

The mechanisms of interest and perseverance in predicting achievement among academically resilient and non-resilient students: Evidence from Swedish longitudinal data

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Background. Students with low socio-economic status (SES) are typically depicted as low performers and more likely to fail in school. However, a group of students, despite their background, manage to succeed in school. The capacity to overcome adversities and achieve successful educational outcomes is referred to as Academic Resilience. Research on the relationship between personality traits and academic performance shows that conscientiousness is a crucial factor in predicting academic success and resilience. However, it has also been shown that achievement is a result of an interaction between conscientiousness and students' interest in the subject.

Aims. The study aims to investigate how students' school-related perseverance and interest predict academic achievement among resilient and non-resilient pupils over time in the Swedish compulsory school setting.

Sample. Study subjects were a subset ($N = 1,665$) of the sampled compulsory school students from the 1992 birth cohort in the evaluation through follow-up (ETF) database.

Methods. Multigroup structural equation modelling (SEM) with latent variable interaction was used. Measurement invariance was tested to examine the comparability of the constructs across groups.

Results. The results suggest that resilient students rely heavily on both perseverance of effort and interest in school subjects to succeed in their education. For the non-resilient group, the later perseverance level was conditioned on the level of the interest, and neither their early nor later grade interest was related to their achievement.

Conclusions. The academically resilient students displayed more consistency in interest and perseverance over time, which might explain their relative success compared to the non-resilient group.

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In research on educational equity, students with low socio-economic status (SES) are typically depicted as low performers and more likely to fail in school (Sirin, 2005). However, a group of students, despite their disadvantaged background, manages to succeed in school. The capacity to overcome adversities and become successful in educational outcomes is referred to as Academic Resilience. Academic resilience is built upon two critical conditions, namely, exposure to significant threat or severe adversity and achievement of positive adaptation despite major assaults on the developmental process (Kiswarday, 2012). Understanding which assets and adaptation mechanisms academically resilient students rely upon will have profound policy implications, not least for the implementation of policies aimed at supporting and fostering positive approaches to learning to prevent a widening of the performance gap (OECD, 2011).

A myriad of studies show that not only cognitive factors (e.g., IQ) are related to academic achievement, but socioemotional factors (e.g., perseverance, willingness and capacity to plan, and low anxiety) are also essential, especially for enhancing academic resilience (e.g., Duckworth, Peterson, Matthews & Kelly, 2007; Fonagy, Steele, Steele & Target, 1994; Martin & Marsh, 2006, 2009). Hence, socioemotional factors seem salient in explaining the achievement success for academically resilient students. Heckman and Rubinstein (2001) found that socioemotional factors are crucial attributes to school attainment and wages in the labour market for the high-school dropouts after controlling for their cognitive ability (e.g., Heckman, Stixrud, & Urzua, 2006; MacCann et al., 2020). However, there is still a lack of consensus on the roots and malleability of academic resilience (OECD, 2011).

Research that examines the relationship between personality traits and academic performance showed that conscientiousness is one of the crucial facets in predicting academic success (e.g., Oshio, Taku, Hirano, & Saeed, 2018; Poropat, 2009; Tamannaefar & Shahmirzaei, 2019). The current study will focus on the perseverance facet of conscientiousness of low-SES individuals and investigate how student's school-related perseverance and interest affect academic outcomes between resilient and non-resilient students over time in the Swedish compulsory school setting.

Explaining academic success

Theorists have developed different models to understand how disadvantaged students overcome challenges and become academically resilient. In a meta-analysis on the relationship between personality and academic performance, Poropat (2009) argued that the positive correlations found were due to the fact that personality predicts individual's socially desired behaviour, willingness to perform, and the shared component with intelligence – all of which are important for academic success. The study concluded that among the Big Five personality traits, conscientiousness was most closely related to the motivation to achieve and thus most strongly predicted academic outcomes ($d = .46$). Based on the empirical evidence from studies at different levels of education, Poropat (2009) found that conscientiousness was the only personality trait that did not decline from primary education to secondary and tertiary education.

Another concept predicting student achievement and that overlaps with conscientiousness is *grit*. Grit is a psychological domain-general trait defined by perseverance of effort and consistency of interest in pursuing long-term goals (Duckworth, Peterson, Matthews, & Kelly, 2007). Beyond intelligence, grit is advocated as a powerful predictor of, among other things, students' school success and academic resilience. Both grit and

academic resilience relate to individuals' capacities to be able to sustain the effort and to prosper by responding positively to challenging situations and overcoming adversities (e.g., Duckworth & Gross, 2014). However, in a meta-analysis by Credé, Tynan, and Harms (2017), the relationship between overall grit and achievement was only modest and restricted to the perseverance facet of grit due to its great overlap with the Big Five conscientiousness. Moreover, Credé (2018) suggested an interaction effect between interest and perseverance in grit as a possible endeavour for future studies.

Investigating how conscientiousness and interest affect academic effort, Trautwein, Roberts, Nagengast, and Lüdtke (2019) developed the Conscientiousness \times Interest Compensation (CONIC) model to account for the extent to which conscientiousness and interest predict academic effort and outcomes separately and as an interaction. The CONIC model is conceptually similar to grit. Unlike the grit framework, the interest domain in the CONIC model is school subject-specific and can motivate achievement-related behaviours (Trautwein, Roberts, Nagengast, & Lüdtke, 2019). The CONIC model also entails a compensatory interactive mechanism (Trautwein et al., 2019), which is described as an interaction between push and pull factors. Since conscientiousness is a less context-dependent factor that reflects the tendency to work hard despite setbacks, being conscientious also implies seeing challenges as obstacles to be overcome, that is, a push factor. However, when people are interested in something, they experience positive emotions in a particular domain and are drawn to engage more in these domains (pull factor) (Rieger, 2018). Hence, if a student is not particularly interested in a subject but is conscientious, he or she will perform well despite the lack of interest. Conversely, if a student is high on interest in one subject, he or she will work hard even though conscientiousness is low (Song, Gaspard, Nagengast, & Trautwein, 2020; Trautwein et al., 2015).

Even though the CONIC model is useful in predicting academic achievement, it does not depict how the previous level of conscientiousness, interest, and school success affect those in the later years. Hill and Jackson (2016) systematically reviewed a myriad of literature on the mechanism through which conscientiousness affected individuals' positive life outcomes and synthesised the Invest-and-Accrue model (IAM) of conscientiousness. The IAM described the 'principles for explaining the benefits afforded by, and the development of, conscientiousness over time'. (p. 143, Hill & Jackson, 2016). The advantage of the IAM is the developmental perspective captured by the loop of investment – return – growth in conscientiousness – reinvestment, implying that individuals with higher levels of the Big Five conscientiousness proactively engage in behaviours that can optimize success. The IAM has been applied in different life domains (e.g., Datu, McInerney, Żemojtel-Piotrowska, 2020; Wright & Jackson, 2020). In education, the conscientious students may invest time and effort in their studies, to overcome different obstacles, and become successful in school. The school success, in turn, makes the conscientious students more interested and confident in learning and willing to invest more to excel themselves (e.g., Bleidorn, 2012). Similarly, the IAM may be used to explain why resilient students are likely to benefit from exhibiting higher levels of grit in the school contexts.

However, to our knowledge, neither the CONIC model nor the IAM has been tested in the Swedish school context, especially for low-SES students in resilient and non-resilient subgroups. Hence, it would be interesting to investigate whether the models would similarly hold in these Swedish subpopulations. The current study adopts the CONIC

model structure and applies the IAM to understand the developmental process over time. We focus on a narrow facet of conscientiousness, namely perseverance (e.g., MacCann, Duckworth, & Roberts, 2009; Rimfeld, Kovas, Dale, & Plomin, 2016) and use hereafter in the text.

Purpose and aims

The study aims to investigate whether interest and perseverance and their interaction can explain the achievements of academically resilient students. With the CONIC model (Trautwein et al., 2015) as the point of departure, combined with the developmental perspective of the IAM, three research questions are examined:

- RQ1 Can measurement invariance be determined between resilient and non-resilient groups with respect to the measurement models of interest and perseverance?
- RQ2 What is the nature of the interaction between interest and perseverance, and to what extent does it predict achievement for resilient and non-resilient students?
- RQ3 What effects do changes in interest and perseverance have for predicting achievement for resilient and non-resilient students over time?

Method

Sample

Data were retrieved from the Evaluation through Follow-up database (ETF), a longitudinal project built on 10% randomly selected national representative samples of ten birth cohorts in Sweden (Härnqvist, 2000). The sampled students were followed up in grades 3, 6, and 9 of compulsory school (the Swedish school system consist of 9-year compulsory education from age 7) and in upper secondary school (non-compulsory) (Giota, Cliffordson, Nielsen & Berndtsson, 2008). The present study used the 1992 ETF sample that consists of, in total, 10,147 individuals. However, only 4,997 individuals completed questionnaires in both grades 6 and 9. Of these, 1,665 were identified with low SES (i.e., student's parents only completed compulsory or vocational upper secondary education). Using the modified definition of academic resilience by PISA (Agasisti, Avvisati, Borgonovi & Longobardi, 2018), these individuals were further divided into resilient and non-resilient groups, depending on their achievement in the Swedish National Test. This resulted in a resilient group of 493 students, whose national test score was above the country mean, and a non-resilient group of 1,164, who achieved below average on the national test. The adjusted resilience definition has been validated and proven to be reasonable.

Measures

Parents' highest educational level

It has been shown that the parental education level in Sweden corresponds well with the social class division (Svensson, Nielsen & Berndtsson, 2007). Therefore, the 6-scaled parents' highest education level (SUN6) is used as an indicator of SES. The 6 categories encompass alternatives 'no information', 'compulsory school', 'vocational upper secondary education', 'academic upper secondary education', 'university 3 years or less' and 'university 4 years or more'.

National tests

The national test score in grade 9 is used as an indicator of students' school achievement. The tests cover the three core subjects – Swedish, English, and mathematics – and are constructed to cover large parts of each curriculum. For each test, it is possible to get *fail* = 0, *pass* = 10, *pass with distinction* = 15, *pass with special distinction* = 20. The principal component analysis was used for creating a continuous variable of the test scores (NPSUM).

Grade point average

The grades used in the present study are from the leaving certificate in grade 9 of compulsory school. The grading scale for the 1992 sample encompass four different grades: *fail* = 0, *pass* = 10, *pass with distinction* = 15, *pass with special distinction* = 20. A mean of all grades is used as an outcome variable (*GPA*).

Interest and perseverance

Data on students' interest in learning different school subjects, and their perseverance were collected in grades 6 and 9 of compulsory school. Eight items measure the student's interest in learning different subjects (*How interested are you in learning: Swedish, English, Social Science, Science, Mathematics, Physical Education, arts and music*). Answers are given on a 5-point Likert scale, ranging from very interested to very uninterested in grade 6, and on a 4-point Likert scale in grade 9. Since the scales were not equal, standardized scores were used. Three parcel variables were constructed.¹ The first parcel *language* summed up indicators of interests in Swedish, English, and social science. The second parcel summed interest in mathematics and science, and the third parcel summed interest in practical aesthetic subjects (i.e., physical education, arts, and music). The shared variance among these interest domains defines the latent variable *interest* in the present study. Compared with the item-level indicators, variable parcels have better psychometric properties, for example, high reliability and communalities, a high ratio of common-to-unique factor variance, and less likely to violate distributional assumption, and relatively equal intervals between scale points (p. 154, Little, Cunningham, Shahar, & Widaman, 2002). Moreover, models using variable parcels are more parsimonious with fewer unknown parameters, less correlated residuals or cross-loadings and less sampling errors (e.g., Little et al., 2002; MacCallum, Widaman, Zhang, & Hong, 1999).

Because perseverance overlaps considerably with conscientiousness (e.g., Rimfeld et al., 2016), and only the items measuring the perseverance facet of conscientiousness are available in the ETF database, the present study focussed on four perseverance indicators: *I give up if I get a difficult task*, *I always do my best*, *I work hard even if it is difficult*, and *I get things done in time*. These indicators have a 5-point Likert scale in both grade 6 and grade 9, and range from always to never.

¹ The measurement models of interest in grade 6 and 9 for both the resilient and non-resilient groups were estimated using eight indicators. However, the single factor model with eight indicators did not fit the data. The modification indices indicated that several indicators shared the same properties. Mainly three clusters of variables can be identified, i.e., the aesthetic subjects including music, physical education and arts, the mathematics and natural science subjects and the Swedish, English and social science subjects. One way to improve the model fit is to add several covariances of the residuals of these related indicators. Another way is to construct variable parcels of the indicators that share large amount of variance. We chose the latter approach.

The items are retrieved from the ETF database. Here, questionnaires measuring, among other things, motivation for studies, academic self-concept, attitudes towards school, and future plans and spare-time interests, have been distributed to students in compulsory school and upper secondary school for several birth cohorts. The questionnaires have been tested and validated within the ETF project over several years (Svensson, 2011). Harman's single-factor score approach was performed to test whether the common factor bias (CMB) is a concern in our study. The percentage of the total variance in the single factor defined by all the variables in our model is <50% (32% for the grade 9 variables; 27% for the grade 6 variables; and 21% for variables from both grades), and it suggests that CMB does not affect the data and results (see e.g., Podsakoff & Organ, 1986).

The descriptive statistics (Table 1) show that the missing is relatively small for all items, both for the resilient and non-resilient group, and in both grades 6 and 9. The means for the resilient group in grade 6 are higher for almost all items, except for the practical aesthetical parcel indicator. A similar pattern can also be observed for grade 9, where the resilient students have a higher mean for all items. Generally, the standard deviations are smaller for the resilient group.

Analytical method

Multiple group structural equation modelling (SEM) was used for investigating the measurement properties of interest and perseverance, and the effects of the two factors on academic achievement for resilient and non-resilient students. In a first step, measurement models of perseverance and interest were fitted for the resilient and non-resilient groups, respectively, across grades 6 and 9. Measurement invariance was then

Table 1. descriptive statistics for resilient and non-resilient group, divided by grade 6 and grade 9

Variables	N	M	SD	N	M	SD
	Resilient group			Non-resilient group		
	Grade 6					
Get things done in time	491	0.155	0.893	1,148	-0.145	1.036
Work hard even when difficult	491	0.006	0.996	1,142	-0.069	1.049
Always do my best	489	0.094	0.935	1,135	-0.061	1.083
Easily give up	491	0.113	0.911	1,155	-0.243	1.055
Interest in language	488	0.123	2.223	1,142	-0.158	2.383
Interest in mathematics	483	0.008	1.597	1,135	-0.044	1.684
Interest in aesthetical subj	484	0.031	2.150	1,138	0.074	2.064
	Grade 9					
NPSUM	493	46.236	4.746	1,162	28.761	8.174
GPA	493	15.661	2.322	1,161	11.530	2.399
Get things done in time	486	0.115	0.940	1,151	-0.133	1.024
Work hard even when difficult	487	0.167	0.950	1,147	-0.167	1.007
Always do my best	489	0.194	0.894	1,148	-0.122	1.066
Easily give up	490	0.247	0.917	1,152	-0.343	1.009
Interest in language	487	0.682	2.097	1,135	-0.827	2.543
Interest in mathematics	490	0.184	1.724	1,127	-0.540	1.724
Interest in aesthetical subj	487	0.046	2.028	1,140	-0.066	2.230

Note. GPA = Grade Point Average; NPSUM = Sum of National Test scores.

tested between resilient and non-resilient groups in grades 6 and 9. Further, an interaction term between the latent variables perseverance and interest was added, and effects on GPA in grade 9 were examined. Finally, the latent variables of interest and perseverance and their interaction in grade 9 were regressed on their grade 6 counterpart, and together they affected the grade 9 GPA. Such a structural model makes it possible to investigate the compensatory mechanisms of interest and perseverance on students' academic outcomes over time, and across resilient and non-resilient groups.

The analysis was conducted using Mplus 8.4 (Muthén & Muthén, 1998-2017). Maximum likelihood estimator with robust standard error in Mplus is robust against multivariate non-normality and non-independence of observations (e.g., Yuan & Bentler, 2000; Muthén & Muthén, 1998-2017) and was applied in the current study. The amount of missing for all variables involved in the present study is below 2% for both grade 6 and grade 9, and the Expectation–Maximization algorithm integrated in Mplus was used to handle the missing values.

For model evaluation, the chi-square goodness-of-fit test, the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), and the comparative fit index (CFI) were used. For RMSEA and SRMR, the values below .08 imply an acceptable model fit. A CFI at or over .95 indicates a good model fit (Brown, 2015; Hu & Bentler, 1999).

Measurement invariance varies in degree. *Configural* invariance requires only the same factor structure across all groups. *Metric* invariance additionally requires factor loadings to be equal. *Scalar* invariance assumes metric invariance, but also requires equal intercepts of the factor indicators. It is suggested that meaningful comparisons of the latent variable mean across different groups can only be achieved under the scalar invariance. However, there is also support for the idea of valid comparison under partial invariance (e.g., Byrne, Shavelson, & Muthén, 1989; Steenkamp & Baumgartner, 1998). To determine measurement invariance at a specific level, model fit indices of the measurement model at the given level are compared with those of a more constraint measurement model. Chen's (2007) simulation study showed that it is insufficient to have an acceptable model fit for the measurement invariance models. It is also necessary to assess how much the model fit changes between different levels of measurement invariance. If the model fit indices do not become significantly worse from, for example, a configural invariance model to a metric invariance model, we can conclude that the metric invariance is achieved. This is analogous for scalar invariance. Since the chi-square difference test tends to be sensitive towards large sample size and non-normality, Chen (2007) recommended that RMSEA, SRMR, and CFI should be used in model comparison. The change in RMSEA between the restricted and less restricted models should be smaller than .03, and the change in CFI and SRMR should be lower than .01, indicating measurement invariance. For parameter invariance, likelihood ratio test and Wald test of mean difference were conducted (Muthén & Muthén, 1998-2018).

Results

Measurement models of interest and perseverance

In order to answer RQ1, two confirmatory factor analysis (CFA) models were set up to measure perseverance and interest.

Perseverance

Measurement models for perseverance were fitted for the non-resilient and resilient groups in grade 6 (Model A1) and grade 9 (Model A2). Figure 1 shows the factor loadings across grades and groups. Metric invariance was achieved for the measurement models of the resilient and non-resilient groups in both grades (Table 2). This implies that not only the factor structure is the same across the two groups and grades, but that the perseverance indicators are also related to the factor (i.e., factor loadings) equally well. It has been clearly demonstrated that the invariance tests rarely find support for scalar invariance when samples are large in the comparison groups, since the test statistics are sensitive to sample size (Van de Vijver & He, 2014, p. 17).

In grade 6, the factor loadings for perseverance ranged between (.40) and (.69) for the non-resilient group, and between (.39) and (.60) for the resilient group. The factor loadings for grade 9 ranged between (.49) and (.77), and between (.44) and (.67) for the non-resilient and resilient group, respectively. A significant mean difference for the latent variable perseverance was found between non-resilient and resilient groups (.16) for grade 6 and (.29) for grade 9.

Interest

The three parcels of interest in different subject areas specified a just-identified measurement model of interest with the perfect model fit (Table 2). Scalar invariance was met between resilient and non-resilient groups in grade 6 (Model B1), while metric invariance was reached in grade 9 (Model B2). In grade 6, the factor loadings of interest ranged between (.45) and (.85) for the resilient group and between (.46) and (.83) for the non-resilient group. The corresponding factor loadings in grade 9 were between (.40) and (.74) for the resilient group and between (.50) and (.83) for the non-resilient group. The factor loadings were, for both groups, consistently lower for the aesthetic indicator (see Figure 2). Possibly, the nature of the interest for aesthetic subjects differs somewhat compared with interest in mathematics, Swedish, and English, the latter being core subjects in compulsory school. However, CFA allows for identifying the shared variance among these indicators. Additionally, the estimated latent variable mean was significantly higher in the resilient group, with a difference of (.15) in grade 6 and (.75) in grade 9.

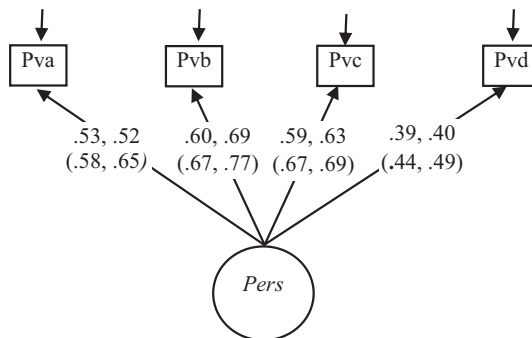


Figure 1. Measurement model of perseverance for resilient and non-resilient groups, grade 6, and grade 9. *Note.* From left to right resilient and non-resilient groups. Grade 9 in parenthesis. Abbreviations are as follows: Pers – perseverance indicated by four items measuring perseverance Pva, Pvb, Pvc, and Pvd.

Table 2. Model fit indices for model AI-DI

Model	χ^2 (df)	RMSEA	CFI	SRMR	$\Delta\chi^2$ (df)	Δ RMSEA	Δ CFI	Δ SRMR
Model A1 Multiple group measurement model of perseverance in resilient and non-resilient groups in grade 6								
Configural	3.586 (4)	.000	1.000	.009				
Metric	7.248 (7)	.007	1.000	.015	3.662 (3)	.007	.000	.006
Scalar	61.240 (10)	.080	.942	.045	53.992 (3)	.073	.058	.030
Model A2 Multiple group measurement model of perseverance in resilient and non-resilient groups in grade 9								
Configural	6.416 (4)	.027	.998	.010				
Metric	8.807 (7)	.018	.999	.013	2.390 (3)	.009	.001	.003
Scalar	74.499 (10)	.089	.960	.053	65.693 (3)	.071	.039	.040
Model B1 Multiple group measurement model of interest in resilient and non-resilient groups in grade 6								
Configural	0.000 (0)	.000	1.000	.000				
Metric	2.995 (2)	.025	.999	.013	2.995 (2)	.025	.001	.013
Scalar	7.093 (4)	.031	.997	.018	4.098 (2)	.006	.002	.005
Model B2 Multiple group measurement model of interest in resilient and non-resilient groups in grade 9								
Configural	0.000 (0)	.000	1.000	.000				
Metric	1.224 (2)	.000	1.000	.008	1.224 (2)	.000	.000	.008
Scalar	40.555 (4)	.107	.964	.048	39.331 (2)	.107	.036	.040
Model C1 Structural multiple group model of perseverance and interest and GPA for resilient and non-resilient groups grade 6, comparison model without interaction term								
	98.978 (46)	.035	.973	.032				
Model C2 Structural multiple group model of perseverance and interest and GPA for resilient and non-resilient groups grade 9, comparison model without interaction term								
	211.559 (46)	.062	.959	.047				
Model DI Longitudinal multiple group model of perseverance and interest and GPA for resilient and non-resilient groups, comparison model without interaction terms								
	525.936 (174)	.050	.939	.043				

Note. $N = 1,655$; resilient group $n = 493$; non-resilient group $n = 1,163$.

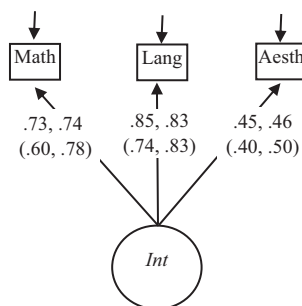


Figure 2. Measurement model of interest for resilient and non-resilient groups, grade 6, and grade 9. Note. From left to right: resilient and non-resilient groups. The estimates of the grade 9 are in parenthesis. Abbreviations are as follows: Int – interest, Math – interest in mathematics, Lang – interest in language, Aesth – interest in practical aesthetical subjects.

Moderation-effects model

In order to investigate RQ2, GPA was regressed on the latent variables interest and perseverance, and their interaction term in grade 6 (Model C1) and in grade 9 (Model C2). Since Mplus gives only the log likelihood and information criteria information for the latent moderation model, likelihood ratio test (LRT) with its degree of freedom was used to examine the measurement invariance of the model. LRT is calculated by minus two times the deviation of log likelihood between the model with the interaction term, and the one without. LRT thus determines whether there is a significant loss in model fit between the two models (Maslowsky, Jager, & Hemken, 2015).

In the present study, LRT = 6,657,212 (df = 1) for grade 6 (Model C1) and LRT = 6949.712 (df = 1) for grade 9 (Model C2) indicate that the addition of the interaction term significantly improved the model fit. Model fit indices for the model without the interaction term can be found in Table 2.

In grade 6, model results show that the interaction term between interest and perseverance is significantly related to GPA in both groups, being .08 for the resilient group and .07 for the non-resilient. While perseverance contributed to predicting GPA for both groups (.13 for the resilient group and .22 for the non-resilient group), interest predicted GPA only in the resilient group (Figure 3). The homogenous characteristic of being perseverant may have resulted in a low variation in the resilient group and thus a low estimated effect on GPA. In sum, the achievement for both resilient and non-resilient students can be explained by perseverance and interest, and their interaction. The interaction is synergistic, implying that achievement is higher when students are high on both interest and perseverance, particularly for the non-resilient group. In grade 9, however, no significant interaction effect on GPA could be found for any of the groups. While perseverance significantly predicted GPA both for the resilient and non-resilient groups (.38 and .34, respectively), interest alone predicted GPA for the resilient group (.18).

While an increase in the perseverance effect on GPA was found from grade 6 to grade 9 in both the resilient and non-resilient groups, the effect of interest was relatively stable over time. It seems that perseverance and interest work together, both separately and interactively, to promote school outcome in the resilient group. In the non-resilient group, interest only moderated the effect of perseverance on GPA.

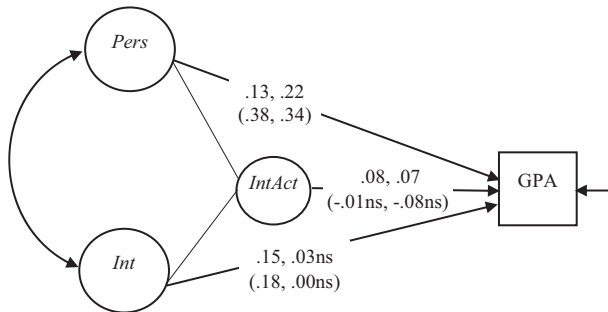


Figure 3. Moderation-effects model of perseverance and interest for resilient and non-resilient groups, grade 6 and grade 9. Note. From left to right: resilient and non-resilient groups. The estimates of grade 9 are in parenthesis. Abbreviations are as follows: GPA = grade point average; Int = interest; IntAct = interaction; Pers = perseverance.

Longitudinal moderation-effects model

In order to investigate RQ3, a longitudinal model was specified. We regressed interest and perseverance, as well as their interaction in grade 9, on the corresponding components in grade 6. Together, they affect GPA in grade 9 (Model D1, see Figure 4).

Previously, we observed significant effects of perseverance in grade 6 on the grade 9 GPA for both groups (Figure 3). However, these direct effects disappeared for the resilient group, with only the non-resilient group having a significant direct effect (.12). The interaction between interest and perseverance in grade 6 was significantly related to GPA for both the resilient and non-resilient group (.05 and .08, respectively). Perseverance in grade 6 was significantly related to perseverance in grade 9, being (.36) for the resilient group, and lower (.24) for the non-resilient group. Perseverance in grade 6 was significantly related to perseverance in grade 9, being (.36) for the resilient group, and lower (.24) for the non-resilient group. Perseverance in grade 9, in turn, affected GPA, (.41) for the resilient group, and again lower (.31) for the non-resilient group. Interest in grade 6 was significantly related to interest in grade 9 (.20) for the resilient group and higher (.33) for the non-resilient group. However, only the resilient

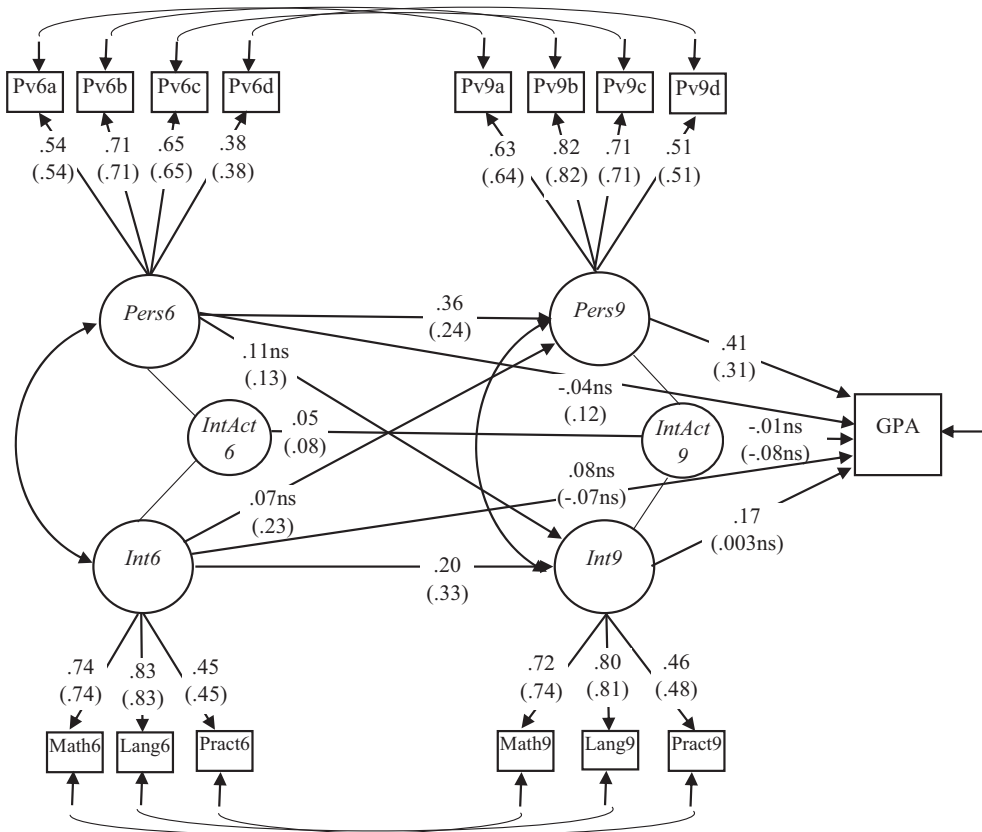


Figure 4. longitudinal moderation-effects model of perseverance and interest for academically resilient and non-resilient groups. *Note.* The estimates of the non-resilient group are in parenthesis. Abbreviations are as follows: Pers6 – perseverance grade 6, Pers9 – perseverance grade 9, Int6 – interest grade 6, Int9 – interest grade 9, IntAct6 – interaction between perseverance and interest grade 6, IntAct9 – interaction between interest and perseverance grade 9, and GPA – grade point average.

group had a significant relation between interest in grade 9 and GPA (.17). The latent variable interaction in grade 9 was not significant for either of the groups. For the non-resilient group, there were cross-lagged relations between perseverance in grade 6 and interest in grade 9 (.13), and between interest in grade 6 and perseverance in grade 9 (.23). No significant cross-lagged effects were found for the resilient group.

The total indirect effects of the grade 6 perseverance on GPA via the grade 9 perseverance were significant in both the resilient and non-resilient groups, being .27 and .12, respectively. No significant indirect effect of the grade 6 interest on GPA was found in the resilient group. In the non-resilient group, on the other hand, the total indirect effect of the grade 6 interest was significant (.09), and it solely was attributed to the indirect effect via the grade 9 perseverance. In total, the longitudinal model explained 33.4% of the variance of GPA in the resilient group, but only 17.3% in the non-resilient group.

Discussion and Conclusions

Adopting the CONIC model structure and the developmental perspective in the Invest-and-Accrue model, the current study tried to understand the relationship between perseverance and interest in predicting children's school outcomes over time across the academically resilient and non-resilient groups. A subset of low-SES compulsory students from the Swedish longitudinal project *Evaluation-through-Follow-up* 1992 sample was used to facilitate the investigation.

Measurement invariance was confirmed when examined the measurement properties of perseverance and interest across time and groups. Resilient students showed a significantly higher level of perseverance and interest than the non-resilient students in each school grade. The differences increased when students got older. Drawing upon the Invest-and-Accrue Model (Hill & Jackson, 2016), the observations of a positive development of conscientiousness over time seem to be reasonable.

However, scrutinizing the impact of perseverance and subject interest on school outcomes separately in each grade provided further insights into the underlying Invest-and-Accrue mechanisms. Interaction between interest and perseverance significantly affected GPA in both resilient and non-resilient students in grade 6 but could not be identified in grade 9. One tentative explanation may be that it is more important for younger students to be interested in schoolwork to persevere. As Credé (2018) suggested, the predictive power of perseverance on students' academic achievement is higher when their interest in schoolwork is high. Such a moderation effect of interest is also proposed in the CONIC model and found the empirical supports in the studies reported in Trautwein et al. (2015).

Trautwein et al. (2015) distinguished between three prototypical interactive effects: additive, synergistic, and compensatory effects. The additive effects model implies no interaction; instead, the combined effect of conscientiousness and interest is a sum of two separate effects. The synergistic and the compensatory effects model imply an interaction between conscientiousness and interest. However, the impact of one variable on academic effort is contingent on the level of the other variable. In the synergistic effects model, the interaction is in the same direction as the main effects, thus reinforcing function.

Besides the synergistic effect of interest on the relationship between perseverance and school outcomes in grade 6, the current study also found an additive effect of interest in

school subjects and perseverance of effort that contributed unique predictive power on school outcomes in the resilient group in grade 9. No such an additive prediction could be found for the non-resilient students. The results seem to suggest two differentiated mechanisms of perseverance and interest in predicting school outcomes in the two groups. For the academically resilient students, the results underpin the CONIC model (Rieger, 2018; Song et al., 2020; Trautwein et al., 2015). The consistency of interests in school subjects may motivate achievement-related behaviour (investment behaviour in the IAM, Hill & Jackson, 2016), and the perseverance of effort makes sure the students keep struggling when meeting difficulties. Together they ensure school success for resilient students. For the non-resilient students, their school outcome is very much dependent on the level of perseverance. Lack of interest as a pulling factor, that is, driven power for investment behaviour, the chance for success will be lower than their resilient counterpart.

When investigating the perseverance and interest relationship longitudinally, the same direct effects were found between perseverance, interest and school outcomes in grade 9 as the results from single-time point analysis. However, perseverance and interest in grade 6 have no direct impact on grade 9 outcomes. The overall effect of the grade 6 perseverance on the grade 9 school outcomes was significant for both the resilient and the non-resilient groups. In that, the perseverance in grade 6 indirectly affected the student's school outcomes in grade 9 only via the grade 9 perseverance. The grade 6 interest significantly predicted grade 9 school outcomes via the grade 9 perseverance in the non-resilient group.

It is interesting to notice the differentiated pathways through which early grade perseverance and interest worked over time to predict the school outcomes in the final year of compulsory education for academically resilient and non-resilient students. The resilient students rely heavily on both perseverance of effort and interest in school subjects to succeed in their education. In line with the 'Invest-and-Accrue' model of conscientiousness, their early perseverance may be associated with the willingness to invest in schoolwork. In other words, individuals with a higher level of conscientiousness optimize their efforts and investment behaviours to facilitate their achievement goals (Hill & Jackson, 2016). This, in turn, will boost their later-year perseverance, leading to higher achievement. The later-year interest also added additional motivation to invest in study-related actions for resilient students. For non-resilient students, on the other hand, their school success is affected by their perseverance level, conditioned on their early-year interest. The current study found that neither early nor later grade interest was related to the grade 9 school outcomes. Therefore, the non-resilient students' willingness to invest in schoolwork depends on their interest level. The impact of early-year perseverance and interest seemed to be especially important for the non-resilient students. Lacking either perseverance or interest in early school years may risk non-resilient students' school success since the positive drive to study is compromised. Such risk, however, is much lower for the resilient students.

The current research extends previous literature on the psychological mechanisms that account for the beneficial impacts of perseverance on learning engagement, achievement, and relevant educational outcomes in several ways. Firstly, our study integrated the CONIC model and the IAM model by bringing a developmental perspective to the static view of the relationship between perseverance, interest, and school outcomes. Secondly, the current study focussed on the heterogeneity of subpopulations and revealed differentiated mechanisms. Additionally, using Swedish data as a showcase enriches the research evidence supporting both the general psychological mechanisms and its differentiated trend across subgroups of individuals and culture.

Table 3. Differences between actual and predicted value for resilient and non-resilient groups

Group	N	GPA observed value	GPA expected value	Diff observed and predicted value
Non-resilient	1,162	11.53	12.62	-1.09
Resilient	493	15.66	12.67	2.99
High SES – low achievement	1,191	12.73	14.59	-1.86
High SES – high achievement	1,800	16.35	14.85	1.50
R^2			.13	
η^2				.36

Note. Regression $p < .001$, Difference actual and predicted value $p < .001$.

The findings suggested that teachers and special-needs educators should pay more attention to low-SES students' learning interest and perseverance. Educational practitioners should be encouraged to initiate educational programmes to promote study interest and persistency in the early years of schooling, with assurance from the policymakers. Such actions will be beneficial, particularly for the low-SES low-performance students, to improve their school outcomes through the positive development spiral proposed in the Invest-and-Accrue model. It is an essential step to closing the achievement gap and enhancing educational equity.

Limitations and future research directions

One limitation in the present study is that the cut-off values of the resilient and non-resilient groups give room for arbitrary interpretations of group belongingness for individuals close to the cut-off. However, measures have been taken to justify the categorisation by regressing the GPA from compulsory school on parental highest education. The average observed value of the resilient group (15.66) is 2.99 points higher than their predicted GPA (Table 3). Resilient students achieve on average above the level of 'pass with distinction' (cut-off value 15).

Even though perseverance was shown to be a facet of conscientiousness (e.g., MacCann et al., 2009), and our measures of perseverance overlap partially with conscientiousness (covering both the industriousness and orderliness facets of conscientiousness), the deviation between the two constructs may have an impact on our results. Additionally, Trautwein et al. (2015, 2019) used interest in each subject in different models to predict the outcome or effort of the subject. We treated interest as a latent variable to capture students' general interest in all school subjects, which corresponds to the outcome measure of the combined GPA of all school subjects. In future research, a moderation-effects model for each subject could provide insight into whether there are differential effects of interest and perseverance for resilient and non-resilient children in different subjects.

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Conflicts of interest

All authors declare no conflict of interest.

Author contributions

Cecilia Thorsen (Conceptualization; Data curation; Formal analysis; Investigation; Project administration; Writing – original draft; Writing – review & editing) Kajsa Yang Hansen (Conceptualization; Investigation; Methodology; Writing – review & editing) Stefan Johansson (Conceptualization; Methodology; Writing – review & editing).

Data Availability Statement

The data that support the findings of this study are available from University of Gothenburg. Restrictions apply to the availability of these data, which were used under licence for this study. Data are available at https://ips.gu.se/english/research/research_projects/ETF/access/?languageId=100001&disableRedirect=true&returnUrl=http%3A%2F%2Fips.gu.se%2Fforskning%2Fforskningprojekt%2Fugu%2Faccess%2F with the permission of University of Gothenburg.

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