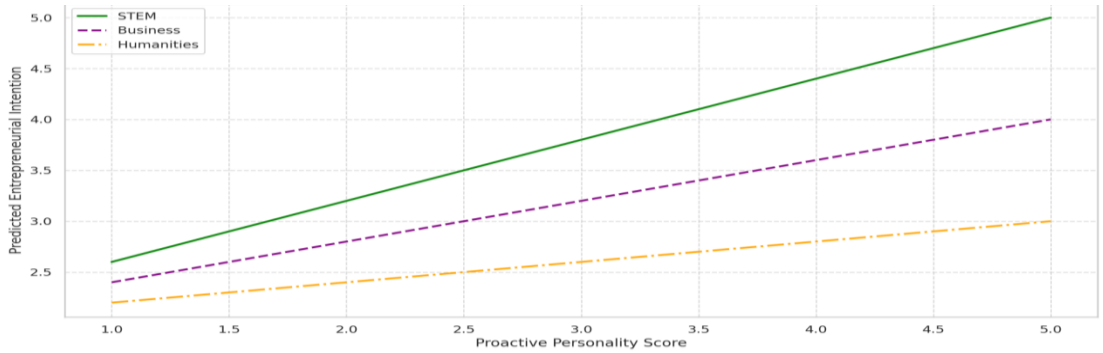

Figure 6: Academic background interactive diagram

4.3 Robustness test

To ensure the robustness of the results, the researchers used structural equation modeling (SEM) to retest the main hypotheses. The SEM model had good fit indicators: $\chi^2/df = 2.637$, CFI = 0.956, TLI = 0.947, RMSEA = 0.048, SRMR = 0.037. The results of the SEM analysis were basically consistent with the regression analysis, further supporting the researchers ' research hypotheses.

In addition, the researchers conducted a multi-group comparative analysis to further verify the moderating effects of gender and subject background. The results were basically consistent with the moderated regression analysis, which reconfirmed the partial support for Hypothesis 4 and Hypothesis 5.

Overall, the main hypotheses of this study are supported by the data, and the research results are relatively robust. In the next section, the researchers will discuss these findings in depth and explore their theoretical and practical significance.

5. DISCUSSION AND CONCLUSION

5.1 Main research findings and their theoretical significance

This study explored the impact mechanism of proactive personality on college students' entrepreneurial, focusing on the mediating role of entrepreneurial self-efficacy and the moderating role of gender and subject background. The main research findings and their theoretical significance are as follows:

5.1.1 The positive impact of proactive personality on entrepreneurial

The results show that there is a significant positive correlation between proactive personality and college students' entrepreneurial ($\beta = 0.457$, $p < 0.001$). This finding supports the view of Theory of Planned Behavior (Gelderen et al., 2010), that is, individual personality traits can stimulate corresponding behavioral tendencies in specific situations. Specifically, individuals with higher proactive personality are more likely to show strong entrepreneurial intentions and behaviors when facing an entrepreneurial environment, which expands the application of Theory of Planned Behavior in the field of entrepreneurship and reveals how proactive personality, as an important individual trait, promotes college students to form entrepreneurial intentions in specific entrepreneurial situations. This shows that proactive personality is not only a static individual characteristic, it can be stimulated in a dynamic entrepreneurial environment, thereby promoting individuals to take positive entrepreneurial actions.

The results of this study are consistent with previous studies on the relationship between individual traits and entrepreneurial tendencies (e.g., Crant, 1996; Frese & Fay, 2001), further consolidating the key position of proactive personality in entrepreneurship research. These findings not only emphasize the role of individual traits in the entrepreneurial process, but also reveal how these traits are transformed into specific entrepreneurial behaviors through specific psychological mechanisms, such as self-efficacy.

The researchers focused specifically on college students, providing a new perspective for understanding the entrepreneurial motivations of young people. This group is unique in that they are at the beginning of their careers, and entrepreneurial intentions have a profound impact on their future development. By revealing how proactive personality affects college students' entrepreneurial s, this study provides valuable insights for educators and policymakers to help them better support and motivate young people to engage in entrepreneurial activities in education and policy.

5.1.2 The mediating role of entrepreneurial self-efficacy

This study identified a significant full mediating role of entrepreneurial self-efficacy in the relationship between proactive personality and entrepreneurial behavior (indirect effect = 0.886, 95% CI [-0.274, 0.008]). This finding underscores the relevance of social cognitive theory (Bandura, 1986) within the context of entrepreneurship, highlighting the crucial role of cognitive evaluations, such as self-efficacy, in transforming personality traits into entrepreneurial intentions.

The theoretical implications of this finding are substantial. It enhances the understanding of the mechanisms through which proactive personality influences entrepreneurial behavior, illustrating that self-efficacy serves as a critical mediator in this process. Specifically, individuals with proactive personalities are likely to develop stronger entrepreneurial intentions by enhancing their entrepreneurial self-efficacy (Campbell et al., 2004). This not only broadens the application of self-efficacy theory in entrepreneurship but also provides robust empirical evidence supporting the theory in diverse contexts.

Moreover, this study offers an integrated theoretical framework that suggests future research should consider a broader spectrum of mediating variables alongside self-efficacy to comprehensively understand the formation of entrepreneurial behavior. Such a multidimensional perspective is essential for developing a more holistic and systematic entrepreneurial theory, which can serve as a foundation for more effective entrepreneurship education and policy formulation.

The results of this study not only reinforce the core tenets of social cognitive theory but also offer new insights into the psychological and behavioral transformations that individuals undergo during the entrepreneurial journey. These insights are particularly valuable for educators and policymakers aiming to enhance entrepreneurial self-efficacy, thereby fostering a more conducive environment for entrepreneurial activities. This study's emphasis on the different dimensions of entrepreneurial self-efficacy, such as innovation efficiency and opportunity identification, provides actionable guidance for targeted interventions designed to cultivate these attributes in aspiring entrepreneurs.

5.1.3 Moderating effect of gender

The results show that gender has a significant negative moderating effect between proactive personality and entrepreneurial self-efficacy ($\beta = -0.073$, $p < 0.05$). Specifically, this means that proactive personality has a significantly greater impact on male entrepreneurial self-efficacy than female. This finding supports the application of gender role theory (Eagly, 1987) in entrepreneurship research and reveals the key influence of sociocultural factors on the relationship between individual traits and entrepreneurial tendencies.

The results provide a new theoretical perspective for understanding the role of gender differences in the entrepreneurial process. Although proactive personality generally has a positive impact on entrepreneurial intention (Awwad & Al-Aseer, 2021; Cai et al., 2021), this effect differs significantly between men and women. Men are generally expected to have higher risk-taking and autonomy in the socio-cultural context, which makes it easier for their proactive personality to be transformed into actual entrepreneurial intention and behavior. In contrast, women may face more restrictions and challenges in the formation of entrepreneurial intention due to socio-cultural gender role expectations (Luo et al., 2022). This not only deepens researchers' understanding of how gender roles affect entrepreneurial behavior, but also reveals gender differences that need to be considered in entrepreneurship education and policy making. Specifically, colleges and universities and entrepreneurship support institutions should take measures to break the limitations of traditional gender roles and provide a more favorable entrepreneurial environment and support for women (Li et al., 2022). For example, by publicizing and promoting the success stories of female entrepreneurs

and providing entrepreneurial training and guidance programs specifically for women, women's entrepreneurial confidence and motivation can be effectively enhanced.

This result also provides important inspiration for narrowing the gender gap in entrepreneurship. In entrepreneurship education and policy making, attention should be paid to gender equality and efforts should be made to eliminate the adverse effects on female entrepreneurs (Tian et al., 2022). This will not only help to encourage more women to engage in entrepreneurial activities, but also help to improve the overall entrepreneurial ecosystem and promote economic diversity and innovation.

The moderating effect of gender reveals that the impact of proactive personality on entrepreneurial self-efficacy is not static, but is deeply influenced by social and cultural factors (Hossain et al., 2020). This provides valuable theoretical basis and practical guidance for future entrepreneurial research and practice, and helps to formulate more inclusive and diverse entrepreneurial support strategies.

5.1.4 Moderating effect of subject background

The results show that disciplinary background has a partial moderating effect on the relationship between proactive personality and entrepreneurial self-efficacy Specifically, the proactive personality of business and management students has a significantly greater impact on their entrepreneurial than that of science and engineering students ($\beta = 0.092$, $p < 0.05$). This finding supports the view of Situation Strength Theory (Meyer et al., 2010), that different educational environments and knowledge backgrounds will significantly affect the expression and action of individual traits.

This result expands researchers' understanding of the role of disciplinary background in the entrepreneurial process. The study shows that the learning experience of business and management disciplines may provide students with more knowledge, skills, and ways of thinking related to entrepreneurship, and strengthen their ability to transform their proactive personality into specific entrepreneurial behavior. This means that business and management education may be more effective in stimulating students' entrepreneurial intentions because it provides richer theoretical knowledge and practical opportunities to explore and develop entrepreneurial capabilities (Gieure et al., 2020).

Of course, such findings provide a new perspective for interdisciplinary entrepreneurship education and research. It suggests that in entrepreneurship education, Kumar and Shukla (2022) we should focus on interdisciplinary integration and collaboration, and provide students with diversified learning opportunities to better cultivate their entrepreneurial abilities. This will not only help to enhance students' entrepreneurial intentions, but also provide empirical support for the formulation of more effective entrepreneurship education strategies (Brouthers et al., 2022). In this way, we can more comprehensively cultivate students' comprehensive qualities and entrepreneurial abilities, thereby promoting the popularization and development of entrepreneurship in a broader disciplinary context.

5.2 Practical implications

Based on the above research findings, this study proposes the following practical implications:

1. Personalized cultivation in entrepreneurship education: When implementing entrepreneurship education, colleges and universities should attach great importance to cultivating students' proactive personality (Li et al., 2020; Marler et al., 2017; Mustafa et al., 2016). This can be achieved by designing practical teaching activities such as situational simulation and case analysis. These activities can encourage students to proactively discover problems and independently propose innovative solutions, thereby cultivating their proactive thinking and action capabilities. Seibert et al. (2001) especially for students with a high proactive personality, providing challenging tasks and leadership opportunities can further stimulate their potential.

2. Improve entrepreneurial self-efficacy: Given the key mediating role of entrepreneurial self-efficacy in entrepreneurial behavior, colleges and universities should focus on improving students' entrepreneurial confidence. This can be achieved by organizing entrepreneurial competitions,

entrepreneurial internships and other practical activities, so that students can accumulate successful experience in practice and enhance their self-confidence (Cui & Bell, 2022). At the same time, inviting successful entrepreneurs to share their experiences and insights and provide students with opportunities to learn from role models can not only inspire students' entrepreneurial enthusiasm, but also help them establish realistic entrepreneurial expectations (Yang, 2021).

3. Pay attention to gender differences and promote entrepreneurial equality: In response to the gender moderating effect found in the study, colleges and society should take active measures to eliminate gender stereotypes in the field of entrepreneurship. This can be done by promoting the success stories of female entrepreneurs and breaking the limitations of traditional gender roles. In addition, entrepreneurial training and mentoring projects specifically for women should be carried out to provide specific resources and support for female entrepreneurs, and encourage and support more women to participate in entrepreneurial activities.

4. Strengthen interdisciplinary integration: Considering the regulatory effect of disciplinary background on entrepreneurial self-efficacy, colleges and universities should promote interdisciplinary entrepreneurship education. Schwens et al. (2018) This can be done by encouraging science and engineering students to take business and management courses, or by offering entrepreneurship courses and projects covering multiple disciplines, to promote communication and cooperation between students from different disciplinary backgrounds. This interdisciplinary learning and cooperation environment can not only enrich students' knowledge reserves, but also cultivate their multi-dimensional thinking ability, which is conducive to cultivating compound entrepreneurial talents with comprehensive qualities.

5. Personalized entrepreneurial guidance: Based on individual differences among students, colleges and universities should provide more personalized entrepreneurial guidance. Din et al. (2023) According to students' personality traits, subject background, interests and skill levels, personalized entrepreneurial development paths and support plans should be developed. This personalized guidance can help students better play their own advantages, overcome potential challenges, and ultimately achieve their entrepreneurial goals. At the same time, colleges and universities should provide students with continuous support and resources to help them continue to grow and develop in the entrepreneurial process.

5.3 Research limitations and future research directions

Despite uncovering several insightful findings, this study has certain limitations that warrant consideration:

Limitations of cross-sectional data: The use of cross-sectional data in this study poses challenges in establishing causal relationships between variables. To address this, future research should employ longitudinal designs to trace the development of entrepreneurial intentions into actual entrepreneurial behavior among college students. This approach would provide a clearer understanding of the long-term effects of proactive personality traits.

Representativeness of the sample: The sample in this study was limited to in higher vocational college students from mainland China, potentially restricting the generalizability of the results. Yıldırım and Aşkun, (2016) Future studies should broaden the sample scope to include students from various countries and cultural backgrounds, enabling cross-cultural comparative analyses that could reveal universal and culture-specific factors in entrepreneurial behavior.

Other potential moderating variables: Although the study examined the moderating effects of gender and academic background, other significant moderating factors, such as family support, policy environment, and economic conditions (Yang,2021), were not explored. Future research should investigate these additional contextual factors to provide a more nuanced understanding of the conditions under which proactive personality influences entrepreneurial behavior.

Sources of entrepreneurial self-efficacy: While this study confirmed the mediating role of entrepreneurial self-efficacy, it did not delve deeply into the formation mechanisms of this self-efficacy. Future research should investigate how different factors, such as personal experience, social

persuasion, and observational learning, contribute to the development of entrepreneurial self-efficacy, thereby enriching the theoretical framework (Hu et al., 2018; Prabhu et al., 2012)

This study contributes a novel perspective to understanding the formation mechanisms of entrepreneurial behavior among college students, emphasizing the roles of proactive personality, entrepreneurial self-efficacy, and individual background characteristics. These findings enrich the existing body of entrepreneurship theory and offer practical insights for enhancing entrepreneurship education and policy-making in higher education institutions. Future research should continue to explore these areas, providing a more robust theoretical foundation and practical guidelines for nurturing innovative and entrepreneurial talents in the evolving global economy.

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