

Study on the Factors Influencing College Students' Academic Achievement: The Method of Computer Data Modeling

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Abstract

As the cradle of talent training, higher education reflects the core indicators of its teaching quality as students' academic achievements. However, the research on the factors influencing the academic achievement of college students is very limited. To elucidate the impact of achievement goal orientation (AGO) on academic achievement (AA), this study developed a regulatory mediation model through computer-based data analysis. The model emphasized the intermediary role of college students' learning engagement (LE) and examines the mediating effect of psychological capital (PC) in this relationship. The results showed that, achievement goal orientation could significantly predict academic achievement; the learning engagement mediated the effect of achievement goal orientation on academic achievement; Psychological capital moderated the direct predictive effect of achievement goal orientation on academic achievement moderated by psychological capital; Psychological capital moderates the effect of achievement goal orientation on learning engagement. And the moderated intermediary model has certain enlightenment on how colleges and universities can promote college students to achieve academic achievement through education management.

Keywords: Academic achievement, achievement goal orientation, psychological capital, learning engagement, computer data modeling.

1. Introduction

In the era of knowledge economy, talents are the most important competitiveness of a country in the 21st century. As the cradle of talent training, higher education reflects the core indicators of its teaching quality as students' AA. At the same time, in the key link of students' employment, employers also regard students' AA as one of the recruitment criteria. Therefore, Enhancing students' AA is of paramount importance. In previous studies, there were many factors that affected student achievement. Komarraju & Nadler and others analyzed that motivational orientation and cognitive strategies had obvious effects on undergraduate AA^[1]. college students' AGO of was one of the frontier topics in achievement motivation research. Previous studies have shown that AGO would affect AA. Research by Hall et al. demonstrated that both achievement-approaching goal orientation and mastery goal orientation had a significantly positive effect on students' academic performance in English^[2]. According to achievement motivation theory, learning goals can indirectly influence academic performance through self-monitoring. AGO has a dual effect on academic success: both mastery goals and performance-approach goals can predict college students' autonomous learning^[3].

Although previous studies have found that AGO helped individuals achieve good AA^[4]. Research findings on the relationship between grade goal orientation and AA have been inconsistent.^[4,5]. Different AGOs can predict different academic outcomes, and some researchers believed that it may be related to LE caused by different goal

orientations^[6,7]; some researchers believed that PC factors had a positive significant impact on AA^[8]; Past research has found that achievement goal motivation, LE, and PC all had a certain impact on college students' AA, but how does achievement goal affect AA? Further researches are required. Therefore, this study combined all the above four variables to further explore the predictive role of AGO on AA Method of modeling by computer SPSS software^[9].

Computational social science is a more modern discipline, which regards the social system as the organization of information processing, and carries out a comprehensive and interdisciplinary research on the social system through advanced computational methods. In this study, computers were used for statistical data analysis, mainly using the PROCESS program in SPSS for data modeling, including the mediation model tested with Model 4 and the moderated mediation model tested with Model 8 for validation^[9]. In this regard, EXCEL2010 was used to input and process the questionnaire data, SPSS23.0 was used to conduct descriptive analysis, correlation analysis and linear regression analysis. And PROCESS was used to verify the mediation model to examine the relationship between AGO, LE and AA^[9], the inspection level $\alpha=0.05$.

2. Theoretical Framework and Hypothesis

2.1 The relationship between achievement goal orientation and academic achievement

Jaspers proposed that the goal of the university was to shape a well-rounded person^[10]. Brittingham believed that the AA of students can be judged through the evaluation dimensions of input, process and output to determine how college students learn, their learning outcomes and the performance of employment market^[11]. Chinese higher education evaluation of students' AA usually included academic performance and non-academic factors. Hou believed that college students' AA reflected a comprehensive quality and skills^[12]. Based on the viewpoints of relevant scholars at home and abroad, This study defined AA as the cumulative measure of college students' learning outcomes, learning behaviors, and learning attitudes over a specified period.^[13]

Achievement goal orientation theory was a learning motivation theory developed on the basis of achievement motivation theory. Atkinson believed that an individual's achievement motivation consists of two stable tendencies to pursue success and avoid failure^[14]. Dweck & Leggett defined achievement goals as a plan of an individual's cognitive process, emphasizing the impact of achievement goals on the emotional, behavioral, and cognitive outcomes of individual achievement behaviors^[15]. This study adopted the definition given by Elliott, and^[16]. Throughout previous studies, different goal orientations can affect students' cognition, behavioral responses and educational performance^[17-19]. A survey of 473 college students revealed that PC significantly influences their AGO. Furthermore, PC also significantly affects AA, with AGO serving as a partial mediator in this relationship. Guo & Shen found that academic emotion would affect AA through cognitive mediating variables such as achievement motivation^[20]. Fang employed a questionnaire-based method to investigate 475 seventh and eighth grade students, aiming to evaluate the impact of parenting style on children's AA by analyzing the roles of AGO and academic self-concept.^[21] Based of previous studies, this paper proposes hypotheses.

Hypothesis 1: Achievement goal orientation has a significant effect on AA.

2.2 The relationship between achievement goal orientation, academic achievement and learning engagement

Academic engagement referred to a positive state that students showed in school life. It referred to the intensity of students' input and the quality of emotional involvement when they started and performed learning activities. It included three dimensions: cognitive input, emotional input and behavioral input. Students with high LE were more energetic and more engaged in learning activities and were able to overcome difficulties, but also showed strong motivation to learn. Relevant research results showed that students' self-determination motivation had a significant positive correlation with their academic commitment, and students' self-determination motivation can positively predict their academic commitment^[22,23]. Therefore, this study suggests that students' self-determination motivation may be an important factor in promoting their academic engagement. Zhou & Mao found through a sample survey of 895 college students' questionnaires in four provinces in central China that AGO significantly predicted LE and was moderated by PC^[24]. Studies have shown that LE can positively predict the AA of

adolescents^[25,26], conducted a longitudinal study involving 756 middle school students and discovered that LE is positively associated with AA. Wang & Zhang took 2458 students as research objects and found that LE had a mediation effect of perceived teachers' feedback on college students' AA^[27]. Since conscience is also one of the intrinsic motivations, we put forward the hypothesis:

Hypothesis 2 Achievement goal orientation has a significant effect on learning engagement.

Hypothesis 3 Learning engagement mediates the relationship between achievement goal orientation and academic achievement.

2.3 The moderating effect of psychological capital

The core tenet of resource conservation theory is that individuals with greater resources are less susceptible to resource loss and more adept at acquiring additional resources.^[28] PC was a personality trait resource and an important factor that determines an individual's internal stress resistance. According to the theory of resource conservation, PC, as an intrinsic positive resource of an individual, can provide resources to replenish energy in the process of energy consumption and stimulate intrinsic motivation. Empirical researches have also indicated that psychological capital moderates the relationship between individual AGO and LE^[29]. College students exhibiting high levels of psychological capital—such as elevated self-efficacy, strong resilience, an optimistic outlook, and a high sense of academic responsibility—were more likely to demonstrate elevated goal orientation. Based on this, it can be inferred that when college students have a high level of PC, sufficient energy was more helpful to support them to devote themselves to learning for goal persistence, and can also provide psychological support for goal achievement. Therefore we hypothesize:

Hypothesis 4 Psychological capital moderates the relationship between learning engagement and academic achievement

Hypothesis 5 Psychological capital moderates the relationship between achievement goal orientation and academic achievement

In summary, Figure 1 below illustrates the research model employed in this study.

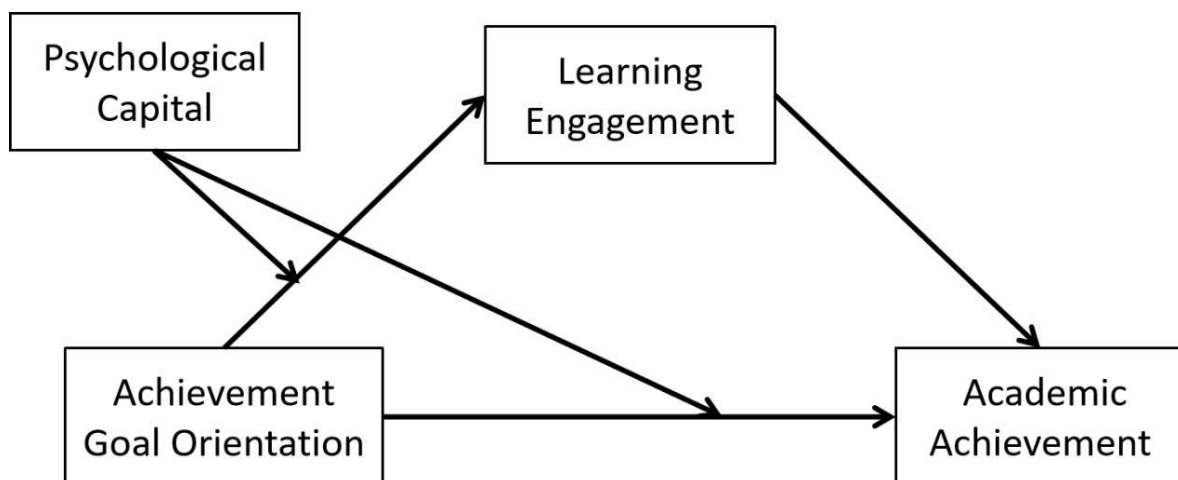


Figure 1 Hypothetical model diagram of the mediation effect of learning engagement and the moderating effect of psychological capital

3. Methods

3.1 Subjects

In this study, from January 2021 to March 2021, a stratified random sampling method was adopted to select samples from 3 colleges and universities. Trained researchers administered the web-based questionnaire (www.wjx.cn) during university classes, informing participants on-site that their participation was voluntary and anonymous, and that the data collected would be safeguarded in accordance with the Declaration of Helsinki

guidelines^[30]. This study was reviewed and approved by the Human Research Ethics Committee of Zhejiang Yuexiu University. Stratified random sampling was employed to select students from a Vocational and Technical College, a General College, and a Double First-Class University. Of the 700 distributed questionnaires, 607 were completed validly, resulting in an effective response rate of 86.7%. Among them, there were 192 boys and 415 girls. There were 217 freshmen, 96 sophomores, 161 juniors and 26 seniors, and 107 in the postgraduate degree or above; 99 students majored in science, industry, agriculture and medicine and so on; 250 students majored in humanities and social science; 139 students majored in sports and art, and 119 students majored in other fields. There were 184 only children and 423 non-only children. 460 of them had experience as student leaders, 147 of them did not. 226 people lived in cities, 188 in towns and 193 in rural areas.

3.2 Research tools

3.2.1 Achievement goal orientation (AGO)

In the definition of AGO content, we mainly drew on the views of Elliot & Chureh^[31]. Wang Yanfei and colleagues adapted the AGO scale to better reflect the specific context of Chinese college students^[12]. The scale had a total of 13 items. The Cronbach's alpha for the scale was 0.873, demonstrating that the questionnaire exhibited strong reliability and validity. Three-factor structural model of AGO was well fitted (GFI=0.905, NFI=0.914, RFI=0.891; IFI=0.926; TLI=0.906; CFI=0.926; PNFI=0.726; PCFI=0.736).

3.2.2 Academic achievement (AA)

The main task of college students is to study, so this study uses AA as a measure of college students' learning effect. This study defines college students' AA as the aggregate of their learning outcomes, behaviors, and attitudes over a specified period, including two parts: behavioral performance and objective performance. The behavioral performance of college students was adapted and revised from the performance scale developed by Wang et al.^[13], encompassing three dimensions: learning performance, interpersonal development, and learning commitment. Objective scores are derived from rankings in intellectual education, moral education, style, and overall performance. The scale's Cronbach's alpha is 0.942, demonstrating high reliability and validity. The four-factor structural model of AA showed a good fit, with the following indices: NFI = 0.912, RFI = 0.886, IFI = 0.928, TLI = 0.906, CFI = 0.928, PNFI = 0.701, and PCFI = 0.713.

3.2.3 Learning engagement (LE)

The scale of LE, scaled by Schaufeli et al.^[32] and revised by Li & Huang^[33] was suitable for Chinese college students. The scale comprised 17 items, categorized into three dimensions: motivation, energy, and concentration. Responses were rated on a 7-point scale ranging from "never" to "always," with higher scores indicating greater levels of LE. The internal consistency coefficient for this scale in the current study was 0.957. Confirmatory factor analysis revealed that the three-factor structural model for LE fit the data well, with the following indices: GFI = 0.84, NFI = 0.893, RFI = 0.875, IFI = 0.906, TLI = 0.89, and CFI = 0.906.

3.2.4 Psychological capital (PC)

In this study, psychological capital (PC) was identified as the most crucial influencing variable, based primarily on Luthans' research^[34]. The PC scale revised by Wang et al.^[13] encompasses four dimensions: self-confidence, resilience, optimism, and responsibility, with a total of 15 items. The Cronbach's alpha for this scale was 0.925, indicating high reliability and validity. Confirmatory factor analysis demonstrated a good fit for the four-factor structural model of PC, with the following indices: GFI = 0.918, NFI = 0.940, RFI = 0.924, IFI = 0.952, TLI = 0.940, CFI = 0.952, and RMSEA = 0.076.

3.2.5 Common method bias test

Exploratory Factor Analysis was performed using Harman's one-factor test. The results indicate that the eigenvalues for the 10 factors obtained from both unrotated and rotated solutions exceed 1. The variance explained by the first factor in the unrotated solution is 32.528%, while in the rotated solution it is 16.888%. Both values are below the 40% threshold. The results of the above tests show that there is no obvious common method bias in this study.

4. Results

4.1 General characteristics of academic achievement

From the independent sample T-test results of student gender, only child, student cadre experience and AA, it can be seen whether the only child or not has no significant difference in the performance of student achievement; There was a significant difference in AA between students with or without student cadre experience ($t=4.196$; $P=0.000$), and the AA of students who had been cadres were significantly higher than those who had not been cadres; The one-way ANOVA of location and parental education level showed that there was no significant difference in the AA of students between family residence, different majors, grades, and parental education level.

4.2 Correlation analysis results of each variable

It can be seen from Table 1 that achievement goals are significantly positively correlated with AA and learning commitment ($r=0.591$, $P<0.001$; $r=0.249$, $P<0.001$), and the correlation coefficient between AA and learning commitment is 0.467 ($P<0.001$), laying a foundation for further prediction of the mediation effect test. PC was significantly correlated with achievement goals, AA and LE ($r=0.622$, $P<0.001$; $r=0.652$, $P<0.001$; $r=0.343$, $P<0.001$), which provided a possibility for the moderation effect test.

Table 1 Descriptive statistics and correlation analysis results (N=607)

	M	SD	1	2	3	4
PC	3.745	0.59	1			
AGO	3.681	0.572	0.622***	1		
AA	3.811	0.511	0.652***	0.591***	1	
LE	4.548	0.883	0.343***	0.249***	0.467***	1

***Indicates a significant correlation at the.001 level (two-sided)

4.3 The Mediating Effect of Learning Engagement and the Moderating Effect of Psychological Capital

Table 2 Mediation model test of learning engagement

Regression Equation (N=607)		Fit Metrics			Coefficient Significance	
Outcome Variable	Predictor Variable	R	R ²	F(df)	B	t
AA		0.595	0.352	165.530*** (2)		
	SL				0.079	1.990*
	AGO				0.518	17.453***
LE		0.252	0.063	20.429*** (2)		
	SL				0.824	0.991
	AGO				0.373	6.042***
AA		0.679	0.461	172.122*** (3)		
	SL				0.063	1.734
	AGO				0.445	15.928***
	LE				0.196	10.957***

***Indicates a significant correlation at the.001 level (two-sided). SL means serving as a student leader.

The direct effect (0.445) and the mediation effect (0.073) accounted for 85.91% and 14.09% of the total effect (0.518), respectively. First, Model 4 (simple mediation model) from the SPSS macro developed by Hayes (2012)^[9] was employed to examine the mediation effect between AGO and AA, while controlling for the role of serving as a student leader. The results, presented in Table 2, reveal that AGO significantly predicts AA ($B = 0.518$, $t = 17.453$, $p < 0.001$). When including the mediator variable, the direct effect of AGO on AA remains significant ($B = 0.445$, $t = 15.928$, $p < 0.001$). AGO also has a significant positive effect on learning engagement (LE) ($B = 0.373$, $t = 6.042$, $p < 0.001$), and LE significantly predicts AA ($B = 0.196$, $t = 10.957$, $p < 0.001$). Furthermore,

the 95% bootstrap confidence intervals for both the direct effect of AGO on AA and the indirect effect through LE do not include 0 (see Table 3), indicating that AGO not only directly predicts AA but also influences AA through LE. The direct effect (0.445) and the indirect mediation effect (0.073) account for 85.91% and 14.09% of the total effect (0.518), respectively.

Table 3 Decomposition table of total effect, direct effect and mediation effect

	Effect size	Boot SE	Boot CI	Relative effect size
Total Effect	0.518	0.03	0.459, 0.576	
Direct Effect	0.445	0.028	0.39, 0.499	85.90%
Indirect Effect	0.073	0.022	0.034, 0.121	14.09%

***Indicates a significant correlation at the.001 level (two-sided)

Secondly, using Model 8 in the SPSS macro compiled by Hayes (2012)^[9] (Model8 assumes that the first half of the mediation model and the direct path are regulated, which is consistent with the theoretical model of this study), the regulated mediation is controlled under the condition of whether the student is a cadre or not. Model is tested. The results (see Tables 4 and 5) show that after the PC is put into the model, the interactive items of AGO and PC has a significant predictive effect on AA and LE (AA: B=0.108, t=4.171, p <0.001; LE: B=0.619, t=12.300, p<0.001), indicating that PC can not only play a moderation role in the direct prediction of AA by AGO, but also moderate the prediction of LE by AGO effect.

Table 4 Moderated mediation model test

Regression Equation (N=607)		Fit Metrics			Coefficient Significance	
Outcome Variable	Predictor Variable	R	R ²	F(df)	B	t
LE		0.545	0.297	63.434*** (4)		
	SL				0.049	0.673
	AGO				0.152	2.239***
	PC				0.604	9.014***
	AGO*PC				0.619	12.300***
AA		0.746	0.556	150.513*** (5)		
	SL				-0.221	-0.666
	AGO				0.27	8.652***
	LE				0.117	6.265***
	PC				0.371	11.294***
	AGO*PC				0.108	4.171***

***Indicates a significant correlation at the.001 level (two-sided); SL means serving as a student leader.

Table 5 Direct and mediation effects at different levels of psychological capital

	PC	Effect size	Boot SE	Boot CI
Direct effect	3.155(M-1SD)	0.207	0.033	0.141,0.272
	3.745(M)	0.27	0.031	0.209,0.332
	4.335(M+1SD)	0.334	0.036	0.263,0.405
Indirect effect	3.155(M-1SD)	-0.025	0.011	-0.047,-0.004
	3.745(M)	0.018	0.01	0.000,0.039
	4.335(M+1SD)	0.061	0.016	0.03,0.095

***Indicates a significant correlation at the.001 level (two-sided)

Further simple slope analysis, illustrated in Figures 2 and 3, indicates the following: As shown in Figure 2, among students with low levels of psychological capital (M - 1SD), those with high AGO exhibit greater LE compared to their peers with low AGO. A larger downward trend; for subjects with a higher level of PC (M+1SD), the high-achieving goal-oriented students showed a larger upward trend in LE than the low-achieving goal-oriented students.

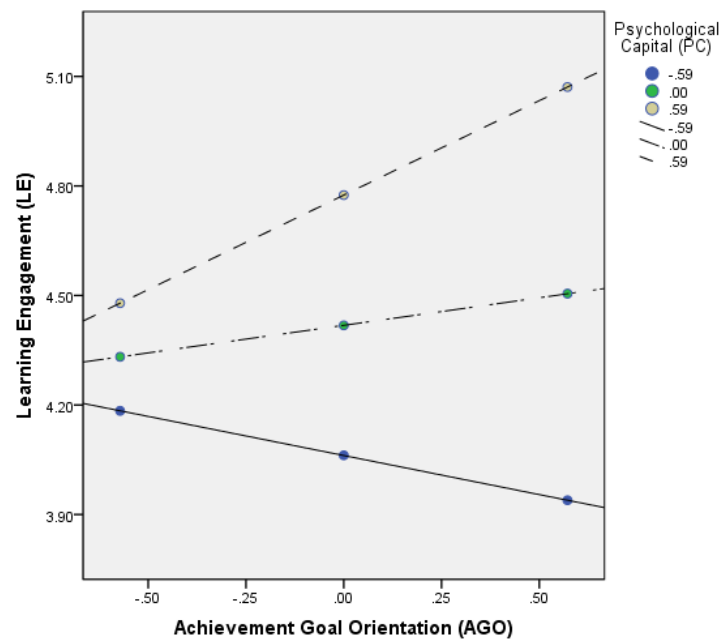


Figure 2 The moderation role of psychological capital in the relationship between achievement goal orientation and learning engagement

Figure 3 illustrates that for subjects with high levels of PC ($M + 1SD$), AGO has a significant positive effect on AA. Conversely, for subjects with low levels of PC ($M - 1SD$), while AGO still positively predicts AA, the effect is comparatively smaller. This suggests that as PC levels increase, the predictive strength of AGO on AA shows a gradual enhancement (see Table 5).

It can be seen from Table 5 that at the three levels of PC, the mediation effect of LE in the relationship between AGO and AA also showed an increasing trend, that is, with the improvement of the PC level of the subjects, the AGO was easier. Improve students' AA by increasing their LE.

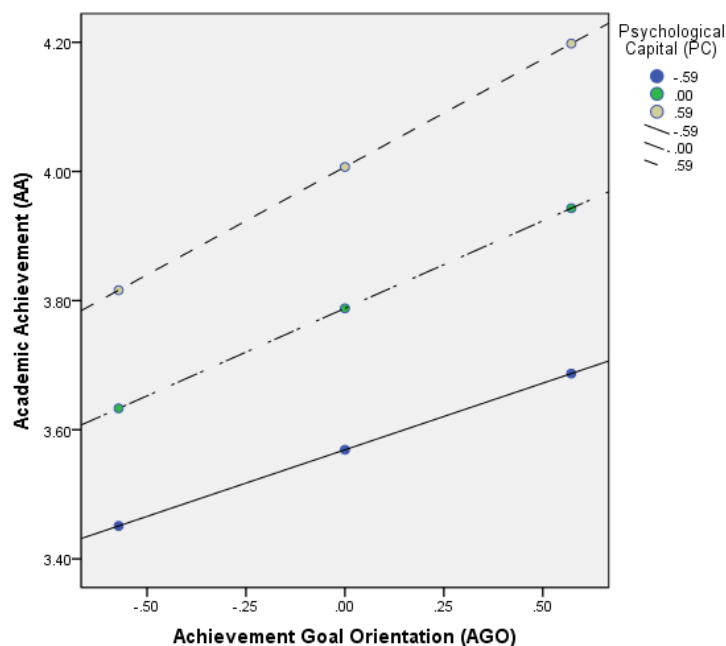


Figure 3 The moderation role of psychological capital in the relationship between achievement goal orientation and academic achievement

5. Discussion

Based on self-motivation theory and goal theory, from the perspective of individual-environment interaction theory, this study constructs a moderated mediation model with PC as the moderating variable and LE as the mediating variable. It also responded to the question under what conditions AGO has a more significant effect on AA (the moderation effect of PC). It is of certain theoretical and practical significance to guide college students to obtain higher AA and to serve higher education management.

5.1 Achievement goal orientation and academic achievement

This study identified a significant positive correlation between achievement goal orientation and both academic achievement and learning engagement. Additionally, a significant positive correlation was found between LE and AA. That is, the increase in AGO may improve AA, and it may also indirectly improve AA by increasing LE. This is consistent with the results of Zhou & Mao's study on English majors^[24], and this is consistent with the findings of Blackwell et al., showing that students who had mastered the method goals tended to show self-regulated learning, which is conducive to improved AA^[35]. On the one hand, McClelland's theory of achievement motivation pointed out that individuals had an inherent desire and tendency to do their best work, which motivated individuals to pursue higher goals, complete difficult tasks, and compete and outperform others^[36]. Students with high achievement goals, the more active their learning performance, the higher their AA^[37].

On the other hand, higher achievement goals would bring corresponding pressure, and if the individual PC was poor, it may also reduced AA. Based on the research findings, it is evident that the impact of AGO may be multifaceted. If one have high achievement goals and have high PC, AA may be greatly improved.

5.2 The mediation role of learning engagement

LE is an active learning behavior practice. Exploring the mediation role of LE in the relationship between AGO and AA, not only helps to reveal the positive impact of AGO on AA from the perspective of social cognition, but also helps us reveal Internal mechanisms of AA. This study found that AGO can predict the AA of college students through the mediation effect of LE. This result supported the view of previous studies, that was, LE played an important role in promoting AA^[38]. The mediation role of LE can be explained based on two theoretical viewpoints, namely, the theory of planned behavior and the theory of achievement motivation. First, according to the theory of planned behavior, human behavior was the result of a well-thought-out plan, and the plan affected the result of behavior. AGO can be seen as part of planning, and LE can be seen as the practice of behavior. AA was the result of behavior. Secondly, achievement motivation theory held that some personal and environmental factors can affect individual AGO, and these goals in turn affect various performance or achievement outcomes, which can also explain the research results. The independent variable AGO significantly predicted AA, and LE was a mediator role.

5.3 The moderating effect of psychological capital

This study found that a moderated mediation model was constructed based on achievement motivation theory to investigate the moderation role of PC in the relationship between AGO, LE and AA. The results indicate that PC not only moderates the relationship between AGO and AA but also influences the mediating chain of "AGO → LE → AA." Specifically, compared with college students with low PC, the direct prediction effect of high AGO on AA was more significant for college students with low PC. This result not only showed that there were individual differences in the cognitive mechanism of AA (the mediation effect of LE), but also indicated that PC was a positive factor for other factors to lead to individual AA, which was consistent with previous research results. First, high-achieving goal-oriented individuals had higher PC, which promoted high AA. Second, individuals with high PC tended to be more optimistic and confident, which also promoted the formation of high-achieving goals.

In addition, this study also discussed the moderating effect of PC on the relationship between AGO and AA, indicating that LE played a role in the moderation effect of PC on AGO and AA. The reason why PC plays a moderation role in the relationship between AGO and AA was that high and low PC played a moderation role in the relationship between AGO and AA. Further analysis shows that college students with high PC are more eager

to pursue more AGO, while college students with high achievement goal tend to show more LE. High and low of college students PC in AGO, LE is significantly reduced without rising, which is due to lack of PC pressure, reduce the LE. Therefore, PC can mediate the relationship between college students' AGO and AA by influencing their LE.

6. Significance and Deficiency of Research

The main conclusions of this study are as follows: (1) College students' AGO significantly and positively predict AA; (2) PC has a moderating effect on the relationship between college students' AGO and academic engagement; (3) LE plays a partially mediating role in moderating the relationship between AGO and AA.

Moderated mediating model not only reveals the process mechanism of AGO predicting AA (the mediating role of LE), but also reveals the individual difference of this process mechanism (the moderation role of PC). The mediation model has adjustments both responded to the question of how the AGO influence AA, also answers the direct prediction effects of AGO to AA and learning into the mediation role under what conditions a more significant problem, to deepen the development of the relationship between achievement goals and AA research has positive significance. Research results show that the LE is important process of AGO lead to AA, and the process will be affected by the regulation of PC, the results agree with the theory of achievement motivation, personal and environmental factors affect personal AGO, and these goals and all sorts of performance or achievements as a result, to build more perfect AA and development model has certain push Action with.

In addition, the moderated intermediary model has certain enlightenment on how colleges and universities can promote college students to achieve AA through education management: first, college students should be encouraged to carry out reasonable AGO, and moderately set learning goals, performance close to goals and avoidance goals; second, college students should be encouraged to increase their LE, including energy, motivation and focus; finally, college students should be encouraged to improve their PC, and actively cultivate excellent characters of self-confidence, optimism, resilience and responsibility. Counseling helps students with low level of PC to improve the corresponding psychological quality.

There are still some deficiencies in this study, which can be improved in future research. First of all, our research object is college students, so the results of the study are not applicable to all students, and future research can further consider high school students or primary and secondary school students; second, this study is based on a Chinese sample, and the level of achievement goals will vary in different cultures, future research can compare the impact of collectivist and individualistic cultural differences on achievement goals to determine whether the findings of this study are applicable to other cultures; finally, this study uses a cross-sectional design, and its findings cannot be causal inferences, future research can use Longitudinal or experimental designs to further explore the causal relationship between AGO and AA.

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