Role of Academic Emotions in the Relationship between Academic Achievement andResilience among Eighth Graders

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Abstract

This study investigated the relationship among academic achievement, academic emotions, and resilience of grade eight students in Guiyang, China. Via a convenience sampling approach, 172 students (45.9% female) were recruited in this study. Students' academic emotions and resilience were measured respectively by using the adolescent academic emotions questionnaire and Connor–Davidson Resilience Scale. Results indicated that positive high arousal academic emotions mediating the relationship between resilience and students' academic achievement. However, there was no direct relationship among resilience, academic achievement and other academic emotions. Combining with the analysis of results and previous studies, ways to improve academic achievement with a healthy mental status were discussed.

Role of Academic Emotions in the Relationship between Academic Achievement and Resilience

It is a myth that adversity brings suffering and agony. Anguish is temporary, after surviving from the tough times, people can improve problem solving ability that benefit them all through their life. More specifically, after experiencing adverse events the ability to deal with troubles will be improved (Mcmillen, 1999). In order to assess this kind of ability, scientists developed a concept known as "resilience," which is defined as the combination of an individual's perseverance to fight despite repeated failures, their ability to recover and make acomeback, and their adaptive capacity and courage in the face of adversity (Xie & Kuo, 2019). In a nutshell, resilience is a positive and developmental adaptation result of individuals in high- risk environments.

There is a Chinese saying, "Interest is the best teacher." This proverb means students who enjoy the content are more willing to learn, which is known as academic emotions. Academic emotions is the term to describe emotions that students experience in academic settings, which explain all kinds of psychological processes during learning (Pekrun, 2006; Pekrun, et al., 2002). Human emotions can be conceptualized within a two dimensional structure in which valence is the horizontal dimension and arousal is the vertical dimension (Russell, 2003; Citron et al., 2014). Valence is defined as the pleasant level of a stimulus; arousal means the activated degree of physiological responses (Van Volkinburg & Balsam, 2014). Considering the valence and arousal dimensions of emotion, academic emotions are subdivided into four categories: negative low arousal academic emotions, negative high arousal academic emotions, positive low arousal academic emotions, and positive high arousal academic emotions (Ravaja et al., 2004).

Past studies (e.g. Jiang & Xu, 2017; Wang et al., 2017) have found that students' resilience could predict academic emotions, and other research has proven academic emotions determined academic achievement of students. However, there are limited research studies specifically analyzing the effect of academic emotions on the relationship of resilience and academic achievement of Chinese students. The most relevant reference this study can find is a study examining the mediating effect of academic emotions on the relationship between school belonging and academic achievement of Macau adolescents (Lam et al., 2015). The limited reference leads to the purpose of this study to focus on whether there is a mediating effect among resilience, academic emotions, and academic achievement.

Nowadays, schools and parents place excessive emphasis on students' examination scores, which significantly increases students' homework time, the amount of learning materials, and the number of tutorial classes (Song & Yang, 2014). By addressing the relationship among resilience, academic emotions, and academic achievement, this research can break the misconception that the only way to improve students' academic achievement is through more practice and exams. It also inspires people to explore and discuss another deeper question: Is there a healthier method that increase students' grades while achieving well-rounded education that ensures students a satisfied and successful school life in addition to extensive examinations and practices, a high-pressure learning environment, and tense curriculum arrangement? This research can provide ideas about this question regarding students' resilience and academic emotions for scholars, policymakers, and practitioners who have the responsibility to adjust curriculum arrangement, modified educational policies, and design teacher training programs.

In the current study, the major purpose is to focus on whether there is a mediating effect among resilience, academic emotions, and academic achievement. The mediation model hypothesis is shown in Figure 1. At the same time, this study will also try to find out how to improve resilience as well as whether positive academic emotions could be enhanced and negative academic emotions reduced. The primary research question of this study is: What is the role of the four academic emotions (i.e., positive high arousal (PHA), positive low arousal (PLA), negative high arousal (NHA), and negative low arousal (NLA) academic emotions) in the relationship between resilience and academic achievement respectively?
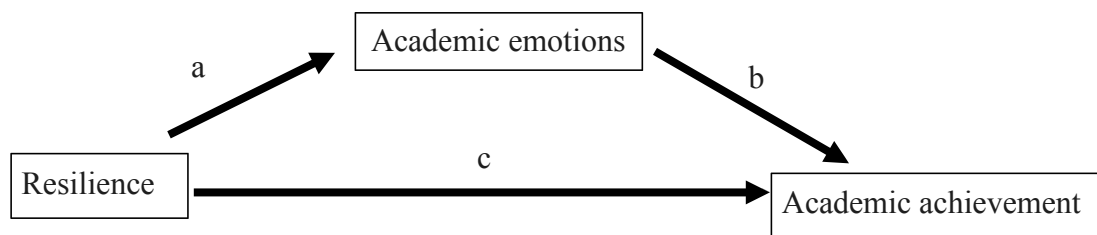
Figure 1. Proposed model for the role of academic emotions (PHA, PLA, NHA, and NLA, respectively) between resilience and academic achievement. Research question: What is the role of the four academic emotions (i.e., PHA, PLA, NHA, and NLA academic emotions) in the relationship between resilience and academic achievement respectively?

Literature Review

Resilience

Name of Resilience in Different Fields

Resilience in some fields has a specific name. In the workplace, people call resilience "adversity quotient" (Stoltz, 2000). In 2000, Paul Stoltz came up with "Adversity Quotient (AQ)"

which is a method for measuring and strengthening human resilience, especially in the workplace. Stoltz developed an AQ questionnaire to measure an employee's ability to face adversities and solve problems in his or her work. The questions in this scale related to issue such as tax, salary, relationship with co-workers, and so on, which are suitable for adult participants who are in the workplace.

In addition, according to other researchers from different countries, such as Iran (Khoshouei, 2009), South Africa (Jørgensen & Seedat, 2008), and Turkey (Karairmak, 2010), we could come to the same decision that tenacity is one of the major factors even though there are cultural differences. Therefore, some scientists use "academic tenacity" to refer to students' resilience (Dweck, Walton, & Cohen, 2014). In general, academic tenacity is the willingness to work hard and smart for a long time. "Academic tenacity is the non-cognitive factor that promotes long-term learning and achievement" (Dweck, Walton, & Cohen, 2014). The translation of resilience in China varies, such as 复原力 recover ability/bounce back ability, 心理韧性 psychological resilience, 心理弹性 psychological elasticity (Xie & Kuo, 2019). Although there are various terms of resilience in both western countries and China, the definitions are similar. Thus, there is no significant difference of these terms in western countries and those in China.

The Way to Improve Resilience

Improving resilience can reduce the adverse effects of stress and improve the ability to adjust the environment among middle school students (Wang et al., 2007). Since resilience plays such an important role in a person's life, what factors can educators proceed with to strengthen students' resilience? The factors that could influence a student's resilience could be the following: prior experience, relationship with parents and peers, personality, environment, and so forth (Edwards et al., 2016; Afifi, & MacMillan, 2011). To summarize, these factors can be categorized into three parts: individual characteristics, social environment, and family level (Pérez-González et al., 2018). Strengthening a student's positive characteristics, improving the study environment, and creating a warm family atmosphere are the things educators should do to enhance students' resilience.

Researchers have found that exercise and activities can improve resilience which involved in the study environment of the above three aspects. Tai chi treatment with escitalopram can significantly enhance older depressed subjects' resilience (Lavretsky et al, 2011). Applying this research to younger people is also useful. In the Understanding Adolescent Program (UAP) from Hong Kong (Education Bureau of Hong Kong), students learn to control their emotions and foster their sense of belonging, competence, and optimism. These improvements can also be achieved by creating a warm family atmosphere through organizing parent-child activities, family meetings, and other kinds of family activities. Psychologists designed several programs to develop people's resilience and large amount of them are suitable for adolescences, such as: Pennsylvania Resilience Training Program developed by Positive Psychology Center at University of Pennsylvania, the six strategies of the psychological resiliency promotion program (Henderson & Milstein, 2003), the International Resilience Project (Grotberg, 1996), and so forth. As the following conclusions and implications part mentioned, designing programs or finding existing programs that can develop both resilience and academic emotions will increase students' academic achievement more effectively. Thus, this section introduces the above conception of the factors that can enhance resilience to inspire educators to design new programs. This section also provides information of the existing resilience training programs that professionals can reference in regards to programs

that positively influence students' resilience and academic emotions.

Academic Emotions

Four Types of Academic Emotions

Academic emotions refer to all kinds of psychological processes during learning. According to the circumplex model of affect presented by Feldman and Russell (1999), the emotions have two dimensions. One is the level of arousal, which can be divided into two levels:high and low. The other one is hedonic value, which can be divided into positive and negative titers. Recently, researchers (Ravaja et al., 2004) suggest that based on the model of valence and degree of arousal, academic emotions can be subdivided into four categories: negative low arousal academic emotions (NLA), negative high arousal academic emotions (NHA), positive low arousal academic emotions (PLA), and positive high arousal academic emotions (PHA).

In Pekrun's study (2002), the academic emotions questionnaire assesses students' academic emotions by measuring their enjoyment, hope, pride, relief, anxiety, anger, shame, hopelessness, and past experience in life. Combining the model of valence and arousal degree together, there are four types of academic emotion, and Table 1 listed some of them.

Table 1. *Four Types of Academic Emotion*

Arousal\Valence	Positive	Negative
Activating	Enjoyment; Joy; Hope;Pride; Gratitude	Anger; Anxiety; Shame
Deactivating	Relaxation; Contentment;Relief	Boredom; Sadness; Hopelessness; Disappointment

Note. Positive = pleasant emotions. Negative = unpleasant emotions. From: Pekrun, R., & Stephens, E. J. (2012). Academic emotions. In K. R. Harris, S. Graham, T. Urdan, S. Graham, J.M. Royer, M. Zeidner., *APA educational psychology handbook, Vol 2: Individual differences and cultural and contextual factors* (pp. 3-31). Washington, DC, US: American PsychologicalAssociation. doi:10.1037/13274-001

The Way to Improve Academic Emotions

Academic emotions are related to the qualities necessary for students' academic goals, learning strategies, and expectancies (Pekrun, 2016). According to the "Survey Report on the Development of Children and Teenagers in China" (Zhang et al., 2017), the average school day for Chinese middle school students is 11 hours, which accounts for almost 45% of their time. That means 45% of their daily mood likely depends on academic emotions, so it is a top priority for schools to ensure students' academic emotions are positive.

Students' academic emotions could be affected by parenting style, teaching style, the academic environments, and other factors (Frenzel et al., 2009). Attitudes of parents' or teachers'and expectations toward students' academic performance will influence their academic emotions (Goetz et al., 2006; Pekrun, 2000). High expectations will increase students' anxiety levels and indifference will reduce their enthusiasm. Teachers treated unfairly to different academic performance students and bringing negative emotions into the classroom can also affect students' academic emotions. Without social supports from parents and teachers, it is difficult for students to have a positive academic emotions (Lei, et al., 2018; Sakiz, 2012). Comparing with social supports from teachers or parents, improvement of academic environments could significantly enhance students' positive academic emotions in a group level such as class, grade or even the

whole school (Pekrun, 2016). Academic environments related to classroom composition, classroom instruction and exams, goal structures and social expectations, feedback and consequences of achievement (Pekrun & Stephens, 2012). Appropriate class hours, a set of effective educational equipment, strike a proper balance between study and rest, reasonable amount of examinations, and so forth are the things that educational institutes should care about, because they belong to academic environments issues which effect students' academic emotions. In the same way we introduce the influences on resilience, the concept of different kinds of emotions and factors are referenced for future program designers. In order to design a new program or recognize existing programs that develop resilience and academic emotions, we should first learn the protective and risk factors of academic emotions and understand what strategies already exist for academic emotion improvement.

Theoretical Frameworks

Except for assigning heavy tasks to students to ensure a high academic performance, existing studies have proposed some healthier methods to enable students to cope with the potential challenges of improving academic achievement without too much stress and pressure. These methods include but are not limited to the adjustment or creative ideas regarding teaching methods, learning environment, and students' mentality to enhance students' academic performance. For instance, research has revealed the significant positive influence of collaborative learning, perceptions of the school environment, and self-efficacy strengthening on enhancing students' academic achievement (Al-Rahmi, & Othman, 2013; Gietz & McIntosh, 2014; Schunk & Pajares, 2002). It is worth noting that two of the ways to support students' academic achievement with a healthy mental wellbeing are improving resilience and academic emotions. Researches highlight the needs to increase academic achievement by fostering education of resilience (Rodríguez, et al., 2018). Moreover, Pekrun and Stephens (2012) listed four things that might be influenced by academic emotions: the availability of attentional resources; motivation to learn; learning strategies and self-regulation of learning. Students' academic achievement was directly influenced by these four things. That is to say, paying attention to students' resilience and academic emotions improvement are good ways to help them learn effectively and increase their satisfaction in the learning process. These implications and suggestions makes this study ask, when improving resilience and academic emotions at the same time, will their impact on academic performance become more significant? Thus, this research decided to study the relationship among resilience, academic emotions, and academic achievement.

Researches demonstrate the relationship between resilience and academic emotions. In the study of Jiang and Xu (2017), resilience could predict positive academic emotions positively, and negative academic emotions negatively. Beyond that Huang and Xie (2016) concluded that students' resilience mediates the relationship between academic emotions and subjective well-being which indirectly assess how resilience and academic emotions are closely related. Factor analysis of previous studies also shows resilience and academic emotions' correlation. There are two factors that have emerged in the resilience study of young children (six-16 years old) who survived an earthquake in China, namely positive thinking and self-awareness (Fu, Leoutsakos, & Underwood, 2014). Moreover, optimism (positive thinking) and self-awareness are also two of the emotional intelligence concepts which could assist the arousal and regulation of emotions (Goleman, 1995; Bar-On, 1997). That is to say, high resilience children will have positive thinking and self-awareness which could promote academic emotions more positively. This correlation is supported by another study, where in the process of factor analysis, Connor and Davidson (2003)

found that one of the strongest factors of resilience is self-efficacy, which correlated with academic emotions in Pekrun and his colleagues' (2004) research.

For the relationship between academic emotions and academic achievement, the control–value theory (Pekrun et al., 2007; Pekrun, 2006) found that academic emotions are the other factors affecting academic achievement in addition to IQ. Academic emotions affect students' attention, motivation, self-regulation and interest in the content (Pekrun & Stephens, 2012).

Students with positive emotions during study could concentrate more on their work and be more motivated to learn and that helps them increase their academic achievement. According to other researchers' study (Jiang & Xu, 2017; Sun & Cheng, 2010), academic emotions are also proved to be one of the factors that affect students' academic achievement. To sum up the aforementioned studies, empirical researches illustrated two significant correlations respectively, one is between academic emotions and resilience, the other is the correlation between academic emotions and academic achievement. That makes this study hypothesize that there is a possible mediating relationship among resilience, academic emotions, and academic achievement. Therefore, this study conducted mediation analysis of resilience, academic achievement, with each type of academic emotion separately to better understand the possible relationship among these three values.

Method

Participants

A total of 205 eighth grade students from Guiyang's middle school, in Guizhou province, were recruited in this study. Multiple considerations informed this decision. Grade seven students have just entered middle school from primary school and are still trying to adapt to the new learning environment, so their experience of adjustment difficulties such as building new relationship with peers is likely to temperately decrease the test results of resilience. Besides that, this research used students' final examination results in spring 2018 for academic achievement. The data once collected at the beginning of fall 2018. At that time, grade seven students just entered school and their final test scores in spring 2018 are from different elementary schools' with level tests of different difficulty. Thus, this study didn't choose them to be participants. Students in Grade nine just joined a "motivational meeting" thatthe school organized to encourage students to work hard and to prepare for the high school entrance exam. That environment will change students' academic emotions to some extent. For example, students might feel more anxiety (high arousal academic emotion).

Therefore, grade eight students were chosen because eighth-graders are less affected by the adjustment issues and "high school entrance examination motivational meeting." After eliminating outliers and those who did not finish the questionnaires, there were a total of172 participants (92 males; 80 females). The school divided students into three different types of class: A (high-achieving, top 30%), B (average) and C (low-achieving, last 30%). These participants are from five classes, 42 of them are from an A-class, 67 students belong to two B-classes and the rest, 63 students, are from two C-classes. A-class students are encouraged to reside at school.They have an independent and entirely closed campus and this campus is only for A-class students in different grades (grade seven to nine). It is a common phenomenon that a Chinese middle school divide students into different class types and let them study under different management styles (i.e. residential or day school), so the results of this study which analyzed students from a variety of categories can be applied to other middle schools with similar characteristics.

Data Sources, Collection and Instruments

Basic Information Collection

Participants were required to complete a short questionnaire including their background information such as name, gender, and age. Students' final exam grade reports for spring 2018 were directly provided by the school. There were five course grades included in their grade report: Chinese, math, English, history, and politics. The full marks for each course were 100.

Academic Emotions Assessment

Pekrun and his colleagues' (2002) academic emotions questionnaire is probably the most comprehensive one, which is widely used among the existing academic emotions measurement (Dong & Yu, 2007). However, due to reasons such as cultural differences when assessing Chinese middle school students' academic emotions, more studies use the adolescent academic emotions questionnaire developed by Dong, Yan and Yu, and Guoliang. After weighing the benefits and limitations of both questionnaires, this study decided to use the Adolescent Academic Emotions Questionnaire. The adolescent academic emotions questionnaire has proven to be a suitable assessment for the students from grade seven to 11. Based on the past research of assessing secondary school Chinese students, this questionnaire has great reliability and validity (coefficient of homogeneity and split reliability were high) and satisfactory construct validity and criterion validity (Dong & Yu, 2007). The questionnaire is in Chinese, 72 items are included, and it uses a typical five-level Likert system to the scoring method. Based on valence and arousal degree, these adolescent academic emotions questionnaire splits into four sub-questionnaires (NL arousal academic emotions questionnaire, NH arousal academic emotions questionnaire, PL arousal academic emotions questionnaire, and PH arousal academic emotions questionnaire) and the alpha coefficient of reliability of these sub-questionnaires are 0.915, 0.833, 0.815, and 0.785 (Dong & Yu, 2007). The alpha coefficient of reliability of these sub-questionnaires tested by current study are 0.924, 0.855, 0.853, and 0.786.

Resilience Assessment

The resilience was measured by the Connor–Davidson Resilience Scale (CD–RISC) which has been evidenced as an assessment with quality reliability and validity for the population aged 10 to 18. This study used its Chinese version. The scale includes 25 items and each item is scored from zero to four. Participants' scores should be within the limits of total scores (zero to 100), with higher scores reflecting better resilience. The internal consistency coefficient of the Chinese version is 0.91 (Yu & Zhang, 2007), and the alpha coefficient of reliability of the Chinese version tested by this study is 0.86.

Each and every area reflects obvious regional and consuetudinary differences because of the different cultures. Chinese culture tends towards altruism, but the west, like the United States, emphasizes more individual values. That makes the two countries' residences' resilience focus on different valences. In one Chinese research project about Chinese earthquake survivors, the resilience score was predicted by level of collectivist well-being, but not by individualistic well-being (Wu et al, 2011). The participants of this study are Chinese, so the level of collectivist well-being was the missing element in the current measure of resilience by the Connor–Davidson Resilience Scale. However, this study did not find any other scale with high reliability, high validity, and low cultural bias as a substitute. Thus, this study decided to continue using the Connor–Davidson Resilience Scale.

Data Analysis

Mediation

Mediation implies the effect of the independent variable (X) on the dependent variable (Y) can be explained by a third variable (Mediator) (Wen, Hou, & Zhang, 2005). The relationships between the independent variable (IV), the mediator (M) and the dependent variable (DV) can be depicted in the form of a path model (Figure 2).

Panel A

$$Y = cX + e_1$$

Panel B

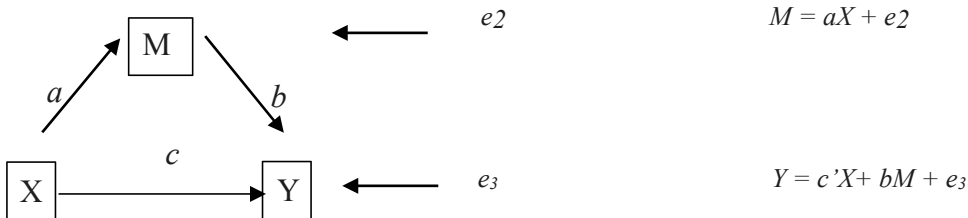$$M = aX + e_2$$

$$Y = c'X + bM + e_3$$
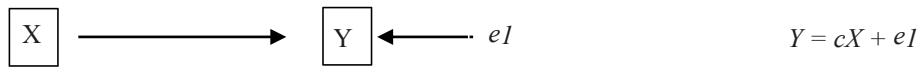
Figure 2. Schematic diagram of mediation effect path model. Panel A: Illustration of a direct effect. X affects Y. Panel B: Illustration of a mediation design. X affects Y indirectly through M. From: Schematic diagram of mediation effect path model. From: Wen, Z. L., Hou, J. T., Zhang, L. & Liu, H. Y. (2004). Testing and application of the mediating effects. *Acta PsychologicaSinica, 36*(5), 614-620.

This study followed the causal steps approach (MacKinnon et al, 2002) shown below (Figure 3) to investigate the relationship between academic emotions and resilience and whether or not this relationship is significant in predicting academic achievement. On the basis of results, conclusion and implications of this study will be discussed.
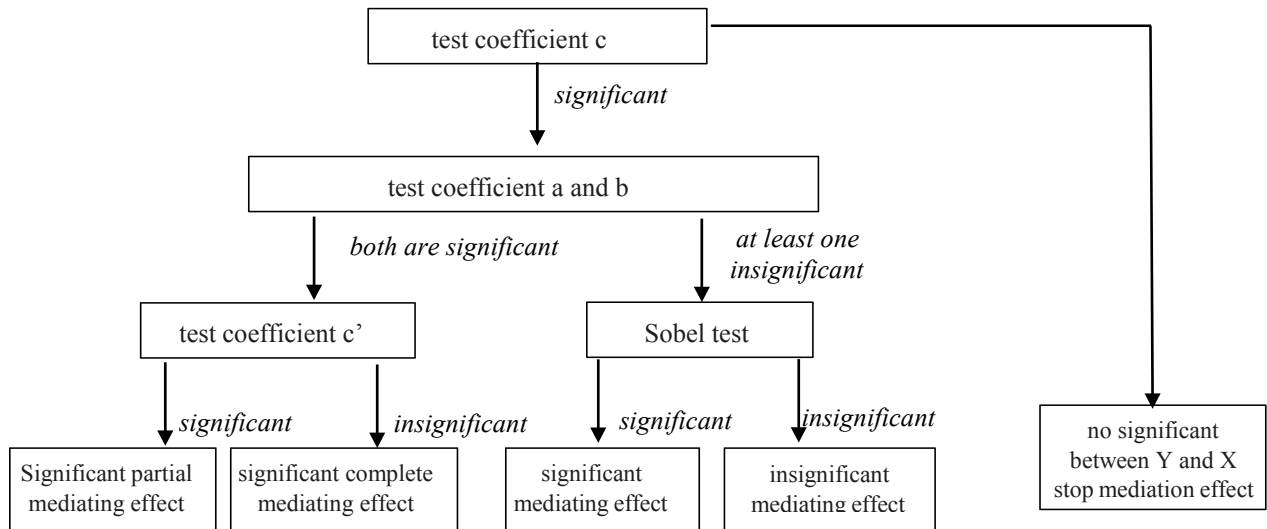
Figure 3. Schematic diagram of mediation effect inspection procedure. From: Wen, Z. L., Hou, J. T., Zhang, L. & Liu, H. Y. (2004). Testing and application of the mediating effects (中介效应检验程序及其应用). *Acta Psychologica Sinica, 36*(5), 614-620.

First of all, we tested coefficient c to confirm the significance of the relationship between the initial IV (resilience) and DV (academic achievement). Next, the partial mediation test (Baron & Kenny, 1986), assesses coefficient a and b to make sure IV can predict mediator (academic emotion), and there is a correlation between mediator and DV separately. If both a and b are significant, the final step is to test the c' to determine whether the mediating effect is complete (Judd, & Kenny, 1981). If c' is significant, that means there was a partial mediating effect of mediator between IV and DV. If not, the mediator has a complete mediating effect in the relationship between IV and DV. If only one of the two coefficients (a, b) is not significant, a Sobel test would be conducted (Sobel, 1982).

Results

Descriptive Statistics

Descriptive statistics and intercorrelations for scores on resilience, academic achievement, and four types of academic emotions are summarized in Table 2. Resilience was positively correlated with academic achievement ($r=0.17$, $p<0.05$), PHA academic emotions ($r=0.216$, $p<0.01$), and PLA academic emotions ($r=0.17$, $p<0.01$), and it was negatively correlated with NLA academic emotions ($r=-0.208$, $p<0.01$). Academic achievement was positively correlated with PHA academic emotions ($r=0.334$, $p<0.01$). PHA academic emotions was positively correlated with PLA and NHA academic emotions ($r=0.41$ and $r=0.267$, respectively, both $p<0.01$) and PLA academic emotions was negatively correlated with both NHA and NLA academic emotions. NHA academic emotions was positively correlated with NLA academic emotions ($r=0.70$, $p<0.01$).

Table 2. *Descriptive Statistics and Intercorrelations for Studied Variables*

	M	SD	1	2	3	4	5	6
1. Resilience	62.62	14.62	-					
2. Academic Achievement	255.26	81.44	.17*	-				
3. PHA	59.55	9.19	.216**	.334**	-			
4. PLA	44.87	9.70	.264**	.08	.41**	-		
5. NHA	52.63	12.64	-.104	.04	.267**	-.33**	-	
6. NLA	64.44	18.78	-.208**	-.11	.051	-.40**	.70**	-

Note. PHA = Positive High arousal academic emotions, PLA = Positive Low arousal academicemotions, NHA = Negative High arousal academic emotions, NLA = Negative Low arousal academic emotions, *p<.05, **p<.01.

Mediation

Based on the Causal Steps Approach, resilience is the independent variable, academic achievement (grades) is the dependent variable, and PHA, PLA, NHA, and NLA were used as mediator to analyze the mediating effect. The results are PHA academic emotions completely mediate the relationship between resilience and academic achievement. Data analysis results are shown in Table 3. In the firststep of data analysis in every model (model 1 of Table 3, 4, 5, and 6), coefficient c is significant (c = 0.166, $p < .05$). Based on the mediation model 2 on Table 3, the results of data analysis showed that positive high arousal (PHA) academic emotions' mediation effect was significant (a = 0.216, $p < .05$; b = 0.312, $p < .01$, c' = 0.099, $p > .05$).

Given the schematic diagram of the mediation effect inspection procedure, PHA plays a complete mediating role between resilience and academic achievement.

Table 3. *The Mediating Effects of Positive High Arousal Academic Emotions upon the Relationship between Resilience and Academic Achievement*

	Model 1		Model 2		
	B	SE	B		SE
Constant	197.192	27.084	56.043		42.230
Resilience	0.927*	0.421	0.552		0.412
M_{PHA}			2.764**		0.654
Model R^2	0.028		0.121		
ΔR^2	0.022		0.110		

Note. B = unstandardized coefficients, SE = standard error of unstandardized coefficients, PHA = Positive High arousal academic emotions. Model 1 = Direct effect resilience (X) to academic achievement (Y), Model 2 = Indirect effect resilience (X) and mediator (M_{PHA}) to academic achievement (Y). *$p<.05$, **$p<.01$. ΔR^2 is the difference between R^2 in Model 1 andModel 2.

The effect of resilience on academic achievement through positive low arousal, negative high arousal, and negative low arousal academic emotions are not significant. These results were obtained by the combination of mediating analysis outcomes in Tables 4, 5 6, and Sobel test outcomes in Table 7.

Table 4 and Table 6 model 2 indicates that if either PLA academic emotions or NLA academic emotions is the mediator, then coefficient a is significant but not coefficient b ($a = 0.264$, $p < .01$; $b = 0.039$, $p > .05$, $c' = 0.156$, $p < .05$; $a = -0.208$, $p < .01$; $b = -0.080$, $p > .05$, $c' = 0.150$, $p < .05$). Table 5 model 2 shows both coefficients a and b are not significant when NHA academic emotions is the mediator ($a = -0.104$, $p > .05$; $b = 0.053$, $p > .05$, $c' = 0.172$, $p < .01$). According to Sobel (1982) this study should conduct Soble tests since one of the two coefficients a and b is not significant.

Table 4. *The Mediating Effects of Positive Low Arousal Academic Emotions upon the Relationship between Resilience and Academic Achievement*

	Model 1		Model 2	
	B	SE	B	SE
Constant	197.192	27.084	186.169	35.166
Resilience	0.927*	0.421	0.870*	0.438
M_{PLA}			0.325	6.659
Model R^2	0.028		0.029	
ΔR^2	0.022		0.018	

Note. B = unstandardized coefficients, SE = standard error of unstandardized coefficients, M_{PHA} = Positive Low arousal academic emotions. Model 1 = Direct effect resilience (X) to academic achievement (Y), Model 2 = Indirect effect resilience (X) and mediator (M_{PLA}) to academic achievement (Y). *$p<.05$, **$p<.01$. ΔR^2 is the difference between R^2 in Model 1 and Model 2.

Table 5. *The Mediating Effects of Negative High Arousal Academic Emotions upon the Relationship between Resilience and Academic Achievement*

	Model 1		Model 2	
	B	SE	B	SE
Constant	197.192	27.084	177.297	26.029
Resilience	0.927*	0.421	0.958*	0.406
M_{NHA}			0.341	0.491
Model R^2	0.028		0.030	
ΔR^2	0.022		0.019	

Note. B= unstandardized coefficients, SE = standard error of unstandardized coefficients, NHA = Negative High arousal academic emotions. Model 1 = Direct effect resilience (X) to academic achievement (Y), Model 2 = Indirect effect resilience (X) and mediator (M_{NHA}) to academic achievement (Y). *$p<.05$, **$p<.01$. ΔR^2 is the difference between R^2 in Model 1 and Model 2.

Table 6. *The Mediating Effects of Negative Low Arousal Academic Emotions upon the Relationship between Resilience and Academic Achievement*

	Model 1		Model 2	
	B	SE	B	SE
Constant	197.192	27.084	225.188	38.393
Resilience	0.927*	0.421	0.835	0.431
M_{NLA}			-0.345	0.335
Model R^2	0.028		0.034	
ΔR^2	0.022		0.022	

Note. B = unstandardized coefficients, SE= standard error of unstandardized coefficients, NLA = Negative Low arousal academic emotions. Model 1 = Direct effect resilience (X) to academic achievement (Y), Model 2 = Indirect effect resilience (X) and mediator (MNLA) to academic achievement (Y). *$p<.05$, **$p<.01$. ΔR^2 is the difference between R^2 in Model 1 and Model 2.

Sobel Test

For PLA, NHA and NLA, at least one of the two coefficients (a and b) is not significant, so Sobel tests were conducted. For PLA ($z = 0.357$, $p > 0.05$), NHA ($z = -0.284$, $p > 0.05$) and NLA ($z = 0.490$, $p > 0.05$), there is no significant *p* value for z scores, thus these three kinds of academic emotions do not play a mediator role between resilience and academic achievement (Table 7).

**Table 7.** *Sobel Test of PLA, NHA and NLA*

	a	b	S_a^2	S_b^2	z
PLA	0.175	0.325	0.049	0.659	0.357
NHA	-0.09	0.341	0.066	0.491	-0.284
NLA	-0.267	-0.345	0.096	0.335	0.490

Note. PLA = Positive Low arousal academic emotions, NHA = Negative High arousal academic emotions, NLA = Negative Low arousal academic emotions, S_a^2 is the estimated variance of the estimated coefficient a, S_b^2 is the estimated variance of the estimated coefficient b, *p<.05, **p<.01.

Path Model

The relationships between the independent, the mediator, and the dependent variables can be depicted in the form of a path model (Figures 4, 5, 6, and 7) which is a straightforward and virtual way to show the above results. In the path model, arrows represent a causal relationship and direct effect between two variables. Each arrow shows the unstandardized coefficients and the significance of the effect.
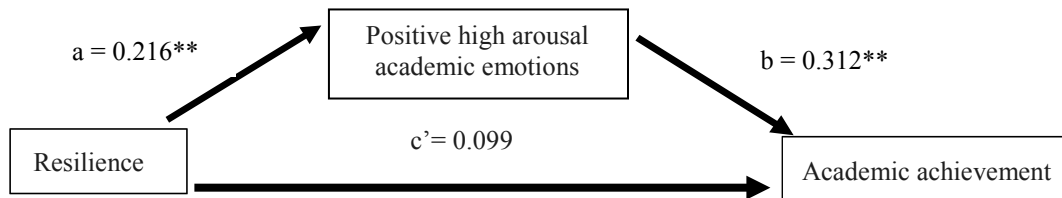
Panel A
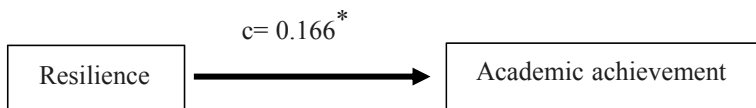
Panel B

Figure 4. Positive high arousal academic emotions mediation effect model. All path coefficientsare unstandardized. *p < .05. **p < .01.
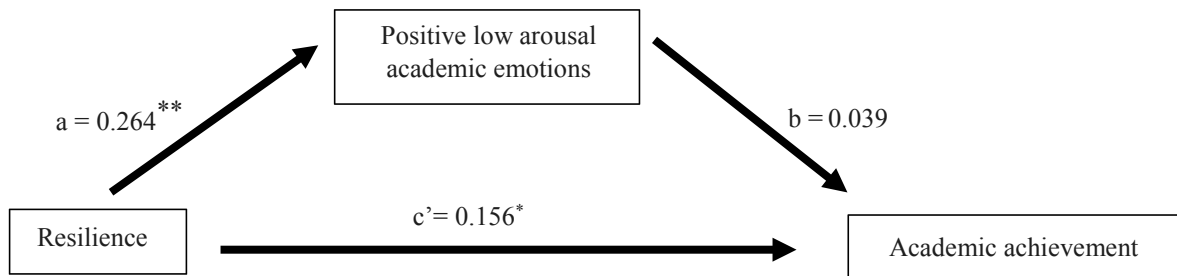

Figure 5. Positive low arousal academic emotions mediation effect model. All path coefficientsare standardized. *p < .05. **p < .01.

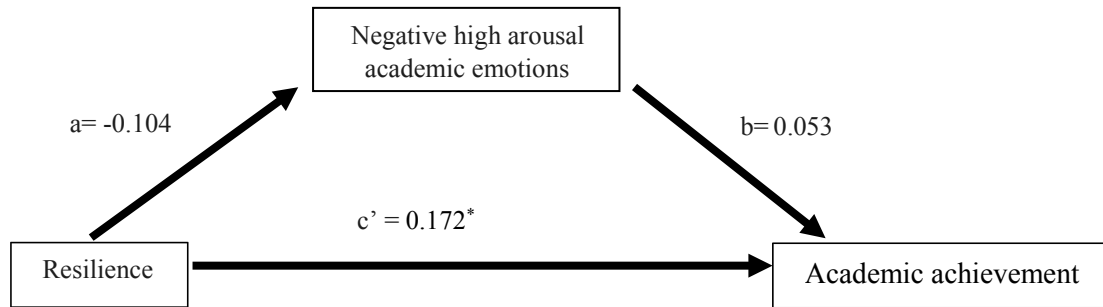*Figure 6.* Negative high arousal academic emotions mediation effect model. All path coefficients are standardized. $^*p < .05.$ $^{**}p < .01.$
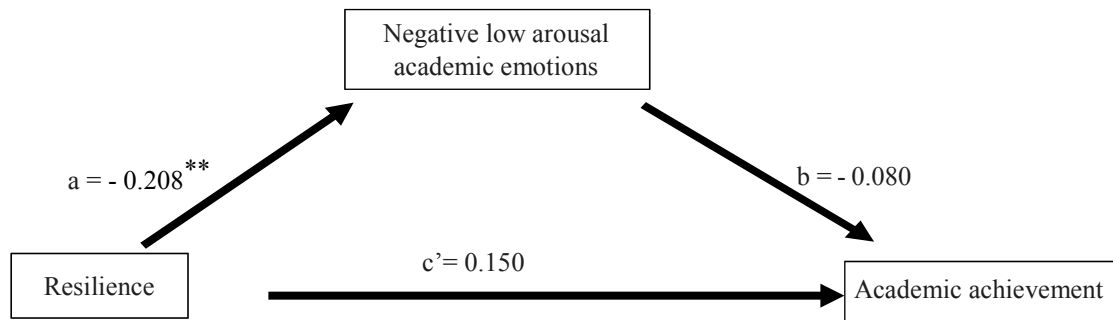

Figure 7. Negative low arousal academic emotions mediation effect model. All path coefficientsare standardized. $^*p < .05.$ $^{**}p < .01.$

Discussion

The research questions is what is the roles of the four academic emotions (i.e. PHA, PLA, NHA, and NLA) in the relationship between resilience and academic achievement. The finding of this study showed that PHA academic emotions completely mediated the effects of resilience when predicting academic achievement. That is to say, resilience cannot directly influence academic achievement but the influence can be conducted through the mediator PHA academic emotions; high-resilience students with PHA academic emotions in this school will get better grades. This finding is consistent with the hypothesis of this study that there is a mediating relationship among resilience, academic emotions, and academic achievement as illustrated in the introduction. However, the other three types of academic emotions (PLA, NHA, and NLA) did not show significant mediation between the resilience and academic achievement which is different from the hypothesis and the previous studies' results.

These results show the implications for the relevant policy-making and practices in the education and student affairs field. In the literature review part, this study provided information abouthow to improve resilience and academic emotions respectively. If we can find some existing programs or design a program that can develop both resilience and PHA academic emotions, then based on the conclusion of this study, we can increase students' academic achievement more effectively.

The lack of significant mediating relationship between resilience and academic achievement with PLA, NHA, or NLA suggests they may be subject to additional influences. The additional influences that may lead to these results are a combination of some reasons and the limitations of this study. The study noticed that the subject school uses academic grouping to divide students into three types of classes and the educational resources each type of class can assess are different.

This might alter the students' academic emotions, likely also affecting the results of the study. Besides that, as this study introduced in the participants' part, A-class students should reside at school. Students living on campus, when compared to those living at home, might have different academic emotions. The school in which this study was conducted was in a public school where a large proportion of students come from low-SES (Socioeconomic Status) families.

According to Ma (2021), family characteristics, such as family socioeconomic status, can greatly affect adolescents' academic emotions. Therefore, one cannot ignore the impact of SES on the participants' academic emotions, since compared to other schools, this school's students' family incomes are lower on average.

Additionally, considering the development stage of the participants is necessary, the average age of these participants was around 14 years old, which was in the period of adolescent rebellion. Students in this development stage are anxious, sensitive, and susceptible to situational circumstances (Good & Willoughby, 2008): they feel anger or hopelessness easily and so they are likely to have more negative academic emotions. Research also illustrated that in adolescent rebellion, adolescents may have difficulties in impulse control, they are impetuous and unable to calm down (Susman et al., 1987), which make students get less positive academic emotions specifically on PLA academic emotions regarding relax. As a consequence, participants' living environment (on-campus or off-campus), participants' family SES, and adolescent rebellion might be some of the reasons that led to this study reaching the conclusion that PLA academic emotions and negative academic emotions have no significant mediating effect on academic achievement and resilience's relationship.

At present, there are few intervention studies aimed to improve the resilience and academic emotions of Chinese students. Most studies use foreign references to conduct intervention experiments on Chinese students. However, as mentioned earlier, because of the differences in culture, education mode, and family education view, it is necessary to design an indigenous intervention model for Chinese students. This study encourages future research work on the design of an indigenous program that considered both resilience and academic emotionsimprovement. Furthermore, we need to know more information regarding the specific roles of academic grouping, students' living environment, family socioeconomic status, and adolescentrebellion. An area of further inquiry would be how those four elements impact students' resilience and academic emotions.

Conclusions and Implications

The major outcome of this study is positive high arousal academic emotions mediates the relationship between resilience and academic achievement. There are multiple reasons why PLA academic emotions and negative academic emotions were shown to not significantly influence the relationship between academic achievement and resilience. These reasons include academic grouping, students' living environment, family socioeconomic status, and adolescent rebellion. Results of this study imply that programs that are beneficial for both resilience and academic emotions are more effective in academic achievement improvement. The methods that could increase both students' positive academic emotions and resilience might be related to the intervention of low self-efficacy, low motivation, and so forth. For educational institutes, set courses related to emotional control such as yoga, tai chi and so on foster academic emotions and have positive effects on students' cultivation of resilience (Lavretsky et al, 2011). In 2016, Villasana et al. argued that a positive coping style could reinforce resilience which is one way to strengthen students' positive characteristics. After obtaining positive feedback, adolescents will

adopt a regulatory approach to enhance positive emotions to maintain pleasure. Pleasure is a positive high arousal academic emotion and it will promote the development of resilience at the same time (Han, Liao, & Zhang, 2016). In additionto academic achievement, after getting the training on resilience and academic emotions and benefits from the program, students can further apply their ability to resist pressure and solve problems with a positive attitude when facing difficulties in daily life. To summarize, a new and healthier perspective to increase students' academic achievement and figure out programs or workshops that can improve both students' resilience and academic emotions should be the two major implications for scholars, policymakers, and practices in the relevant field.

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