



# Building Grit: The Longitudinal Pathways between Mindset, Commitment, Grit, and Academic Outcomes

Xin Tang<sup>1</sup> · Ming-Te Wang<sup>2</sup> · Jiesi Guo<sup>3</sup> · Katariina Salmela-Aro<sup>1</sup>

Received: 1 December 2018 / Accepted: 6 February 2019 / Published online: 20 February 2019  
© The Author(s) 2019

## Abstract

Despite academics' enthusiasm about the concept of grit (defined as consistency of interest and perseverance of effort), its benefit for academic achievement has recently been challenged. Drawing from a longitudinal sample ( $N = 2018$ ; 55.3% female; sixth–ninth grades) from Finland, this study first aimed to investigate and replicate the association between grit and achievement outcomes (i.e., academic achievement and engagement). Further, the present study examined whether growth mindset and goal commitment impacted grit and whether grit acted as a mediator between growth mindset, goal commitment, and achievement outcomes. The results showed that the perseverance facet of grit in the eighth grade was associated with school achievement and engagement in the ninth grade, after controlling for students' conscientiousness, academic persistence, prior achievement and engagement, gender and SES, although the effect on engagement was stronger than on achievement. In addition, grit was predicted by goal commitment in the sixth grade, but not by the growth mindset in the sixth grade. Finally, the perseverance of effort (not the consistency of interest) mediated the effect of goal commitment on engagement. These findings suggest that grit is associated with increased engagement and academic achievement; and practitioners who wish to improve grit of adolescents may encourage goal commitment more than growth mindset.

**Keywords** Grit · Growth mindset · Goal commitment · Longitudinal data · GPA · Engagement

## Introduction

Academic learning is an incremental process that requires perseverance of effort, particularly in the face of challenges and setbacks (Binning et al. 2018). Recent research has shown that *grit*, defined as passion and persistence in the pursuit of long-term goals, is an important factor related to student engagement and academic success (Duckworth et al. 2007; Duckworth and Quinn 2009; Eskreis-Winkler

et al. 2014). That is, students who work hard but also love what they do are more likely to overcome barriers and perform better (Dweck et al. 2014).

The construct of grit has been described as a resource of psychological strength, which is unique and integral to Finnish culture and the collective academic discourse. In fact, the Finnish word *sisu*, which is often translated as grit, denotes a determination to overcome adversity and is perceived by Finns as a hallmark of their national character (Duckworth 2016). With grit, Finnish people survived through the harsh, cold winter and invasion of Soviet Union, and became one of the most technically advanced and happiest countries in the world (Nylund 2018). Despite the prominent role of grit in academic learning in general and in Finnish culture specifically, few empirical studies using a longitudinal research design have examined the factors that promote grit among adolescents and in particular in the Finnish school setting. As such, this study focuses on two theoretically-driven psychological precursors (i.e., growth mindset and goal commitment), examining whether adolescents who have a growth mindset and high commitment to their educational goals tend to be gritty in academic learning. This study also investigates the

---

These authors contributed equally: Ming-Te Wang, Jiesi Guo

✉ Xin Tang  
xin.tang@helsinki.fi

<sup>1</sup> Faculty of Educational Sciences, University of Helsinki, Helsinki, Finland

<sup>2</sup> Departments of Psychology and Education, and Learning Research and Development Center, University of Pittsburgh, Pittsburgh, USA

<sup>3</sup> Institute for Positive Psychology and Education, Australian Catholic University, Sydney, Australia

extent to which grit acts as a mediator in the relationship between growth mindset, goal commitment, and academic outcomes (i.e., Grade Point Average [GPA] and engagement).

### Grit, Academic Achievement and Engagement

Grit is related to retention and performance in the military, the workplace, and school (Duckworth et al. 2007; Duckworth and Quinn 2009; Eskreis-Winkler et al. 2014). In the school context, grit has been associated with indicators of academic achievement, such as students' current GPA (Muenks et al. 2017; Muenks et al. 2018) and future GPA (Duckworth and Quinn 2009) in high schools. Recently, the role of grit in academic achievement has been challenged due to only low-to-moderate correlations between these two constructs, as well as grit's low incremental validity above and beyond conscientiousness (see the meta-analysis review by Credé et al. 2017) and self-regulation (Muenks et al. 2017). One possible explanation for these findings is that most extant studies have used an overall sum score of grit by aggregating two facet-level scores (see Credé et al. 2017; Guo, Tang, & Xu, 2019). When grit was examined as two separate dimensions (i.e., the consistency of interests [CI] and the perseverance of effort [PE]), PE showed stronger correlations with academic achievement than CI or overall grit scores (Credé et al. 2017; Muenks et al. 2017). In response to prior limitations, this study conceptualized grit as these two dimensions (i.e., PE and CI) to better reveal the associations between grit and academic outcomes.

It is noteworthy that one recent study (Steinmayr et al. 2018) used relative weight analysis to examine grit in two German adolescent samples, finding that grit subscales (mainly those for PE) added only little-explained variance (3–6%) to academic achievement after controlling for prior school grades, personality traits, school engagement, values, self-efficacy, and other motivation variables. In Steinmayr and colleagues' (2018) study, the effect of grit on achievement was smaller than that of ability self-concept, expectancies of success, or school engagement. However, grit had similar effect sizes to those of self-efficacy, achievement value, and interest in predicting achievement. Given that few empirical studies of grit have been conducted in Finland, one aim of this study was to examine whether the association between grit and academic achievement would be replicated in the Finnish school context because of the salience of and emphasis on grit within the Finnish culture.

In addition to GPA, grit has been positively associated with another indicator of academic outcomes: school engagement (Muenks et al. 2017; Steinmayr et al. 2018); yet many extant studies have treated engagement as a covariate instead of an outcome (Muenks et al. 2017, 2018;

Steinmayr et al. 2018). By including engagement and achievement as outcomes, the differential effects between grit and achievement and grit and engagement can be examined, therefore uncovering other benefits that grit may bring to students' learning. As student engagement has shown to be an important school factor for students' achievement and wellbeing (Archambault et al. 2009; Wang and Eccles 2012), engagement shall be examined as an independent academic outcome of grit.

Furthermore, most existing studies of grit and engagement have used cross-sectional data. To date, there appears to be only one published longitudinal study and this short-term (4-month) longitudinal study (O'Neal et al. 2018) found a reciprocal relationship between grit and school engagement: grit predicted later school engagement, and in turn, school engagement predicted grit in the third wave. However, O'Neal and colleagues' study was limited to a sample of dual-language learners in primary school (third–fifth grade). Given that adolescents often disengage from school and lose study interest (Wigfield et al. 2015), it is important to understand how to promote grit and engagement during the secondary school years.

### Psychological Antecedents of Grit

Researchers have argued that grit is a malleable trait (Duckworth 2016; Park et al. 2018), and Duckworth (2016) discussed possible psychological sources of grit (i.e., interest, deliberate practices, purpose, and hope). Scant empirical studies have examined the antecedents of grit, with existing studies indicating that life purpose commitment (Hill et al. 2016) and self-reported mindfulness (Raphiphattana et al. 2018) are potential precursors to grit. However, both of these studies used samples of undergraduates, thus providing little knowledge on the antecedents of grit among adolescents in secondary school. Another recent study demonstrated that the type of goal orientation embedded within a school's culture matters in the development of grit among adolescents students: When adolescents perceived their school environment as mastery-oriented, they displayed a higher level of grit (Park et al. 2018). As can be seen, the extant literature on adolescent students' grit remains in its nascent stages. Research that explores the predictive factors of grit in adolescence is sorely needed, as these studies could illuminate important practical implications for schools and students that address adolescents' declining engagement, motivation, and willingness to learn after entering secondary school (Upadaya and Salmela-Aro 2013; Wigfield et al. 2015).

In the present study, two psychological antecedents of grit—growth mindset and commitment towards education-related goals—were examined. Mindset, also known as the implicit theory of intelligence, is the belief an individual

holds about the developmental nature of intelligence (Dweck 1986). A growth mindset reflects the belief that intelligence is malleable and can be improved through practice and hard work. Conversely, a fixed mindset is the belief that intelligence is a finite ability that cannot be changed or improved (Dweck 1986). According to Dweck (1986), people with a growth mindset tend to have learning goals oriented towards mastery; therefore, these individuals are more likely to view challenges as learning opportunities, be open to failure, and show high persistence in the face of difficulties and setbacks. In other words, a growth mindset is hallmarked by perseverance in learning efforts and displaying high consistency in pursuing their learning goals, two elements central to the concept of grit. In fact, the theoretical assumption that growth mindset improves grit has been discussed widely (e.g., Dweck et al. 2014; Duckworth 2016), despite the absence of empirical studies that would validate this assumption.

In addition to mindset, the present study also examines goal commitment as a precursor of grit. According to Klein, et al. (2013), goal commitment is a volitional psychological bond reflecting the dedication to a specific goal. Thus, high commitment toward a goal encourages individuals adhering to their goal and being persistence and consistency in their goal achieving process, which are notably associated with grit (Duckworth 2016). One previous study (Hill et al. 2016) found that having a life purpose and being highly committed to this purpose predicts grit among undergraduates. Accordingly, in the school context, it is reasonable to assume that students who have a strong commitment towards an educational goal (e.g., good grades, attending university) display high grit in their daily school learning.

### Grit as a Mediator

Studies have shown that growth mindsets are positively associated with academic achievement (see meta-analysis review Costa and Faria 2018). Indeed, interventions (Blackwell et al. 2007; Yeager et al. 2016) have demonstrated that encouraging students to adopt growth mindset improves their academic achievement. As such, it appears that the underlying mechanism behind this relationship is that individuals with a growth mindset attribute their successes and failures to effort and practice rather than to ability (Dweck 1986).

Students with a growth mindset are more likely to perceive challenges and setbacks as opportunities to learn; therefore, they tend to show persistence in the face of obstacles and pay more attention to coping with problems. This persistence and attention, in turn, lead to academic success in school (Dweck et al. 2014). Consequently, grit may act as a mediator between growth mindset and academic engagement and achievement. For example, Zeng,

Hou, and Peng's (2016) cross-sectional study indicated that students' resilience mediated the relationship between growth mindset, school engagement, and wellbeing. Unfortunately, there does not appear to be any empirical longitudinal studies examining the association between grit, mindset, academic achievement, and school engagement.

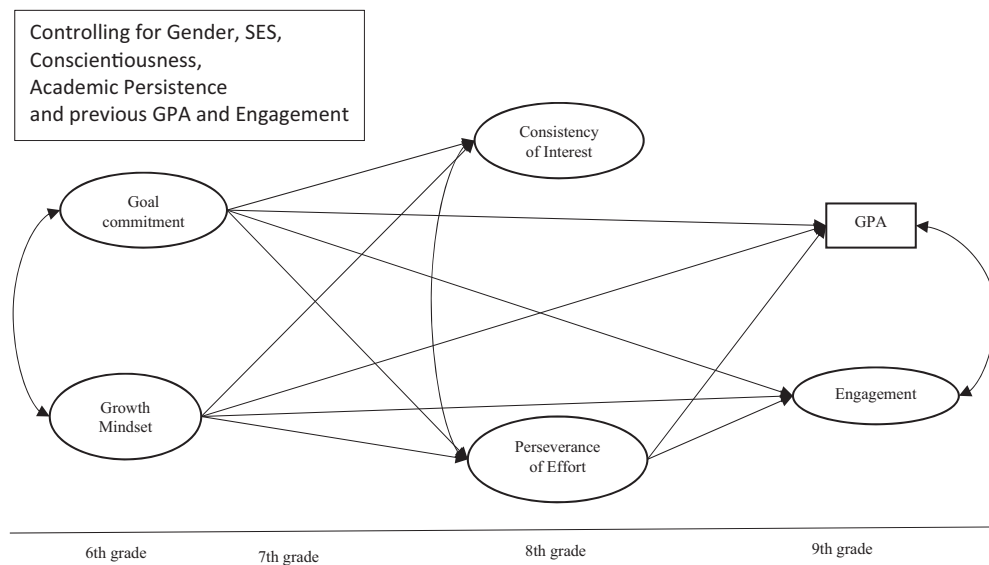
It is also plausible that grit acts as a mediator between goal commitment, school engagement, and academic achievement. According to the goal-setting theory (Locke and Latham 2002), having a goal leads an individual to direct their attention and energize their efforts, which in turn positively affects their performance. When goals are challenging and require intensive efforts, commitment has been shown to be the most significant predictive factor as to whether people stick with or abandon their goals as compared to other factors, such as feedback and incentives (Locke and Latham 2002). Besides, some studies have established the relationship between goal commitment, effort, persistence, and performance (Chang et al. 2009; Klein et al. 2013).

### Current Study

To address limitations in existing research and advance scholarly discourse, this study examines the longitudinal association between growth mindset, goal commitment, grit, academic achievement, and school engagement among sixth through ninth graders enrolled in Finnish secondary schools. In this study, conscientiousness, academic persistence, previous achievement and engagement, gender, and socioeconomic status were included as covariates, given that grit has been suggested to conceptually overlap with conscientiousness and self-control and shows no strong incremental validity over them (Credé et al. 2017; Muenks et al. 2017). In sum, this study addressed three primary questions (see Fig. 1 as the theoretical framework).

First, does Finnish adolescents' grit (i.e., consistency of interest and perseverance of effort) influence their academic achievement and engagement, after controlling for conscientiousness, academic persistence, previous achievement and engagement, gender and socio-economic status? According to recent findings (Credé et al. 2017; Muenks et al. 2017), the authors hypothesize that *perseverance of effort*, rather than *consistency of interest*, will be positively associated with achievement and engagement (Hypothesis 1).

Next, this study investigates whether adolescents' growth mindset and commitment to an education-related goal impact their level of grit. Based on theories of intelligence (Dweck 1986) and goal-setting (Locke and Latham 2002), the authors expect that students with a growth mindset (Hypothesis 2a) and commitment to an educational goal (Hypothesis 2b) are more likely to have a higher level of grit.



**Fig. 1** Theoretical model

Finally, this study asks whether grit mediates the pathway between growth mindset, goal commitment, and academic outcomes (i.e., engagement and achievement). Given that the growth mindset and goal commitment have been shown to (a) correlate with academic performance and engagement and (b) lead to persistence when facing challenges and suffering setbacks, the authors expect that grit will mediate the link among mindset-outcomes (Hypothesis 3a) and commitment-outcomes (Hypothesis 3b). Furthermore, the authors expect that the mediation effect of grit will mainly lie in its *perseverance of effort* facet (Hypothesis 3c), as recent empirical studies have demonstrated perseverance of effort to have a stronger association with achievement and engagement than will *consistency of interest* and overall grit (Credé et al. 2017; Muenks et al. 2017).

## Methods

The sample in the present study consisted of Finnish adolescents (sixth–ninth grades) who participated in the Mind-the-Gap longitudinal study (2013–2016). During the first assessment (sixth grade), the sample included 747 students from 33 schools (55.8% female, ages 12–13). In each subsequent year, the study sought to track the students who had participated in the previous assessment(s) while also incorporating students who had become members of Mind-the-Gap classrooms since the initial assessment. This strategy resulted in the following sample sizes for data collection in 2014, 2015, and 2016: 1296 students in seventh grade (56.4% female), 1166 students in eighth grade (57.4% female), and 853 students in ninth grade (59.9% female). Across all four assessments (i.e., sixth–

ninth grade), a total of 2018 students (55.3% female) took part in the study. 59.91% of the sample ( $N = 1,209$ ) participated in at least two assessments, and 33.89% ( $N = 684$ ) took part in at least three assessments. The response rate at each time wave was high, with missing data rates being 1.5%, 1.8%, 3.8% and 15% from sixth to ninth grade, respectively. The questionnaire was administered during school hours and took about an hour to complete. Participation was voluntary, and informed consent forms were collected from both the students and their parents.

## Measurements

### Grit

Students' grit was measured using the short version of the grit scale (8 items; Duckworth and Quinn 2009) in the eighth grade (Wave 3). In this short scale, four items addressed the students' consistency of interests (CI: e.g., "I often set a goal but later choose to pursue a different one"), and four items tapped the students' perseverance of effort (PE: e.g., "I am diligent"). The participants indicated their agreement with each item on a scale of 1 = *not at all like me*, to 5 = *very much like me*. The Cronbach alpha in this study for CI was .70 and for PE, .78.

### Growth mindset

The students' mindsets about learning and ability were assessed using six items (e.g., "Intelligence is something about a person that they can't change very much", "Conscientiousness and diligence are human qualities that are hard to change by oneself.") adopted from the Growth

Mindset Measure (Blackwell et al. 2007) in the first wave (sixth grade). Participants were asked to indicate their agreement with each item on a scale of 1 = *Completely disagree* to 5 = *Completely agree*. Two items (e.g., “Some people are more hardworking by nature than others.” and “A person can achieve almost anything if they really want to and are willing to work for it.”) were removed from further analyses due to their poor factor loadings (<.1). The remaining four items ( $\alpha = .68$ ) were then reverse coded, with higher scores representing students who had more of a growth than a fixed mindset.

### Education-related goal commitment

The revised version of the Personal Project Analysis Inventory (B. R. Little 1983) was used to measure the education-related personal goal assessment in the sixth grade (Wave 1). First, participants were asked to write down one personal goal related to school and education. Then they were asked to appraise this goal and specify their goal-directed behaviors (see Flunger et al. 2016). Goal commitment was measured using three items (e.g., “How committed are you to this goal?”, “How important is this goal?”;  $\alpha = .76$ ). The items were rated on a seven-point Likert-type scale, ranging from 1 = *not at all* to 7 = *very much*.

### Academic engagement

The present study assessed academic engagement using the Schoolwork Engagement Inventory (EDA; Salmela-Aro and Upadaya 2012) in the ninth grade (Wave 4). The EDA measures energy (three items, e.g., “When I study, I feel that I am bursting with energy”), dedication (three items, e.g., “I am enthusiastic about my studies”), and absorption (three items, e.g., “Time flies when I’m studying”) in relation to school. Participants rated all items on a seven-point Likert-type scale ranging from 1 = *Never* to 7 = *Every day*. In this study, the Cronbach alphas for the subscales and the overall scale were .85, .86, .83 and .95, respectively.

### Academic achievement

Students’ grade point averages (GPAs) were obtained from school records in each subject in the spring and fall term of the ninth grade. This data enabled us to calculate their GPA based on two terms.

### Covariates

Gender, SES, conscientiousness, and academic persistence were assessed using self-report items at Wave 3 (eighth grade). Seventh grade (Wave 2) GPA and engagement were

included as covariates as well. SES was determined by asking participants to rate their family’s financial situation (1 = *bad* to 5 = *good*). Conscientiousness was measured by two items (“I can be careless sometimes” and “I tend to be lazy”;  $\alpha = .64$ ) on a five-point Likert-type scale (i.e., 1 = *Completely disagree* to 5 = *Completely agree*), and these responses were reverse-coded for further analyses. The measure for academic persistence was adapted from the Achievement Goal Orientation Scale-academic withdrawal (Niemi-virta 2002), which consisted of three items (e.g. “I have realized that I give up easily if school tasks are difficult.”;  $\alpha = .81$ ) rated on a seven-point Likert scale (1 = *Not true at all* to 7 = *Very true*). These responses were also reverse coded for further analyses.

### Analysis Strategy

The missing completely at random test (MCAR; Little 1988) for each variable revealed that data was not missing completely at random. Since this study used a longitudinal design using a “snowball” strategy for the sample recruitment, a series of attrition tests were conducted to compare the key studied variables of those who participated in the following data collection and those who dropped out. The sixth graders who also participated in the seventh grade ( $N = 411$ ) and those who quit the study ( $N = 336$ ) did not differ in terms of their gender ( $\chi^2 = .00$ ,  $p = .96$ ), growth mindset ( $t = 1.19$ ,  $p = .23$ ), engagement ( $t = 1.54$ ,  $p = .12$ ), or GPA ( $t = 1.81$ ,  $p = .07$ ) in the sixth grade. The seventh graders who also participated in the eighth grade ( $N = 768$ ) and those who did not ( $N = 528$ ) did not differ in terms of goal commitment ( $t = 1.23$ ,  $p = .22$ ), engagement ( $t = -.07$ ,  $p = .95$ ) or GPA ( $t = 1.64$ ,  $p = .10$ ) in the seventh grade; however, more girls than boys participated in the following data collection (i.e., eighth grade;  $\chi^2 = 5.52$ ,  $p < .05$ ). The eighth graders who also participated in the ninth grade ( $N = 603$ ) and those who did not ( $N = 563$ ) did not differ in terms of Grit-CI ( $t = -.42$ ,  $p = .67$ ), SES ( $t = 1.45$ ,  $p = .15$ ), academic persistence ( $t = 1.65$ ,  $p = .10$ ) or conscientiousness ( $t = .35$ ,  $p = .72$ ) in the eighth grade, but those who stayed in the ninth grade had higher Grit-PE ( $t = 2.03$ ,  $p < .05$ ), engagement ( $t = 2.26$ ,  $p < .05$ ) and GPA ( $t = 5.08$ ,  $p < .001$ ) in the eighth grade, and tended to be girls rather than boys ( $\chi^2 = 5.02$ ,  $p < .05$ ). Full Information Maximum Likelihood (FIML) estimation with the robust maximum likelihood estimator was used to handle the missing data.

In this study, structural equation modeling (SEM) was used for the path analyses and was conducted in Mplus (Version 8.2; Muthén and Muthén 1998–2018). In order to see the unique role of grit beyond its competitive constructs (e.g., conscientiousness and academic persistence), three models were run separately. The first model included

**Table 1** Descriptives and correlations among studied variables

	1 GROW6	2 GCOM6	3 CI8	4 PE8	5 CONS8	6 Aca_per8	7 SES	9 Gender	10 GPA7	11 ENG7	12 GPA9	13 ENG9
1 GROW6												
2 GCOM6	.08											
3 CI8	.09	.08										
4 PE8	.15*	.31**	.09									
5 CONS8	.05	.14†	.48**	.30**								
6 Aca_per8	.13*	.12†	.52**	.39**	.45**							
7 SES	.05	.28**	.06	.28**	.05	.14**						
9 Gender	.02	−.00	.03	−.03	.02	.07†	.10**					
10 GPA7	.32**	.18**	.05	.29**	.14**	.31**	.06†	−.22**				
11 ENG7	.09	.32**	.07	.46**	.19**	.20**	.13**	−.01	.20**			
12 GPA9	.30**	.13*	.06	.37**	.18**	.34**	.10**	−.21**	.87**	.20**		
13 ENG9	.04	.26**	.11*	.44**	.17**	.24**	.18**	−.06†	.18**	.51**	.26**	
Mean	3.12	5.79	3.19	3.33	3.20	4.57	3.96	1.45	8.18	4.25	8.23	4.32
SD	.88	.95	.74	.79	.66	1.41	.98	.50	.86	1.49	1.01	1.48
Range	1–5	1–7	1–5	1–5	1–5	1–7	1–5	1–2	5–10	1–7	5–10	1–7

Note. Number after name denotes measurement grade level

GROW growth mindset, GCOM goal Commitment, CI consistency of interest, PE perseverance of effort, CONS conscientiousness, Aca\_per academic persistence, SES social economic status, ENG engagement

† $p < .10$ , \* $p < .05$ , \*\* $p < .01$ ;

grit-CI and grit-PE as mediators and gender and SES as covariates. The second model added conscientiousness and academic persistence as extra mediators to examine the unique role of grit. The final model added previous GPA and engagement as additional covariates to see whether the grit effect remained.

## Results

Confirmatory factor analysis (CFA) was first used to assess factor structure and inter-correlations among all variables included in this study. Mean scores, standard deviations, and correlations between the latent variables are listed in Table 1. The CFA provided a good fit,  $\chi^2 = 2377.74$ ,  $p < .001$ , CFI = .92, TLI = .91, RMSEA = .03. The sizes of all factor loadings were acceptable, ranging from .36 to .88. As shown in Table 1, growth mindset and goal commitment were more highly correlated with grit-PE ( $r_s = .15$ –.31) than with grit-CI ( $r_s = .08$ –.09). Grit-CI had stronger associations with conscientiousness and academic persistence ( $r_s = .48$ –.52) than grit-PE ( $r_s = .30$ –.39). Moreover, engagement and GPA were more closed with grit-PE ( $r_s = .29$ –.46) than grit-CI ( $r_s = .05$ –.11).

The first mediation model (i.e., grit-CI and grit-PE as the only mediators; gender and SES as covariates) showed a good model fit,  $\chi^2 = 1042.68$ ,  $p < .001$ , CFI = .92, TLI = .90, RMSEA = .04 (see Appendix Table 3 and Fig. 4). The second mediation model, which added

conscientiousness and academic persistence as extra mediators, still displayed good model fit,  $\chi^2 = 1390.03$ , CFI = .91, TLI = .90, RMSEA = .03 (see Table 2 and Fig. 2). The model fit for the final mediation model when adding 7<sup>th</sup> grade GPA and engagement as extra covariates, was also good,  $\chi^2 = 2377.74$ , CFI = .92, TLI = .91, RMSEA = .03 (see Table 2 and Fig. 3).

## Grit and Academic Outcomes

After all covariates (i.e., conscientiousness, academic persistence, prior GPA and engagement, gender and SES) were entered (Model 3), PE affected both GPA ( $\beta = .12$ ,  $p < .01$ ) and engagement ( $\beta = .22$ ,  $p < .01$ ) significantly. In other words, a higher PE was associated with later achievement and engagement in school after grit's competitive constructs (i.e., conscientiousness and academic persistence), the students' GPA and engagement, and demographic variables were taken into account. However, CI did not affect GPA ( $\beta = -.03$ ,  $p = .26$ ) or engagement ( $\beta = .05$ ,  $p = .44$ ) after including control variables.

## Growth Mindset, Goal Commitment, and Grit

Before prior GPA and engagement were entered into the model, Model 2 showed that growth mindset positively related with PE ( $\beta = .14$ ,  $p = .05$ ), but not CI ( $\beta = .10$ ,  $p = .20$ ); however, the effect of growth mindset on PE disappeared after prior GPA and engagement were included

**Table 2** Total effects, indirect effects, and direct effects for mediation model 2 and model 3

	Model 2 <sup>a</sup>				Model 3 <sup>b</sup>			
	CI $\beta$ (SE)	PE $\beta$ (SE)	GPA $\beta$ (SE)	Engagement $\beta$ (SE)	CI $\beta$ (SE)	PE $\beta$ (SE)	GPA $\beta$ (SE)	Engagement $\beta$ (SE)
<i>Growth mindset</i>								
Direct effect	.10 (.08)	.14 <sup>†</sup> (.07)	.21** (.05)	.05 (.07)	.08 (.09)	.05 (.07)	.02 (.03)	-.05 (.07)
Total indirect effect	–	–	.06* (.03)	.06* (.03)	–	–	.01 (.01)	.02 (.02)
Specific indirect effect								
GROW->CI->DV	–	–	-.02 (.01)	.00 (.01)	–	–	-.00 (.00)	.00 (.01)
GROW->PE->DV	–	–	.03* (.01)	.05 <sup>†</sup> (.03)	–	–	.01 (.01)	.01 (.02)
GROW->AP->DV	–	–	.04* (.02)	.01 (.01)	–	–	.00 (.01)	.00 (.00)
GROW->CONS->DV	–	–	.00 (.00)	.00 (.00)	–	–	.00 (.00)	.00 (.00)
Total effect	–	–	.27** (.05)	.02 (.07)	–	–	.03 (.03)	-.03 (.07)
<i>Goal commitment</i>								
Direct effect	.10 (.07)	.29** (.07)	.01 (.06)	.13 (.09)	.06 (.08)	.15* (.07)	-.07* (.02)	.05 (.09)
Total indirect effect	–	–	.09** (.03)	.11** (.03)	–	–	.02 <sup>†</sup> (.01)	.04* (.02)
Specific indirect effect								
GCOM->CI->DV	–	–	-.02 (.01)	.00 (.01)	–	–	-.00 (.00)	.00 (.01)
GCOM->PE->DV	–	–	.06** (.02)	.10** (.03)	–	–	.02 <sup>†</sup> (.01)	.03* (.02)
GCOM->AP->DV	–	–	.04 <sup>†</sup> (.02)	.01 (.01)	–	–	.00 (.00)	.01 (.00)
GCOM->CONS->DV	–	–	.01 (.01)	-.00 (.01)	–	–	.00 (.00)	-.00 (.01)
Total effect	–	–	.10 <sup>†</sup> (.05)	.24** (.09)	–	–	-.05 <sup>†</sup> (.03)	.09 (.09)
<i>Covariates</i>								
SES	.01 (.02)	.08** (.02)	.01 (.04)	.07 (.06)	.04 (.04)	.21** (.04)	.04* (.02)	.06 (.05)
Gender	.01 (.01)	-.01 (.01)	-.47** (.06)	-.15 <sup>†</sup> (.09)	.03 (.04)	.01 (.04)	-.04* (.02)	-.06 (.04)
GPA7					.00 (.05)	.17** (.04)	.81** (.02)	.01 (.05)
ENG7					.04 (.06)	.37** (.05)	-.02 (.02)	.38** (.05)

Note. All coefficients shown are standardized

GROW growth mindset, GCOM goal commitment, CI consistency of interest, PE perseverance of effort, AP academic persistence, CONS conscientiousness, DV dependent variable (i.e., GPA and engagement)

<sup>†</sup> $p < .10$ , \* $p < .05$ , \*\* $p < .01$ .

<sup>a</sup>Controlled for gender, SES, conscientiousness, and academic persistence

<sup>b</sup>Adding previous GPA and engagement as extra covariates

( $\beta = .05$ ,  $p = .49$ , Model 3). In other words, the impact of growth mindset on grit was rather limited after prior GPA and engagement were considered. The relationship between goal commitment and grit was more stable. In Model 2, goal commitment significantly associated with grit-PE ( $\beta = .29$ ,  $p < .01$ ) but not grit-CI ( $\beta = .10$ ,  $p = .16$ ). After accounting for prior GPA and engagement (Model 3), goal commitment still affected grit-PE ( $\beta = .15$ ,  $p < .05$ ). Thus, when adolescents are committed to an educational goal, they tend to have high perseverance of effort.

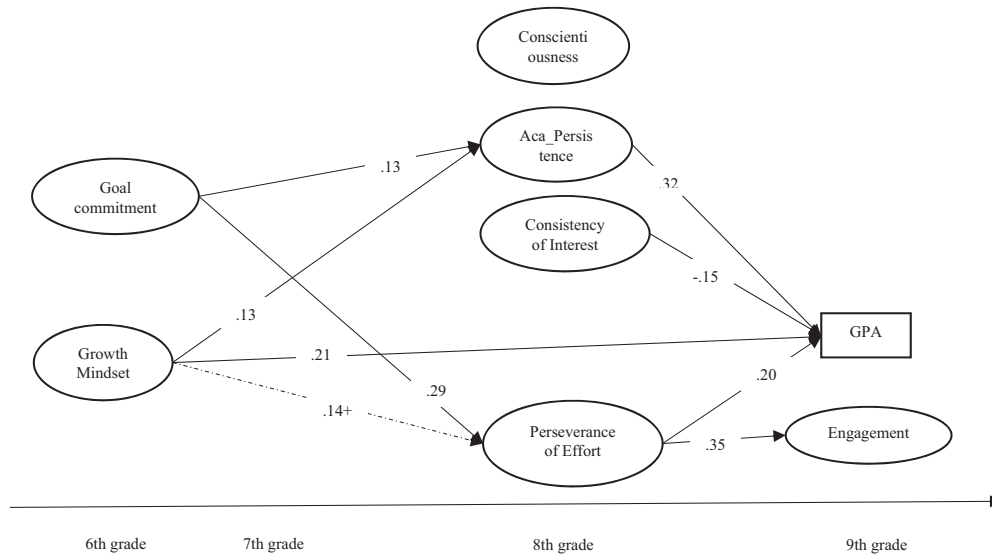
### Grit as a Mediator between Growth Mindset and Academic Outcomes

When only gender and SES were included as covariates (Model 1; see Appendix Table 3), results showed that grit-

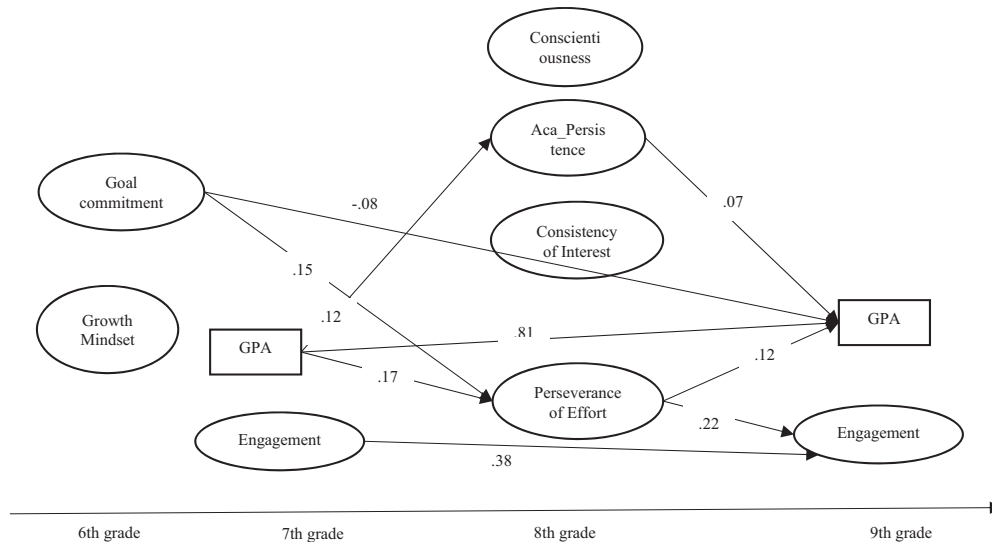
PE ( $\beta = .05$ ,  $p < .05$ ), and not grit-CI ( $\beta = .00$ ,  $p = .62$ ), mediated the pathway between growth mindset and GPA. This mediation effect by grit-PE still held after conscientiousness and academic persistence were included ( $\beta = .03$ ,  $p < .05$ ), but this effect did not hold when further including prior GPA and engagement as covariates ( $\beta = .01$ ,  $p = .49$ ). Grit-PE and grit-CI did not play a mediating role in the pathway between growth mindset and engagement in any of the three models.

### Grit as a Mediator between Goal Commitment and Academic Outcomes

Model 2, which controlled for conscientiousness, academic persistence, gender and SES, showed that grit-PE ( $\beta = .06$ ,  $p < .01$ ;  $\beta = .10$ ,  $p < .01$ ) but not grit-CI ( $\beta = -.02$ ,  $p = .21$ ;



**Fig. 2** Mediation model 2; adding academic persistence and conscientiousness as extra covariates. For the ease of model presentation, only significant path were presented



**Fig. 3** Mediation model 3; adding seventh grade achievement (GPA) and engagement as extra covariates. For the ease of model presentation, only significant path were presented

$\beta = .00, p = .99$ ) mediated the effects of goal commitment on GPA and engagement, respectively. Further analyses revealed that grit-PE ( $\beta = .03, p < .05$ ) still mediated the relationship between goal commitment and engagement, even after adding prior GPA and engagement to the model, but grit-PE ( $\beta = .02, p = .07$ ) did not serve as a mediator between goal commitment and ninth grade GPA. In other words, adolescents are likely to have higher PE when committed to an education-related goal, and this perseverance contributed to their higher school engagement.

### Alternate Model Analyses

Given that a transition period happened from sixth grade to seventh grade, the authors tested an alternate model that replaced sixth grade goal commitment with seventh grade goal commitment. However, growth mindset was only measured at the sixth grade in the study. Most of the original findings held in this alternative model and some associations were stronger among seventh grade goal commitment, eighth grade grit-PE, and ninth grade



engagement. For example, seventh grade goal commitment influenced grit-PE ( $\beta = .23, p < .01$ ) and grit-CI ( $\beta = .10, p = .06$ ) marginally. A stronger mediation effect of grit-PE ( $\beta = .08, p < .01$ ) was found between seventh grade goal commitment and engagement.

## Discussion

Although it has been proposed that grit is a psychological strength that promotes student engagement and achievement in academic learning, few empirical studies have attempted to investigate the determinants of two grit facets—perseverance of effort and consistency of interest—and their associations with adolescents' achievement outcomes, particularly in Finland. The findings indicated that grit, specifically the *perseverance of effort* facet, makes a unique contribution to promoting students' academic outcomes and engagement (Hypothesis 1). Moreover, although growth mindset had an impact on perseverance of effort over conscientiousness and academic persistence; its role as a precursor of grit was trivial after accounting for prior achievement and engagement. Results also demonstrated that goal commitment is a stronger precursor of grit than growth mindset. Finally, this study showed that perseverance of effort (but not consistency of interest) mediated the association between goal commitment and engagement.

### Engagement as a Stronger Outcome than Achievement

This study indicated that *grit-perseverance of effort* had a small but unique effect on adolescents' academic achievement in Finnish schools. Recent grit studies on adolescents from the U.S. (Muenks et al. 2017; Usher et al. 2018) and Germany (Steinmayr et al. 2018) have shown mostly null associations between grit and achievement when prior achievement and motivation-related variables were controlled for, although these findings have not been consistent, possibly varying according to the context. In another recent study, Park et al. (2018) drew an adolescent sample from the U.S. and found grit to have a modestly positive effect on achievement. The context of this study was in Finland, where the concept of *sisu* has been much appreciated and cultivated (Duckworth 2016). *Sisu*, a term (Nylund 2018) that mixes the meaning of courage, tenacity, or perseverance, characterizes the spirit of life for Finns. It is possible the adolescents growing up in Finland are more likely to accept and less likely to resist the value of perseverance than their counterparts in other Western countries. Finnish students may also be more likely to translate their beliefs and acts of perseverance into school-work, thus bolstering their academic achievement.

This study also found that *grit-perseverance of effort* had a greater impact on engagement than academic achievement. In other words, the higher association between grit and engagement may imply that engagement is a more proximal outcome of grit than achievement. One speculation about the weak relationship between grit and achievement is that the influence of grit on achievement may go through engagement or other variables such as studying efforts, and motivations (Usher et al. 2018). Indeed, recent studies have shown that school engagement mediates the relationship between grit and academic performance (O'Neal et al. 2018). In sum, these findings are significant and remit messages that more studies from other cultures or contexts are needed to replicate the associations between grit and achievement; and more academic outcomes, not limited to the academic achievement and engagement, need to be studied in relation to grit in the future.

### Goal Commitment as a Better Precursor than Growth Mindset

Behavior genetic studies (Vukasović and Bratko 2015) have confirmed that about 40% of someone's personality, which is often regarded as a stable and unchanged trait, is due to genetic reasons, leaving about 60% of personality variations attributable to environmental influences. In other words, a large part of human personalities can be changed, shaped, and cultivated. Conceptualized as a malleable trait (Duckworth 2016; Duckworth et al. 2007), grit is influenced by many external and internal forces. Although the growth mindset had been discussed extensively as a potential precursor for grit (Duckworth 2016; Dweck et al. 2014), the findings of the current study did not support this assumption (H2a). While growth mindset was found to significantly associate with *grit-perseverance of effort* (but not consistency of interest) when conscientiousness, academic persistence, and demographics were accounted for, the effect of growth mindset on *grit-perseverance of effort* disappeared once prior achievement and engagement were constrained in the model. This result may be partly due to the age groups of the samples—adolescents. Grit has been conceptualized as the passion and perseverance for a long-term goal; nonetheless, adolescents are still exploring and forming their identities and interests while simultaneously pursuing multiple goals (Flunger et al. 2016). Thus, it is likely that the growth mindset may have less influence on grit for adolescent students.

However, once adolescents have an education-related goal and commit to it, they are likely to have higher perseverance of effort, even after controlling for conscientiousness, academic persistence, prior academic achievement and engagement, gender, and socioeconomic status. This finding is in line with the authors' expectation

(H2b). In this study, goal commitment was measured by asking adolescents to write down one of their educational-related goals first, and then asking them to rate how committed they are in pursuing this goal. It is plausible that when adolescents are committed to this self-stated educational goal, they are more likely to show high persistence in their study efforts and interest in school (Klein et al. 2013; Locke and Latham 2002). This finding is also consistent with previous research showing that college students' grit was predicted by their life purpose commitment (Hill et al. 2016).

In short, the findings have two important implications for future studies of grit and interventions targeting grit. First, contrary to the much-discussed assumption (Duckworth 2016; Dweck et al. 2014), growth mindset may only act as a marginal predictor of grit, at least for adolescent groups. Second, encouraging adolescents to set a goal and to commit to this goal may help develop their grit.

### The Mediating Role of Grit

Given that a weak association between growth mindset and grit was observed in this study, it is not surprising that grit did not mediate the relationship between growth mindset and academic outcomes, which is inconsistent with the stated hypothesis (H3a). However, these results extend previous research by indicating that adolescents' educational goals and their level of commitment to these goals enhance grit-perseverance (rather than consistency of interest), which in turn increase engagement in schoolwork (H3b & H3c). The goal-setting theory posits that people with a goal and commitment to this goal would lead them to spend their effort intensively and to show persistence in finishing their goal (Locke and Latham 2002). Likewise, the four Cs - channeling, choice, co-agency, and compensation of the motivation model of life development (Salmela-Aro 2009) state that after setting personal goals, people engage in regulation of their goal-oriented efforts and activities that help them reach their goals. With extant evidence showing that adolescents have a natural decline in school engagement (Upadyaya and Salmela-Aro 2013; Wigfield et al. 2015), the mediation role of grit implies that grit and goal commitment can be targeted as important point for intervention for those hoping to increase adolescents' school engagement.

### Marginal Role of Grit-Consistency of Interest in Findings

Throughout the findings, *consistency of interest* consistently was not associated with growth mindset, goal commitment, grit, and academic outcomes. One reason for this absence,

as stated above, could be that the adolescent and young adult participants were actively exploring their identities and interests (Flunger et al. 2016). Accordingly, it is difficult to observe adolescents as holding a strong interest in specific things or goals, which may contribute to the weak relationship between consistency of interest and academic outcomes. Another explanation for these results may relate to measurement issues. Consistency of interest was measured by negatively worded items. These items are sometimes psychometrically problematic because they are more difficult to answer and tend to have lower reliability and validity (Credé 2018). Furthermore, there are issues with measuring grit as a factor in making long-term goals. Though Duckworth claimed that grit denotes passion and perseverance in pursuing a long-term goal, the measurement of grit itself does not sufficiently tap into the long-term feature of the concept (Credé 2018; Muenks et al. 2017). For example, in the item "I often set a goal but later choose to pursue a different one" the term *later* is ill-qualified to refer to long-term goals, and some other items do not even reflect or include the term *long-term* (e.g., "New ideas and projects sometimes distract me from previous ones."). Future research should refine grit measurement and examine whether the new items of *long-term* consistency of interest and perseverance of effort affect academic outcomes.

### Implications

During the last decade, grit has been introduced, popularized, and caught intensive attention both within and outside of academia. Many national and international institutes have started to include grit in their assessments of students' learning in school (National Assessment of Educational Progress 2017; OECD 2015), and policymakers have suggested that grit and other "non-cognitive" factors should be promoted in schools (Gutman and Schoon 2013; Zhou 2016). Most recent studies (Credé et al. 2017; Muenks et al. 2017; Usher et al. 2018), though, have challenged the effects of grit on academic achievement. By showing grit to have a unique but small incremental effect on academic achievement in the Finnish adolescents, the present study is opening a call to have more studies of grit and achievement from other countries and cultures. The majority of grit studies have been conducted in the United States (e.g., Duckworth et al. 2007; Eskreis-Winkler et al. 2014; Muenks et al. 2017), thus, the field needs studies with diversified samples to replicate previous findings to address the recent debate of the grit-achievement link (Credé et al. 2017). In addition, the finding that grit related more strongly to school engagement than to academic achievement supports the call for future research that explores other educational outcomes associated with grit. This study should be

regarded as a seminal work, with the hopes of sparking more studies of grit in more diversified samples with a wider range of academic outcomes.

For those who are interested in promoting grit in their classroom, school, or organizations, this study suggests that goal commitment, not the growth mindset, should be the target for enhancing grit, particularly for adolescents. This finding should underscore the importance of understanding youth development and inform policymakers and practitioners in their efforts to promote grit. So, what are the best possible ways to increase adolescents' commitment towards an educational-related goal? Eccles' theory of expectancy-value (Wigfield and Eccles 2000) and stage-environment fit (Eccles and Roeser 2009) suggests that the home context, school environment, and school-related experiences matter in student commitment. To promote this commitment, parents should value education, transfer their expectations for academic achievement to their children, and be involved in children's learning (Wang and Sheikh-Khalil 2014), while school should create an environment that promotes students' academic engagement, avoids negative learning experiences (e.g., burnout), and provides appropriate stage-fitted supports (Wang and Degol 2016). Locke (2002) and Klein (2013) have also suggested internal factors, such as goal importance, goal explicitness, and self-efficacy, they may help people to highly commit to and complete their goals.

### Limitations and Future Directions

This study has several limitations. First, this study examined only two psychological precursors of grit, but more of these factors exist, both on the psychological and social sides. For example, Duckworth (2016) discussed at least four psychological sources (i.e., interest, deliberate practice, purpose, and hope) and three social sources (i.e., parenting, participation in extracurricular activities, and culture) for developing grit. Perceived autonomy support has also been shown to predict persistence among professional swimmers (Pelletier et al. 2002). Hence, it is reasonable to assume that supportive parenting and autonomy granted by parents are related to grit. Future studies should examine other antecedents of grit to advance the knowledge about how to improve it.

Furthermore, future studies should also examine different indicators of academic outcomes, especially longitudinal indicators such as school/college choice and college completion. Previous studies (e.g., Eskreis-Winkler et al. 2014) have demonstrated that grit has strong associations with high school graduation after controlling for conscientiousness, academic achievement, demographics (e.g., gender, SES), and situational variables (e.g., perceived teacher support). Since grit conceptually includes striving for long-

term outcomes (Duckworth et al. 2007), researchers must examine how it affects adolescents' long-term academic outcomes in the future. In doing so, the most direct, strongest, and weakest products of grit can be determined, thereby providing knowledge about the boundaries of grit effects.

In addition, though this study used the longitudinal data, growth mindset was only measured at 6th grade and grit was not assessed at 7th grade. As such, the longitudinal mediation effect of grit is somehow limited in this study. Therefore, it would be beneficial in future research to study the dynamic associations among growth mindset, goal commitment, grit, and academic outcomes using the full longitudinal mediation design.

Finally, future studies should use alternative analysis methods, such as the person-oriented approaches (e.g., Guo et al. 2018), to study the effect of grit across multiple outcomes. For example, grit was conceptualized as perseverance and consistency in pursuing a long-term goal, but in the school context, this definition is likely to hold only among those with a strong personal goal related to their education (e.g., attending university). Those who choose personal goals other than education, such as sports or music, may "be gritty" but not show grit in their academic learning. Rather, these individuals might apply their grit to physical training or practice. Therefore, it is possible that these adolescents may have high-levels of grit that would be undetectable by a survey exclusively measuring academic grit, thus suggesting context- or activity-dependent grit. Person-oriented approaches can help scholars examine this phenomenon to better understand the complex connections between grit and achievements.

### Conclusion

Grit has sparked interest and enthusiasm of researchers and practitioners due to its potential benefit for facilitating positive youth development. However, the role of grit in academic achievement has been challenged recently due to its limited and inconsistent empirical evidence, and scholars have called for more studies across different contexts, developmental periods, and academic outcomes. This study demonstrated that in a culture with strong endorsement and appreciation of grit, adolescents' academic achievement and engagement can be potentially enhanced through fostering grit. These findings highlight the benefit of grit in promoting students' academic success and emphasized the necessity of conducting studies of grit in diverse contexts and samples. In order to help adolescents to be grittier in the school, growth mindset may not be the viable option as it has been hypothesized. In contrast, educational policy makers, practitioners, and school-based interventionists

who aim for promoting grit in adolescents shall consider focusing on goal commitment. Helping adolescents to set and develop a proper long-term goal on education and providing the supportive environment to achieve that goal may increase their level of grit, and in turn, promote adolescents’ engagement and achievement in the school.

**Data Availability**

The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request

**Acknowledgements** The author thanks the earlier comments and suggestions by Barbara Schneider.

**Authors’ Contributions** X.T. conceptually designed the study, carried out analyses, interpreted the results, and drafted and revised the manuscript; M.T.W. contributed to the conceptual design of the study and interpretation of the results, and reviewed and revised drafts of the manuscript; J.G. contributed to the conceptual design of the study and interpretation of the results, and reviewed and revised drafts of the manuscript. K.S.A. conceived the Mind-the-Gap project and reviewed and revised drafts of the manuscript. All authors read and approved the final manuscript.

**Funding** The study has been supported by the Academy of Finland Grants 263328 Mind-the-Gap, 273872 LEAD, 308351 Bridging the Gaps. Open access funding provided by University of Helsinki including Helsinki University Central Hospital.

**Data Sharing and Declaration** The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

**Compliance with Ethical Standards**

**Conflict of Interest** The authors declare that they have no conflict of interest.

**Ethical Approval** The study protocol was approved by the University of Helsinki Ethical Review Board in the Humanities and Social and Behavioral Sciences.

**Informed Consent** Participation was voluntary, and informed consent forms were collected from both the students and their parents.

**Publisher’s note:** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Open Access** This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, duplication, adaptation, distribution, and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

**Appendix**

Table 3 and Fig. 4

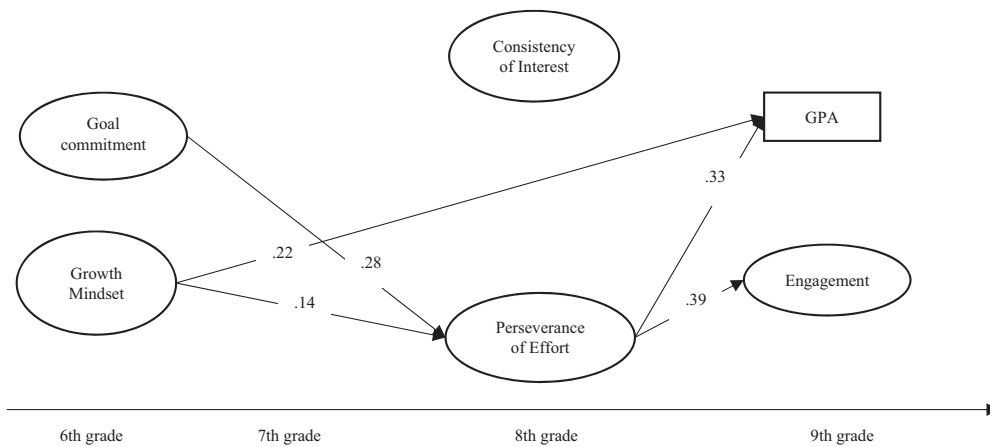
**Table 3** Total effects, indirect effects, and direct effects for mediation model 1

	CI		PE		GPA		Engagement	
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE
<i>Growth mindset</i>								
Direct effect	.10	.08	.14*	.07	.22**	.05	-.04	.07
Total indirect effect	–		–		.05*	.02	.06*	.03
Specific indirect effect								
GROW- > CI- > DV <sup>1</sup>	–		–		.00	.00	.00	.01
GROW- > PE- > DV <sup>1</sup>	–		–		.05*	.02	.05 <sup>†</sup>	.03
Total effect	–		–		.27**	.05	.02	.07
<i>Goal commitment</i>								
Direct effect	.10	.07	.28**	.07	.01	.05	.13	.09
Total indirect effect	–		–		.09**	.02	.11**	.02
Specific indirect effect								
GCOM- > CI- > DV <sup>1</sup>	–		–		.00	.00	.00	.01
GCOM- > PE- > DV <sup>1</sup>	–		–		.09**	.03	.11**	.03
Total effect	–		–		.10 <sup>†</sup>	.05	.24**	.09
<i>Covariates</i>								
SES	.03	.04	.20**	.04	.01	.04	.06	.04
Gender	.03	.04	-.04	.04	-.21**	.03	-.05	.04

Note. All coefficients shown are standardized

GROW growth mindset, GCOM goal commitment, CI consistency of interest, PE perseverance of effort, DV dependent variable (i.e., GPA and engagement)

<sup>†</sup>  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$ .



**Fig. 4** Mediation model 1. *Note.* SES and gender as covariates. Only significant paths were presented in the model for clarity

## References

- Archambault, I., Janosz, M., Morizot, J., & Pagani, L. (2009). Adolescent behavioral, affective, and cognitive engagement in school: Relationship to dropout. *Journal of School Health, 79*(9), 408–415. <https://doi.org/10.1111/j.1746-1561.2009.00428.x>.
- Binning, K.R., Wang, M. Te, & Amemiya, J. (2018). Persistence Mindset among Adolescents: Who Benefits from the Message that Academic Struggles are Normal and Temporary? *Journal of Youth and Adolescence*. <https://doi.org/10.1007/s10964-018-0933-3>
- Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Dev, 78* (1), 246–263. <https://doi.org/10.1111/j.1467-8624.2007.00995.x>.
- Chang, C.-H. D., Johnson, R. E., & Lord, R. G. (2009). Moving Beyond Discrepancies: The Importance of Velocity as a Predictor of Satisfaction and Motivation. *Human Performance, 23*(1), 58–80. <https://doi.org/10.1080/08959280903400226>.
- Costa, A., & Faria, L. (2018). Implicit Theories of Intelligence and Academic Achievement: A Meta-Analytic Review. *Frontiers in Psychology, 9*. <https://doi.org/10.3389/fpsyg.2018.00829>
- Credé, M. (2018). What Shall We Do About Grit? A Critical Review of What We Know and What We Don't Know. *Educational Researcher, 0013189X1880132*. <https://doi.org/10.3102/0013189X18801322>
- Credé, M., Tynan, M. C., & Harms, P. D. (2017). Much ado about grit: A meta-analytic synthesis of the grit literature. *J Pers Soc Psychol, 113*(3), 492–511. <https://doi.org/10.1037/pspp0000102>.
- Duckworth, A. L. (2016). *Grit: The Power of Passion and Perseverance*. New York, NY: Scribner.
- Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *J Pers Soc Psychol, 92*(6), 1087–1101. <https://doi.org/10.1037/0022-3514.92.6.1087>.
- Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the short Grit Scale (Grit-S). *J Pers Assess, 91*(2), 166–174. <https://doi.org/10.1080/00223890802634290>.
- Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist, 41*(10), 1040–1048. <https://doi.org/10.1037/0003-066X.41.10.1040>.
- Dweck, C.S., Walton, G.M., & Cohen, G.L. (2014). *Academic Tenacity: Mindsets and Skills that Promote Long-Term Learning*. Retrieved from <http://k12education.gatesfoundation.org/resource/academic-tenacity-mindsets-and-skills-that-promote-long-term-learning/>
- Eccles, J. S., & Roeser, R. W. (2009). Schools, Academic Motivation, and Stage-Environment Fit. In: Lerner, R. M., & Steinberg, L., (eds.) *Handbook of Adolescent Psychology*. Hoboken, NJ, USA: John Wiley & Sons, Inc.
- Eskreis-Winkler, L., Shulman, E.P., Beal, S.A., & Duckworth, A.L. (2014). The grit effect: predicting retention in the military, the workplace, school and marriage. *Frontiers in Psychology, 5* (FEB). <https://doi.org/10.3389/fpsyg.2014.00036>
- Flunger, B., Marttinen, E., Tuominen-Soini, H., & Salmela-Aro, K. (2016). How Do Young Adults Orchestrate Their Multiple Achievement-Related Goals? Associations of Achievement Goal Orientations With Identity Formation and Goal Appraisals. *Res Hum Dev, 13*(4), 342–362. <https://doi.org/10.1080/15427609.2016.1234309>.
- Guo, J., Wang, M.-T., Ketonen, E. E., Eccles, J. S., & Salmela-Aro, K. (2018). Joint trajectories of task value in multiple subject domains: From both variable- and pattern-centered perspectives. *Contemp Educ Psychol, 55*, 139–154. <https://doi.org/10.1016/j.cedpsych.2018.10.004>.
- Guo, J., Tang, X., & Xu, K. M. (2019) Capturing the multiplicative effect of perseverance and passion: measurement issues of combining two grit facets. Proceedings of the National Academy of Sciences, 201820125, <https://doi.org/10.1073/pnas.1820125116>.
- Gutman, L. M., & Schoon, I. (2013). The impact of non-cognitive skills on outcomes for young people: Literature review. (pp. 1–59). London England: Education Endowment Foundation. [https://v1.educationendowmentfoundation.org.uk/uploads/pdf/Non-cognitive\\_skills\\_literature\\_review\\_1.pdf](https://v1.educationendowmentfoundation.org.uk/uploads/pdf/Non-cognitive_skills_literature_review_1.pdf). (November) Retrieved from..
- Hill, P. L., Burrow, A. L., & Bronk, K. C. (2016). Persevering with Positivity and Purpose: An Examination of Purpose Commitment and Positive Affect as Predictors of Grit. *J Happiness Stud, 17*(1), 257–269. <https://doi.org/10.1007/s10902-014-9593-5>.
- Klein, H. J., Cooper, J. T., & Monahan, C. A. (2013). Goal Commitment. In E. A. Locke & G. P. Latham (Eds.), *New Developments in Goal Setting and Task Performance* (pp. 65–89). New York: Routledge. <https://doi.org/10.4324/9780203082744>
- Little, B. R. (1983). Personal projects: A Rationale and Method for Investigation. *Environ Behav, 15*(3), 273–309. <https://doi.org/10.1177/0013916583153002>.
- Little, R.J.A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association, 83*(401), 1193–1201. <https://doi.org/10.1080/01621459.1988.10478722>
- Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey.

- American Psychologist*, 57(9), 705–717. <https://doi.org/10.1037/0003-066X.57.9.705>.
- Muenks, K., Wigfield, A., Yang, J. S., & O'Neal, C. R. (2017). How true is grit? Assessing its relations to high school and college students' personality characteristics, self-regulation, engagement, and achievement. *J Educ Psychol*, 109(5), 599–620. <https://doi.org/10.1037/edu0000153>.
- Muenks, K., Yang, J. S., & Wigfield, A. (2018). Associations between grit, motivation, and achievement in high school students. *Motivation Science*, 4(2), 158–176. <https://doi.org/10.1037/mot0000076>.
- Muthén, L. K., & Muthén, B. O. (1998–2018). Mplus users guide and Mplus version 8.2. Retrieved from 10 Nov 2018, <http://www.statmodel.com/index.shtml>.
- National Assessment of Educational Progress. (2017). Nation's report card: Survey questionnaires. Retrieved from 5 Oct 2018, [https://nces.ed.gov/nationsreportcard/experience/survey\\_questionnaires.aspx](https://nces.ed.gov/nationsreportcard/experience/survey_questionnaires.aspx).
- Niemivirta, M. (2002). Motivation and performance in context: The influence of goal orientations and instructional setting on situational appraisals and task performance. *PSYCHOLOGIA -An International Journal of Psychology in the Orient*, 45(4), 250–270. <https://doi.org/10.2117/psysoc.2002.250>.
- Nylund, J. (2018). *Sisu: The Finnish Art of Courage*. London, Great Britain: Octopus Publishing Group Ltd.
- O'Neal, C. R., Goldthrite, A., Weston Riley, L., & Atapattu, R. K. (2018). A reciprocal, moderated mediation model of grit, engagement, and literacy achievement among dual language learners. *Social Development*, 27(3), 665–680. <https://doi.org/10.1111/sode.12288>.
- OECD. (2015). *Skills for Social Progress: The Power of Social and Emotional Skills*. OECD Skills Studies. OECD Publishing. <https://doi.org/10.1787/9789264226159-en>.
- Park, D., Yu, A., Baelen, R. N., Tsukayama, E., & Duckworth, A. L. (2018). Fostering grit: Perceived school goal-structure predicts growth in grit and grades. *Contemp Educ Psychol*, 55, 120–128. <https://doi.org/10.1016/j.cedpsych.2018.09.007>.
- Pelletier, L. G., Fortier, M. S., Vallerand, R. J., & Brière, N. M. (2002). Associations among perceived autonomy support, forms of self-regulation, and persistence: a prospective study. *Motiv Emot*, 25(4), 279–306. <https://doi.org/10.1023/A:1014805132406>.
- Raphiphathana, B., Jose, P., & Salmon, K. (2018). Does Dispositional Mindfulness Predict the Development of Grit? *Journal of Individual Differences*, 39(2), 76–87. <https://doi.org/10.1027/1614-0001/a000252>.
- Salmela-Aro, K. (2009). Personal goals and well-being during critical life transitions: The four C's-Channelling, choice, co-agency and compensation. *Advances in Life Course Research*. <https://doi.org/10.1016/j.alcr.2009.03.003>
- Salmela-Aro, K., & Upadaya, K. (2012). The Schoolwork Engagement Inventory. *European Journal of Psychological Assessment*, 28(1), 60–67. <https://doi.org/10.1027/1015-5759/a000091>.
- Steinmayr, R., Weidinger, A. F., & Wigfield, A. (2018). Does students' grit predict their school achievement above and beyond their personality, motivation, and engagement? *Contemp Educ Psychol*, 53, 106–122. <https://doi.org/10.1016/j.cedpsych.2018.02.004>.
- Upadyaya, K., & Salmela-Aro, K. (2013). Development of School Engagement in Association With Academic Success and Well-Being in Varying Social Contexts. *European Psychologist*, 18(2), 136–147. <https://doi.org/10.1027/1016-9040/a000143>.
- Usher, E.L., Li, C.R., Butz, A.R., & Rojas, J.P. (2018). Perseverant grit and self-efficacy: Are both essential for children's academic success? *Journal of Educational Psychology*. <https://doi.org/10.1037/edu0000324>
- Vukasović, T., & Bratko, D. (2015). Heritability of personality: A meta-analysis of behavior genetic studies. *Psychological Bulletin*. <https://doi.org/10.1037/bul0000017>
- Wang, M.-T., & Degol, J. L. (2016). School Climate: a Review of the Construct, Measurement, and Impact on Student Outcomes. *Educational Psychology Review*, 28(2), 315–352. <https://doi.org/10.1007/s10648-015-9319-1>.
- Wang, M.-T., & Eccles, J. S. (2012). Adolescent Behavioral, Emotional, and Cognitive Engagement Trajectories in School and Their Differential Relations to Educational Success. *J Res Adolesc*, 22(1), 31–39. <https://doi.org/10.1111/j.1532-7795.2011.00753.x>.
- Wang, M.-T., & Sheikh-Khalil, S. (2014). Does Parental Involvement Matter for Student Achievement and Mental Health in High School? *Child Development*. <https://doi.org/10.1111/cdev.12153>
- Wigfield, A., & Eccles, J. S. (2000). Expectancy-Value Theory of Achievement Motivation. *Contemp Educ Psychol*, 25(1), 68–81. <https://doi.org/10.1006/ceps.1999.1015>.
- Wigfield, A., Eccles, J. S., Fredricks, J. A., Simpkins, S., Roeser, R. W., & Schiefele, U. (2015). Development of achievement motivation and engagement. In R. M. Lerner & M. E. Lamb (Eds.), *Handbook of Child Psychology and Developmental Science* (3rd ed., pp. 1–44). Hoboken, NJ, USA: John Wiley & Sons, Inc. <https://doi.org/10.1002/9781118963418.childpsy316>
- Yeager, D. S., Romero, C., Paunesku, D., Hulleman, C. S., Schneider, B., Hinojosa, C., & Dweck, C. S. (2016). Using design thinking to improve psychological interventions: The case of the growth mindset during the transition to high school. *J Educ Psychol*, 108(3), 374–391. <https://doi.org/10.1037/edu0000098>.
- Zeng, G., Hou, H., & Peng, K. (2016). Effect of growth mindset on school engagement and psychological well-being of Chinese primary and middle school students: The mediating role of resilience. *Frontiers in Psychology*, 7. <https://doi.org/10.3389/fpsyg.2016.01873>.
- Zhou, K. (2016). Non-cognitive skills: definitions, measurement and malleability. Paper commissioned for the Global Education Monitoring Report 2016, Education for people and planet: Creating sustainable futures for all. Retrieved from <http://unesdoc.unesco.org/images/0024/002455/245576E.pdf>

**Xin Tang** is a Post-doc researcher at the Faculty of Educational Sciences, University of Helsinki, Finland. He received his doctorate in psychology in University of Jyväskylä, Finland. His research interests include motivation, engagement, grit, curiosity, and classroom practices.

**Ming-Te Wang** is an Associate Professor of Psychology and Education and Research Scientist of Learning Research and Development Center at the University of Pittsburgh. He received his doctorate in Human Development and Psychology from Harvard University. His research interests include motivation and engagement, risk and resilience, stereotype threat and learning, and school-based psychosocial intervention

**Jiesi Guo** is a Senior Research Fellow at the Institute for Positive Psychology and Education, Australian Catholic University. He received his doctorate in psychology in Australian Catholic University. He has a particular interest in how multiple ecological systems on the cultural, social, motivational, and behavioral development shape students' learning processes and subsequent choice behaviors.

**Katariina Salmela-Aro** is Professor at the Faculty of Educational Sciences, University of Helsinki, Finland and Visiting Professor, Institute of Education, University College London, UK. She received her doctorate in psychology in University of Helsinki. Her major interest include motivation, well-being and educational transitions.