




Grit and Academic Self-Efficacy as Serial Mediation in the Relationship Between Growth Mindset and Academic Delay of Gratification: A Cross-Sectional Study

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Purpose: With a growth mindset, individuals focus on the process of growth, actively seek challenges, recognise and accept failures, and apply more effort and monitor themselves to overcome difficulties. Doing so translates into excellent academic performance. However, it has not yet been fully clarified how growth mindset affects academic delay of gratification (ADG) and the mechanisms underlying their interactions. In this study, grit and academic self-efficacy were tested as mediating mechanisms between growth mindset and the ADG using a serial mediation effect model based on self-determination theory (SDT).

Methods: A cross-sectional design was conducted with 759 Chinese junior high school students using the following tools: Growth Mindset Scale, Short Grit Scale, Academic Self-efficacy Scale, and Academic Delay of Gratification Scale. Hypotheses were tested using structural equation modeling.

Results: The results showed that: (1) by gender and grade control, growth mindset indicated a positive significance in the prediction of ADG; (2) grit and academic self-efficacy played a mediating role in the influence of a growth mindset on the ADG. Grit and academic self-efficacy also have a serial mediation effect between growth mindset and ADG.

Conclusion: The results showed that a growth mindset does not only directly affect the ADG but also indirectly affects it through grit and academic self-efficacy. Based on SDT, this study further revealed the potential mechanism of a growth mindset affecting the ADG. Furthermore, it provides practical guidance for the cultivation of ADG for junior high school students.

Keywords: junior high school students, academic delay of gratification, growth mindset, grit, academic self-efficacy

Introduction

Students in junior high school are undergoing rapid physiological and psychological development, and their engagements at this stage of their lives, including their studies, are demanding. In the rapidly developing modern society, students are faced with the increasing temptations of entertainment and online leisure activities. This has impacted their academic progress and self-development. Thus, it is imperative for them to give up the present temptation for the sake of future long-term interest in their academic careers. As an essential component of self-control and self-regulation,¹ academic delay of gratification (ADG) refers to a psychological tendency of students to postpone the urge for immediate gratification in favour of pursuing more valuable long-term objectives.² Research has shown that ADG is a necessary condition for learners to pursue and complete academic tasks, avoid temptations, and change their beliefs and expectations about the future.³ It can effectively promote the use of metacognitive, cognitive, and resource management learning strategies of students;^{2,4} better predict their allocation of learning time;⁵ and predict their completion of homework and academic performance.⁶ Therefore, ADG is regarded as an important quality for learners to obtain higher academic achievement, and it is crucial to investigate the factors that influence the ADG of students.

Previous studies have explored the factors influencing ADG from various perspectives such as achievement goal orientation,⁷ future time perspective,⁸ and motivation and self-regulated learning strategies used in academic tasks.⁹ However, although implicit theory is an important topic in academic motivation,¹⁰ its effects on ADG have not been comprehensively studied. Implicit theory is mainly used to help individuals predict and judge the meaning of events in their lives.¹¹ The implicit theory holds that an individual's mindset affects their self-regulation ability and behavioural choice.¹² Individuals with growth mindsets hold the implicit belief that a given trait can be continuously improved and developed through unrelenting effort,¹³ especially in adverse or challenging situations, which will enable them to face setbacks with a more positive attitude.^{14,15} At present, although many achievements have resulted from research of growth mindset in the field of learning, such as facilitating learning engagement,¹⁴ improving academic performance,¹⁶ and affecting mathematics achievements,¹⁷ there are few studies on the impact of the growth mindset on junior high school students' ADG. The learning motivation of individuals in early adolescence declines after entering junior high school as the desire for control increases, resulting in fewer decisions and choices at a time.¹⁸ Junior high school students are in an active stage of mindset development. It is of great significance to cultivate their growth mindset and explore the mechanism of its influence on ADG, both for individual growth and the improvement of current educational practices.

In addition, growth mindset and ADG are both good indicators for predicting personal performance, and previous studies have considered them as parallel factors to explore learning outcome variables.¹⁹ However, few studies have explored the internal mechanisms of a growth mindset affecting ADG. Self-determination theory (SDT) holds that individuals have three basic psychological needs, namely autonomy needs, competence needs, and relatedness needs.²⁰ Having a growth mindset can satisfy individual autonomy needs, reinforce intrinsic motivation, and increase individual grit.²¹ Grit is a personality trait that positively affects the perception of competence provided by academic self-efficacy and promotes high-quality motivational regulation.²² There is scientific evidence that efficacy beliefs and the staying power of dispositions are essential for undertakings that teem with daunting obstacles, such as academic performance.²³ Whether grit and academic self-efficacy are the mediating mechanisms of growth mindset on ADG remains to be confirmed. Based on SDT, this study introduced two key variables, grit and academic self-efficacy, to deeply analyse the internal mechanism of the growth mindset on ADG. This study conducted a questionnaire survey with 759 junior high school students in Henan province, and used structural equation modeling (SEM) to analyse the relationship between growth mindset, grit, academic self-efficacy and ADG. Simultaneously, the bootstrap method was used to test the mediating effect of grit and academic self-efficacy on growth mindset and ADG.

This paper offers the following contributions: Firstly, despite the widespread discussion of the factors influencing ADG, few studies have explored mindsets as a predictor of this.²⁴ Through this study, we hope to expand the perspective of ADG research from the point of view of implicit beliefs and to make some theoretical contributions to the literature related to implicit theory or growth mindset. Secondly, this paper has been able to conduct a detailed internal mechanism analysis due to the inclusion of two mediating variables, grit and academic self-efficacy. Thirdly, the research built on the background of Chinese group culture will provide a theoretical reference for future research on ADG and other academic variables in various groups and cultural contexts. In summary, the current study aims to further our understanding of the interplay between a growth mindset, grit, academic self-efficacy and ADG, to provide practical guidance for junior high school students to cultivate ADG.

Literature Review

Growth Mindset and ADG

ADG is defined as the postponement or the deferring of immediate impulses by students to achieve more meaningful academic goals or rewards that are distant in time but ostensibly more rewarding.² The mindset of an individual refers to their implicit belief about whether their basic traits are changeable.¹³ A growth mindset is the belief that individuals have different traits that can be changed and developed through unrelenting practice and effort.¹³ Students with a growth mindset focus on the process of growth, actively seek challenges, take the initiative to recognise and accept failures, and make more effort and self-monitor to overcome difficulties²⁵ and correctly deal with setbacks and pressure in the process of study. Metcalfe & Mischel²⁶ discussed the physiological mechanism of delay of gratification from a biological

perspective, pointing out that the cognitive mode of thought, based on the cool system dominated by the hippocampus and prefrontal cortex, would continue to delay through effective self-regulation and alleviate the eager desire for immediate rewards when the stress level increases (eg, encountering frustration). In addition, studies have revealed that growth mindset is closely related to the cultivation of motivation and its internalisation development,^{21,27} which enables students to focus on internal progress, thus generating positive intrinsic motivation. Students with higher intrinsic motivation can mobilise subjective initiative, value their academic tasks, and are more likely to postpone immediate gratification and obtain a delayed one.² The growth mindset is future-oriented; therefore, it affects the perceptions and plans of an individual and has a positive impact on their beliefs and motivations²⁸ to focus on more valuable delayed rewards.⁸ Hence, this leads us to conclude that a growth mindset is closely associated with ADG. Thus, we propose as follows:

Hypothesis 1: The growth mindset has a positive impact on ADG.

Mediating Effect of Grit

In recent years, most schools have given considerable attention to grit, which may play an influential role as a non-cognitive personality characteristic to link growth mindset and ADG. As defined by Duckworth et al,²⁹ grit allows an individual to persistently pursue long-term goals over an extended period and to consistently demonstrate a high level of interest or enthusiasm for it throughout the period. Individuals with a growth mindset regard difficulties and setbacks as feedback information in the learning process, strive to seek challenging tasks to improve their ability,³⁰ actively seek effective strategies to solve problems in the face of difficulties and setbacks, and work tirelessly towards the goal, thus showing a high level of grit.³¹ Individuals with a higher growth mindset are concerned with their ongoing development and advancement and prefer tasks that focus on competency development and learning process.¹³ A study by Park et al revealed that when adolescents perceived their school culture as valuing learning and ability development, they demonstrated a higher level of grit.³² Increasing evidence has shown the mechanism of a growth mindset on grit. For example, a growth mindset can improve grit through the roles of individuals' focus on the future as their time perspective, and through achievement motivation;²⁸ autonomous motivation based on SDT facilitates the influence of a growth mindset with a sense of control on grit;²¹ and structural magnetic resonance imaging (sMRI) was used to discover the neural mechanism of a growth mindset affecting grit.³³ In summary, a growth mindset affects an individual's grit level.

The grit effect on ADG has received little scholarly attention. Data from a previous study showed that grit was significantly correlated with the dimension of delay of gratification in work ethics.³⁴ Grit, as a stable personality trait, affects individual attitudes and behaviours in different environments.³⁵ We speculate that grit has an impact on the delay of gratification in an academic setting. A delay of gratification is also described as "future-oriented self-regulation",³⁶ which transforms individuals' expectations and beliefs about future goals into actual regulatory behaviours. The action control theory reveals that volitional control is an important intermediary variable between goals and achievement outcomes, and individuals need to have strong willpower to promote future goals.³⁷ Maintaining constant willpower can help generate grit and help individuals accomplish their goals, regardless of external circumstances.²⁹ Some prospective longitudinal studies^{29,35,38} have shown that despite obstacles and setbacks, grit remains a reliable indicator for overcoming challenging goals. Grit emphasises long-term stamina and sustains consistency of interest. Therefore, individuals with higher grit can control their behaviour from being influenced by external temptations in the process of completing academic tasks, thus choosing to postpone instant gratification, and show delayed gratification tendencies and behaviour. Based on the above analysis, we propose as follows:

Hypothesis 2: Grit mediates the relationship between the growth mindset and ADG.

Mediating Effect of Academic Self-Efficacy

Previous studies have shown that the advantages of a growth mindset should be based on stable internalised academic self-efficacy.³⁹ Academic self-efficacy refers to the judgement of a learner about their ability to achieve desired performance in the academic field, which is an important self-perception construction in the educational context.⁴⁰

Social cognitive theory posits that self-efficacy, as a situational heterogeneous conception, affects the individual construction of activities, goals, and persistent choices. It is primarily derived from active mastery, vicarious experiences, verbal persuasion, and physiological arousal.⁴¹ Individuals with a growth mindset are convinced that human abilities are malleable; they will actively work towards goals and foster a higher sense of control,⁴² that is, a form of active mastery that becomes a prerequisite for self-efficacy. According to SDT, individual perspectives on the significance of their choices influence their motivation for autonomy.⁴³ Therefore, growth-mindset individuals with a sense of control tend to have more autonomous motivation and believe that they are capable of a certain activity, thereby generating a high self-efficacy level. To increase their ability and challenge the difficulties they face, they focus on the adjustment of problem-solving strategies, and the effective use of these strategies encourages them to achieve goals and enhance self-efficacy.⁴⁴ McWilliams⁴⁵ interviewed ninth-grade students and found that students with a growth mindset tend toward internal attribution, have a clear understanding of themselves, and have a strong sense of academic self-efficacy.

Self-efficacy is a key variable influencing self-regulated learning⁴⁶ and correlates with commitment, persistence in tasks, and successful performance.⁴⁰ Furthermore, it significantly impacts ADG. In academic tasks, highly self-efficacious students are associated with greater confidence in performing assigned tasks in a certain course; they regulate their learning behaviours better through a higher level of delay of gratification ability to complete academic tasks with high quality.¹ This means that the self-efficacy of a student determines their choice of delay behaviour and maintenance. Some of Bembenutty's research^{2,47,48} also proved that the self-efficacy of students contributes to their willingness to self-regulate and delay their gratification. Recently, Bembenutty⁴⁹ emphasised that a successful delay of gratification relies on the self-efficacy perceptions of individuals, according to his analysis of delayed gratification from the perspective of hot/cool cognitive-affective systems. As Metcalfe & Mischel observed,²⁶ delayed behaviour is enhanced when a person is confronted with a stimulus situation that mobilises the cool-system rather than the hot-system. Based on the above analysis, we propose as follows:

Hypothesis 3: A growth mindset may influence ADG through the mediation of academic self-efficacy.

Serial Mediating Effect of Grit and Academic Self-Efficacy

Researchers have pointed out that students need both staying power and efficacy beliefs to succeed in undertakings strewn with obstacles, such as academic performance.²³ As a stable individual difference in disposition, grit is widely regarded as a precursor or potential influence on attitudes and beliefs regarding how academic achievement is regulated.⁵⁰ Grit and self-efficacy are considered the most essential non-cognitive factors that affect student academic performance;^{51,52} however, they have different levels of expression.⁵³ Grit is a trait-level personality construct, while self-efficacy is a state-based assessment of one's capabilities within a specific domain. Research has shown that grit can influence student cognitive strategies and academic achievements through academic self-efficacy,^{50,54} and improve the school satisfaction of students in the primary and secondary stages.⁵⁵ Similarly, Usher et al⁵³ confirmed the mediating aspect of self-efficacy by studying the influence of grit and self-efficacy on academic achievement and motivation of public elementary and middle school students in reading and mathematics. That is, persistence and other trait-like variables cannot fully explain academic success without considering learners' own perceptions of their capabilities.^{23,53} Thus, we propose the following hypothesis:

Hypothesis 4: A growth mindset can affect ADG through the serial mediating roles of grit and academic self-efficacy.

Based on SDT and previous research, this study aims to explore the positive effects of a growth mindset on ADG in junior high school students. Moreover, this study analyses the mechanisms underlying growth mindset affecting ADG; specifically, examining the mediating role of grit and academic self-efficacy. [Figure 1](#) represents the research model.

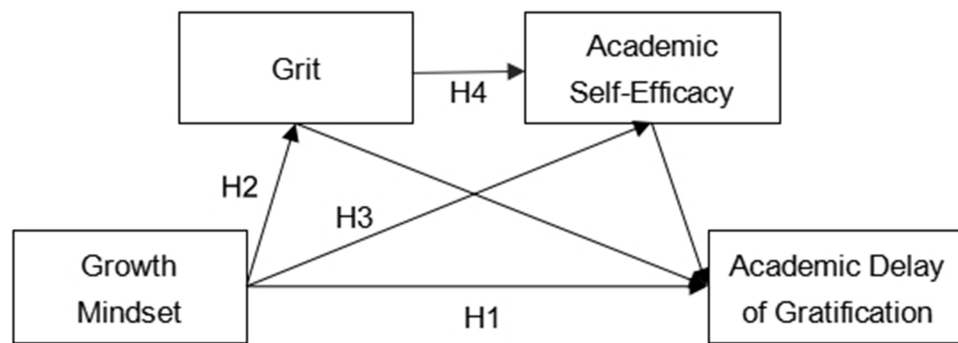


Figure 1 Research Model.

Methods

Questionnaire investigation and experimental methods are often used to measure the growth mindset,^{56–58} but some researchers have pointed out deficiencies in the starting effect of manipulating the growth mindset through experiments.^{25,59} Nonetheless, questionnaire investigation is an effective quantitative method that enables the identification of mediational effects from a statistical perspective.⁶⁰ In addition, questionnaire investigation is the most common research method used in previous studies to measure ADG.^{61,62} Thus, considering the reliability and effectiveness of questionnaire investigation and drawing on previous research methods on the growth mindset and ADG, this study used questionnaire investigation to explore the relationship between the growth mindset and ADG, as well as the mediating effect of grit and academic self-efficacy, in junior high school students.

Participants and Procedure

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Henan Normal University. Written informed consent was provided from all participants. We also obtained written informed consent from the parents of participants under the age of 18 in this study. This cross-sectional study was conducted using a convenience sampling method with participants from one junior high school in Henan Province, China. This public ordinary junior high school is located in the area where the researchers worked and included 1536 students from grades 7 to 9. The overall academic performance of the students was at the Chinese average level and therefore representative of the general situation of Chinese junior high school students. After obtaining the informed consent of the school teachers, we randomly selected half of the classes in each grade (four classes in grade 7, three classes in grade 8 and three classes in grade 9) to issue informed consent to the students, requesting that they and their parents read and sign it. The questionnaire was anonymous, and it was stated at the beginning that the information obtained was for this study only and will be kept strictly confidential. Under uniform guidance, 792 participants from all three grades completed the survey independently, according to their actual situation. To overcome the common method biases, we used two time points for measurement, with an interval of 1 week between them. At the first time point, we measured demographic variables, independent variable (growth mindset), and two intermediary variables (grit and academic self-efficacy). At the second time point, we measured the dependent variable (ADG), and used participants' ID card numbers to match their measurements from both time points. Questionnaires with unsuccessful matches were deleted. We also excluded questionnaires with illogical and contradictory responses according to the reverse items in the measurement questions and eliminated the questionnaires with the same answers or obvious rules of answering. Finally, 759 valid questionnaires were retained (effective rate = 95.83%) and input into SPSS software for data analysis.

Among the participants, 396 (52.2%) were girls, and 363 (47.8%) were boys. There were 277 students in grade 7 (36.5%, 144 girls and 133 boys), 225 students in grade 8 (29.6%, 118 girls and 107 boys), and 257 students in grade 9 (33.9%, 134 girls and 123 boys). The sample average age was 13.91 years (SD = 1.04), ranging from 12 to 16 years old. There was no significant difference in the distribution of gender by grade, $\chi^2(2) = 0.01, p = 1.00$.

Measures

Growth Mindset

The growth mindset was evaluated using the Chinese version of the Dweck Mindset Inventory,⁶³ which consists of eight items (eg, “I can always substantially change how intelligent I am”). Items were scored on a 5-point Likert scale (1 = strongly inconsistent, 5 = strongly consistent). A good reputation for reliability has been established in China.⁵⁸ The higher the score from this scale, the higher the growth mindset level. Cronbach’s alpha coefficient for the scale was 0.72. Confirmatory factor analysis (CFA) ($\chi^2/df=4.128$, $CFI=0.944$, $TLI=0.908$, $RMSEA=0.064$) was within acceptable limits.

Grit

The Short Grit Scale (Grit-S) developed by Duckworth and Quinn³⁵ was used to assess grit, which has been translated and tested for good reliability and validity in Chinese adolescents;⁶⁴ therefore, this study directly adopts the eight items in the Chinese version of the scale. The two dimensions were perseverance of effort (eg, “I finish whatever I begin”) and consistency of interests (eg, “I often set a goal but later choose to pursue a different one”). A Likert-type scale was used to rate the items from 1 (strongly inconsistent) to 5 (strongly consistent). Cronbach’s alpha coefficient of the scale was 0.74 in this study. CFA ($\chi^2/df=3.270$, $CFI=0.971$, $TLI=0.949$, $RMSEA=0.055$) was within acceptable limits.

Academic Self-Efficacy

We evaluated academic self-efficacy using the revised Chinese version of the Motivated Strategies for Learning Questionnaire developed by Lee et al,⁶⁵ which has good reliability in China.³⁹ There were seven items in total, such as “Compared to other students in this class, I expected to do well”. Participants stated their level of approval with each item on a 5-point Likert scale. Higher scores indicated a higher sense of academic self-efficacy. Cronbach’s alpha coefficient of this subscale was 0.84. CFA ($\chi^2/df=2.750$, $CFI=0.989$, $TLI=0.979$, $RMSEA=0.048$) was within acceptable limits.

ADG

Li adapted the Academic Delay of Gratification Scale for Chinese junior high school students,⁷ which is widely used in China and has good reliability and validity. There were nine choice scenarios, and the scale was used to assess which alternatives students would select when faced with a given academic scenario. For example, Scenario 1: A) Watch my favourite TV show even though it may mean getting a lower grade on an exam I will take tomorrow, OR B) Study hard to increase my chances of getting a higher grade. Four answers are available for students to choose from, according to what they think they would actually do: “1: Definitely choose A, 2: Probably choose A, 3: Probably choose B, 4: Definitely choose B”. The average cumulative score for all the items was the ADG score. The higher the average cumulative score of all items, the more inclined students were to ADG. Cronbach’s alpha coefficient for this scale was 0.87 in this study. CFA ($\chi^2/df=4.624$, $CFI=0.962$, $TLI=0.947$, $RMSEA=0.069$) was within acceptable limits.

Statistical Analyses

Data analyses were performed using SPSS and Amos. Amos was used to conduct CFA. SPSS was used to conduct reliability tests, descriptive statistics, and Pearson correlation analysis. In structural model testing, Model 6 in the PROCESS plug-in version 3.3 was used.⁶⁶ Bootstrapping was mainly used to sample 5000 times repeatedly to test the mediation effect.

In previous studies, ADG was found to differ by gender;^{9,67} the ADG of girls was higher than that of boys. Moreover, gender⁶⁸ and grade⁶⁹ differences were significant in terms of the development of growth mindsets. The data analysis was controlled for gender (male or female) and grade (grades 7, 8, or 9) to eliminate the influence of these variables.

Results

Common Method Bias Test

Procedure control and Harman’s single-factor test were used to verify the presence of common method bias.⁷⁰ Procedure control included setting reverse questions in the questionnaire and emphasising anonymity and confidentiality. Because

of Harman's single-factor test, six factors were found to have eigenvalues greater than one. Furthermore, 26.24% of the variance was explained by the first factor, which was below the 40% critical threshold. Therefore, serious common method bias did not exist in this study.

Correlations Between Primary Variables

In Table 1, the study variables are summarised with their mean values, standard deviations, and Pearson correlation coefficients. Because the variable grade is a category variable, this study converts grade into a dummy variable; that is, "grade 7 is the control group, Grade¹ = grade 8, Grade² = grade 9" (the same below). In terms of gender, "male is the control group, Gender⁰ = female" (the same below). The table shows that growth mindset, grit, academic self-efficacy, and ADG all have significant and positive correlations with one another.

Hypothesis Testing

Taking gender and grade as control variables, Table 2 shows the results of the regression analysis. The growth mindset affected ADG in a significant way ($\beta = 0.172, p < 0.001$). In the path of "growth mindset → grit → ADG", the effects of growth mindset on grit ($\beta = 0.470, p < 0.001$) and grit on ADG ($\beta = 0.311, p < 0.001$) were significant. Thus, a growth mindset improved ADG through the mediation of grit. In the path of "growth mindset → academic self-efficacy → ADG", the effects of growth mindset on academic self-efficacy ($\beta = 0.229, p < 0.001$) and academic self-efficacy on ADG ($\beta = 0.282, p < 0.001$) were significant. Thus, a growth mindset improved ADG by enhancing academic self-efficacy. In the path of "growth mindset → grit → academic self-efficacy → ADG", grit was found to have a strong positive impact on academic self-efficacy ($\beta = 0.511, p < 0.001$). This finding indicates that grit is closely correlated with students' academic self-efficacy. Furthermore, a growth mindset positively affects ADG through the serial mediation of grit and academic self-efficacy. Hypotheses 1–4 were supported by these results. Figure 2 also shows the results of the serial mediating effect analysis.

Table 1 Means, Standard Deviations and Correlations of the Study Variables

Variables	Mean	SD	1	2	3	4	5	6	7
1. Gender ⁰	0.520	0.500	I						
2. Grade ¹	0.300	0.457	0.004	I					
3. Grade ²	0.340	0.474	0.000	-0.464**	I				
4. Growth Mindset	3.108	0.553	-0.071*	-0.054	-0.027	I			
5. Grit	3.184	0.606	-0.109**	-0.068	-0.026	0.439**	I		
6. Academic Self-Efficacy	2.930	0.691	-0.061	0.004	-0.018	0.376**	0.524**	I	
7. ADG	2.713	0.692	0.093**	-0.007	-0.226**	0.364**	0.477**	0.471**	I

Notes: * $p < 0.05$, ** $p < 0.01$. Gender⁰ = female, Grade¹ = grade 8, Grade² = grade 9.

Abbreviations: ADG, academic delay of gratification; SD, Standard Deviation.

Table 2 Regression Analysis Results

Variables	Grit			Academic Self-Efficacy			ADG		
	β	SE	t	β	SE	t	β	SE	t
Gender ⁰	-0.095	0.040	-2.388*	0.001	0.042	0.026	0.208	0.040	5.222***
Grade ¹	-0.086	0.049	-1.763	0.084	0.052	1.612	-0.156	0.049	-3.164**
Grade ²	-0.057	0.047	-1.210	0.035	0.050	0.703	-0.377	0.047	-7.962***
Growth Mindset	0.470	0.036	13.097***	0.229	0.042	5.405***	0.172	0.041	4.228***
Grit				0.511	0.039	13.167***	0.311	0.041	7.674***
Academic Self-Efficacy							0.282	0.034	8.202***
R²	0.202			0.304			0.385		
F	47.726***			65.653***			78.549***		

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Gender⁰ = female, Grade¹ = grade 8, Grade² = grade 9.

Abbreviations: ADG, academic delay of gratification; SE, Standard Error.

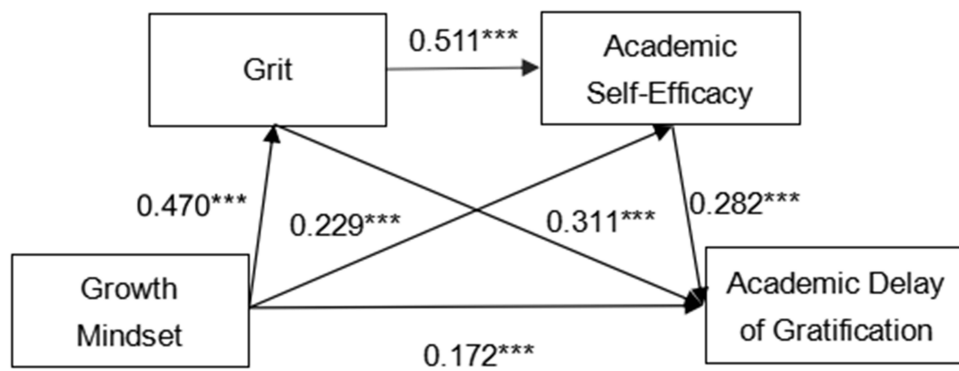


Figure 2 Mediation effect of grit and academic self-efficacy on the influence of a growth mindset on the academic delay of gratification. **Note:** *** $p < 0.001$.

As shown in Table 3, the total indirect effect of grit and self-efficacy was 0.278 (SE = 0.030, 95% CI [0.220, 0.341]), which accounted for 61.8% of the total effect (0.450). Thus, the relationship between a growth mindset and ADG was significantly mediated by grit and academic self-efficacy, with effect values of 0.146 (SE = 0.024, 95% CI [0.101, 0.195]) and 0.064 (SE = 0.015, 95% CI [0.038, 0.095]) for the two mediating variables, respectively. The mediating effect of grit and academic self-efficacy as mediating variables was significant, with an effect value of 0.068 (SE = 0.012, 95% CI [0.047, 0.092]). Specifically, the 95% Confidence Interval of all three indirect effect paths did not contain zero, indicating that the estimated effects were significant. In terms of effect values, the three mediated paths contributed 32.4%, 14.2%, and 15.1% to the total effect, and the path of “growth mindset→grit→ADG” had the strongest mediating effect. The growth mindset primarily improved ADG by enhancing grit, based on a comparison of the three paths of mediation.

Discussion

Theoretical Implications

Although the factors influencing ADG have been widely discussed,²⁴ few studies have explored mindsets as a predictor of it. The implicit theory holds that the mindset of an individual affects their self-regulation ability and behavioural choice.¹² Starting with Dweck’s implicit theory, this study explored the mechanism of a growth mindset on ADG, which expanded the perspective of research on ADG and made important theoretical contributions to the literature on implicit theory or growth mindset. The research results support Dweck’s meaning system with mindsets as the core⁷¹ and demonstrate the importance of implicit theory in the field of ADG.

This study found that the growth mindset significantly predicted ADG; that is, individuals with a higher growth mindset demonstrated a stronger ability to ADG. The reasons are as follows: the growth mindset is future-oriented forward-thinking,²⁸ which will affect individuals’ perceptions and planning: individuals with a high-growth mindset will

Table 3 The Serial Mediating Effects Analysis Among Variables

Pathway		Effect	Boot SE	95% CI	
				LLCI	ULCI
Direct pathway	Growth Mindset→ADG	0.172	0.041	0.092	0.252
Indirect pathways	Growth Mindset→Grit→ADG	0.146	0.024	0.101	0.195
	Growth Mindset→Academic Self-Efficacy→ADG	0.064	0.015	0.038	0.095
	Growth Mindset→Grit→Academic Self-Efficacy→ADG	0.068	0.012	0.047	0.092
Total indirect effect		0.278	0.030	0.220	0.341
Total effect		0.450	0.041	0.370	0.530

Abbreviations: ADG, academic delay of gratification; Boot SE, Bootstrap Standard Error; CI, confidence interval; LLCI, lower level of confidence interval; ULCI, upper level of confidence interval.

have a long-term vision and are more likely to pursue valuable long-term learning goals while delaying immediate gratification impulses and make positive efforts to achieve the goals. This result is also supported by an analysis of hot/cool systems based on the socio-biological model of delayed gratification.²⁶ When people are under stress, they will reduce the activities of the cool system and potentiate the activities of the hot system, which can easily generate impulses and other avoidance reactions. Thus, it is considered that those with a growth mindset can improve their abilities as long as they apply themselves and that they are more inclined to opt for challenging learning tasks as they can face setbacks and pressures calmly, as well as alleviate their eagerness for immediate rewards, while continuing to delay gratification when needed or when it is advisable to do so.

This study found that grit can play a mediating role in the impact of a growth mindset on ADG. This result supports previous studies on the impact of a growth mindset on grit,^{21,28,33} expands the research on the relationship between grit and delayed gratification in the academic field, and enriches the literature on the role of grit as a mediator between growth mindset and ADG. There are several possible reasons for the findings. First, growth-mindset individuals believe that they can improve their abilities and intelligence through their own efforts. This makes them less vulnerable to external manipulations. According to SDT, it is possible for individuals to be more self-motivated when they develop a mindset that fosters a sense of control.⁴³ When one's motivation is autonomous, one is more likely to persevere and maintain interest in the activities that have to be done;⁷² that is, being self-motivated promotes grit. Second, individuals with a high degree of growth mindset enjoy the process of hard work and are good at reflecting on and adjusting themselves from failure so that they can easily stick to the process of realising long-term goals and show a higher degree of grit. In addition, grit helps individuals maintain their motivation and a stable interest in learning, enabling them to resist any temptation to slack off in learning and also show a high level of ADG. We explain this result from the action control theory.⁷³ In the dynamical system of learning, there are motivational and volitional components. The motivational component pushes interest in learning, and the volitional component enhances the willingness to learn, helping students make effective efforts and focus their energy on learning tasks, and avoid distractions. Grit is generated by maintaining the persistence of willpower.²⁹ It is an important mediating variable between goal and achievement outcomes³⁷ and thus plays an important mediating role between growth mindset and ADG.

The present study revealed that academic self-efficacy mediates the relationship between a growth mindset and ADG. Specifically, a growth mindset as a cognitive factor stimulates the autonomous motivation of students and promotes the development of ADG by improving the student's academic self-efficacy. The advantage of a growth mindset depends on the acquisition of academic self-efficacy.³⁹ The explanation is as follows: both active mastery and verbal persuasion are potential sources of self-efficacy in social cognitive theory.⁴¹ Growth-mindset individuals focus on improving their abilities and knowledge. Even when their current competence level is low, they are confident that their abilities will improve as soon as they put in an effort to learn.³¹ This kind of positive mindset enables individuals to actively seek solutions to various problems and becomes a key facilitator of academic self-efficacy. They are not afraid of challenges and believe that everyone has the capacity to succeed despite lack of experience, which implies a strong belief that "development is possible". Such persuasion is also a critical process in enhancing academic self-efficacy.⁷⁴ This conclusion supports the results of McWilliams's interview,⁴⁵ which stated that students who had a growth mindset were more likely to assign internal attribution and have a strong sense of academic self-efficacy. Furthermore, in agreement with Bembenuity's findings,⁴⁷ this study supports the conclusion that self-efficacy is a critical factor in ADG success. This indicates that, in the academic field, if learners are confident in their ability to complete the academic task assigned to them, they are more likely to resist the temptation of being distracted from their goal.⁷⁵ Higher levels of academic self-efficacy may lead to better self-motivation and a greater sense of confidence in learning success, resulting in a greater ADG.

This study further revealed the serial mediating influences of grit and academic self-efficacy on growth mindset and ADG and provided theoretical contributions for a deeper comprehension of the mechanism between the two. The ability to demonstrate grit is a stable personality trait that influences attitudes and behaviours regardless of the environment.³⁵ Self-efficacy is the judgement of one's ability based on the state level in a specific field.⁴⁰ High grit levels are associated with perseverance in the face of adversity, remaining undistracted by setbacks, maintaining a passion for achieving goals, and showing confidence in one's abilities to complete academic tasks,⁵⁰ which may promote a sense of self-efficacy in students. This is consistent with the findings of previous studies in which self-efficacy beliefs increased with other

personality strengths in children/adolescents.⁷⁶ Learners with grit attain academic achievement through perceptual ability and other social cognitive factors that indicate to them that they are capable.⁵³ It is evident that students who are inclined to persevere will do well academically when they perceive themselves as having the ability to do so.

The serial mediation model has provided a powerful explanation of how the growth mindset relates to ADG through an intermediary. It posits that people are positive organisms with innate motivation for psychological growth and development and like to feel that they have control over things, thus promoting the formation of autonomous motivation.²⁰ This is in line with people with a growth mindset. Their focus is on their personal growth process, believing they can change their ability and attributes through effort and are eager to accept challenges, and are adept at reflecting on mistakes and demonstrating a higher level of grit. A high degree of grit allows individuals to persist and remain interested in their goals despite difficulties and setbacks, believe in their own abilities, and thus build confidence in academic tasks.⁵⁰ Therefore, they mobilise a more self-regulating learning willingness and achieve a stronger ADG.^{47,48}

This study is based on the specific cultural background of China to explore the impact of a growth mindset on ADG in junior high school students. The level of ADG is jointly determined by individuals and the social environment. In the context of different cultures and social systems, as well as different ethnic groups, the ADG of students will also vary.⁷⁷ Studies have indicated that Asian youngsters have a stronger desire for success, a greater sense of self-efficacy, better persistence, and more effective control of their own behaviour.⁷⁸ Exploring the antecedents of ADG in this group culture enriches the cross-cultural research fields of a growth mindset, grit, academic self-efficacy, and ADG, and provides a theoretical reference for future research on ADG and other academic variables in different groups and cultural contexts.

Practical Implications

First, junior high school students should be encouraged to cultivate a growth mindset by encouraging them to believe that their intelligence and ability can develop. Dweck stated that individuals could cultivate a growth mindset and transform a low-growth mindset into a high-growth mindset;⁷⁹ numerous studies^{31,80} have demonstrated this point. Dweck and his team have been committed to developing an intervention programme for a growth mindset in recent years,⁷¹ integrating research results from brain science and psychology. Education intervention programmes anchored on school-based research can be designed and implemented to cultivate growth mindsets in students and guide them in correctly viewing the relationship between ability and effort, in actively thinking about future efforts and improvement directions when confronted with pressure and frustration, and in pursuing valuable long-term learning goals while delaying immediate gratification impulses. Additionally, teachers should be mindful of encouraging and praising the efforts of students rather than their talents, teaching about brain plasticity, providing process-based specific and authentic feedback to facilitate active problem solving,^{81,82} and positively influencing their students by developing a growth mindset themselves.⁸³

Second, a growth mindset may lead to the formation of grit, which allows individuals to maintain learning motivation and interest, resist the temptation to deviate from this learning, and demonstrate a high level of ADG. Therefore, school and family education should attach importance to the development of grit, which is a non-cognitive factor of personality and volition. During teaching or even in life itself, students are encouraged to persist in their efforts and to pay attention to process understanding. Teachers can stimulate the long-term enthusiasm and learning interest of students by designing diverse and interesting teaching methods and providing corresponding assistance to the various interests of students (eg, organising students with the same interests to exchange and evaluate activities) so that they are encouraged to pursue their interests over a long period.⁸⁴ Whenever possible, teachers need to avoid pushing students beyond their cognitive abilities, consider the actual situation of a student, and provide clear and organised learning tasks to ensure positive affect is passed on to them, create an enjoyable classroom atmosphere, and further improve the interest of students in participating in classroom learning.⁸⁵

Third, academic self-efficacy plays a crucial role in the pathway of a growth mindset affecting ADG. Consequently, schools and parents can assist students in becoming self-motivated and self-directed growth-mindset individuals, directing them to develop accurate internal attributions and improving their sense of academic efficacy. Educators should praise and encourage students, teach them appropriate learning skills, such as help-seeking, peer learning, time management, effort regulation, and regulation of time and study environment to help them understand and complete tasks;⁴⁹ set positive examples for them because when observing how a self-efficacious model perform and complete tasks, students will be motivated to try to emulate them;⁸⁶ and establish realistic learning goals from short-term goals to long-term or ongoing goals,⁸⁶ which can be

achieved through homework logs and self-monitoring forms.⁶ These are valuable in helping students acquire hands-on mastery experience through self-expression and can help them be more confident in completing their academic assignments and resist the temptation of prioritising non-academic activities over academic ones.

Conclusion

The current study utilised SDT to establish a serial mediation model, which enabled an in-depth explanation of the relationship of growth mindset to the ADG of junior high school students. The findings show that the growth mindset appears to have both direct and indirect positive effects on ADG. Growth mindset and ADG are mediated by grit and academic self-efficacy, both of which play a serial mediating role between the aforementioned variables. Specifically, individuals with a high-growth mindset exhibited greater grit and increased academic self-efficacy, thus enhancing their ability for ADG. This study highlighted the importance of a growth mindset in promoting ADG among students in junior high school, and the necessity of cultivating grit and academic self-efficacy in the field of education.

Although this paper provides more insight into the relationship between growth mindset and ADG, it still has several limitations. First, the causal relationship between the variables cannot be fully inferred since this research utilised a cross-sectional design. In future research, longitudinal tracking or intervention experiments should be designed to further explain the long-term effect of a growth mindset on ADG. Second, this study revealed the internal mechanism in terms of personality traits and beliefs. Situated expectancy-value theory⁸⁷ emphasises that task choices are influenced by the importance, value, interest, and cost of success. It may also be worthwhile to investigate whether the individual perceptions and expectations of the task value mediate growth mindset and ADG. In addition, as stated in the conservation of resources theory,⁸⁸ specific internal resources are consumed in the process of enhancing the ADG, and individuals who possess more resources are less vulnerable to resource loss, and they have greater opportunities to obtain resources. Consequently, future studies can examine the reinforcing effect of external resources, such as social support and school atmosphere, on the association between growth mindset and ADG to explore the gain of external resources on internal resources.

Ethical Approval

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Henan Normal University. Written informed consent was provided from all participants. We also obtained written informed consent from the parents of participants under the age of 18 in this study.

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Disclosure

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