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Academic Success of "Tiger Cubs": Self-Control (not IQ) Predicts Academic Growth and Explains Girls' Edge in Taiwan

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Abstract

Studies in the United States have shown that self-control can predict academic performance beyond intelligence quotient (IQ), which also explains why girls (vs. boys) tend to have higher grades. However, empirical evidence is scarce; moreover, little is known about whether these effects generalize to other cultures. To address these limitations, we conducted a 2-year longitudinal study in Asia and examined the effects of self-control, IQ, and gender on students' academic achievement over time. Specifically, we first measured 195 Taiwanese seventh grades' self-control and IQ, and then traced their overall grades over four school semesters. Latent growth curve model analyses suggest that IQ predicted students' initial academic performance more strongly than self-control; however, self-control—but not IQ—predicted students' academic growth across the four time points and explained girls' higher grades. Overall, the findings support the argument that self-control has unique long-term benefits academically and provide initial evidence outside of the North American context.

Keywords

IQ, self-control, academic performance, culture, longitudinal

Cognitive ability (intelligence quotient [IQ]) is known to be the strongest predictor of academic success (e.g., Kuncel, Hezlett, & Ones, 2004; Sackett et al., 2012). However, recent studies in North America have shown that self-control can predict academic performance beyond IQ and explain why females performed better than males at school (e.g., Duckworth & Seligman, 2006; Duckworth, Shulman, et al., 2015). Given IQ is strongly related to academic performance, the claim that any factor, such as self-control, has incremental validity beyond IQ is not without challenge (Credé, Tynan, & Harms, 2016; Ruffing, Wach, Spinath, Brünken, & Karbach, 2015). Therefore, the current study serves two goals: first, to provide a timely and rigorous replication of the predictive validity of IQ and self-control on academic success; second, as most past studies were conducted in the states, to extend the findings outside of the North American context.

Most would agree that both IQ and self-control are beneficial to academic success; however, there are reasons to believe that self-control is particularly relevant, perhaps more so than IQ, when predicting academic growth (i.e., positive or negative changes in level of academic performance over a certain period of time; Duckworth & Seligman, 2005; Duckworth, Tsukayama, & May, 2010). Academic tests at school are often challenging not only because the learning content can be complicated but also because learning requires an effort to absorb a large amount of information and persistence when students face difficulties repeatedly. Although IQ might benefit students by giving them an immediate edge in understanding complex materials, self-control helps students stay persistent and achieve long-term success (e.g., via paying attention in class and handing in homework on time; Duckworth, Eichstaedt, & Ungar, 2015). If the theory is true, we would expect that although IQ predicts students' initial academic performance, self-control—but not IQ—would play a more important role in predicting *change* in students' academic performance over time (i.e., academic growth). In other words, we test whether IQ predicts more strongly between-subject differences in initial academic performance, whereas self-control predicts more strongly within-subject differences in academic growth. Because testing these hypotheses appropriately would require more advanced multilevel statistics and a more time-consuming longitudinal study design, not surprisingly, empirical evidence testing the theory is scarce (Hsin & Xie, 2014).

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Moreover, the extant literature lacks systematic investigations outside of North America, and we do not know if the effects of self-control and IQ on academic performance are universal. Specifically, Asians have long been praised for their high self-control (e.g., Chao, Chiu, Chan, Mendoza-Denton, & Kwok, 2013), but little is known whether self-control indeed drives the academic success among students in Asia. Furthermore, one particular phenomenon that still awaits empirical investigation is whether self-control is related to girls' edge in academic performance in Asia. Ample evidence in North America has shown that female students attained higher grades not only across levels of education but also across academic subjects (e.g., Cole, 1997). While studies in the United States suggest that the difference is due to girls having higher self-control than boys, it is unknown whether self-control would also explain similar gender differences in Asian countries, like Taiwan, where girls tend to perform better than boys academically (Huang & Hwang, 2014).

In sum, our study tests the effects of IQ and self-control on (1) students' initial academic performance and (2) their academic growth, and (3) whether self-control explains girls' edge in academic performance in Asia. We recruited seventh-grade students in Taiwan, measured their IQ and self-control immediately before the academic year, and then traced their academic grades in the subsequent 2 years. This longitudinal design allows for the comparison of the effects of IQ and self-control over the course of four semesters (i.e., a growth curve with four time points). Moreover, we included multiple methods to assess students' self-control to avoid self-serving bias in self-report measures of self-control. In sum, this study provided a rigorous test of the hypotheses and extended the findings outside of the North American context.

Method

Participants and Procedure

All seventh-grade students from a public school in Taipei were invited to participate in the study on a voluntary basis. Compensation was not provided for participating in the study. One hundred and ninety-eight Taiwanese seventh-grade students were successfully recruited (44% females; $M_{age} = 13.45$ years, $SD_{age} = .71$; 88% participation rate). We obtained permission from the school principal for administering a survey to students before asking them to complete the survey. Before the end of Spring 2011, we measured students' self-control and obtained their IQ scores from the school measured (during school-based activities) at around the same time. To avoid language issues, existing English materials were translated into Chinese using the standard back-translation procedure. We then traced students' grades from school records over the course of 2 years—four consecutive semesters in total.[1] Having multiple time points of academic performance enables us to examine the effects of IQ and self-control on academic growth. Three participants had missing data and were not included in the analyses, resulting in 195 students in our final sample.

Measures

IQ. We used the Academic Aptitude Test to assess students' IQ, which is available in Chinese and is commonly used among Chinese schools (Wu & Chiu, 1986). The test includes two components—verbal and reasoning (60 items) and quantitative ability (60 items). Unfortunately, the school cannot provide us with individual student's responses to each test item, and we cannot calculate the reliability estimates of the test. However, large-scale validation studies of the test have shown acceptable reliabilities in the past ($N = 4{,}557$ Taiwanese students; split-half reliabilities = .71–.84; Kuder-Richardson-20 reliability [KR-20] = .76–.90; see Wu & Chiu, 1986).

Self-control. We measured both students' domain-general and domain-specific self-control. General self-control was measured with the Brief Self-Control Trait Scale (Tangney, Baumeister, & Boone, 2004), which is composed of 13 items (e.g., "I have a hard time breaking bad habits," with response options ranging from 1 = *not like me at all* to 5 = *very much like me*; $\alpha = .69$). Domain-specific self-control was measured with the Impulsivity Scale for Children (Tsukayama, Duckworth, & Kim, 2013), which consists of 8 items assessing impulsive behaviors in schoolwork and interpersonal contexts (e.g., "I forgot something I needed for class"; 1 = *almost never*, 2 = *about once a month*, 3 = *about 2-3 times a month*, 4 = *about once a week*, and 5 = *at least once a day*; $\alpha = .77$). The scores were reverse-coded for easier interpretations (i.e., the higher the score, the higher the students' domain-specific self-control).[2]

Delay choice task. Besides self-report measures, we also included the Delay Choice Task (Duckworth & Seligman, 2005, 2006) as a behavioral measure of self-control in the study. The ability to delay gratification for better long-term outcomes is the hallmark of people with high self-control. Based on the results from two pilot studies (see SOM for details), we had participants choose between receiving 20 NTD ($\sim$1 USD) immediately and waiting 2 weeks to receive 25 NTD ($\sim$1.25 USD). Seventy percent of the participants chose to delay the reward and attain a larger one. Participants' choice was binary-coded (0 = *immediate reward*; 1 = *delayed gratification*).

Academic performance. We obtained students' overall grades from the school records for each of four school semesters, and because we obtained the grades directly from the school there was no missing value. Each semester has roughly equal time interval, and each grade was the average between teachers' assessments of students' everyday performance (50%) and three exams (50%). An initial linear mixed model analysis of academic performance over the four time points revealed that there was significant amount of variance to be analyzed on both the within- and between-subject levels (within-subject: $b = 14.73$, Wald $Z = 17.10$, $p < .001$; between-subject: $b = 148.84$, Wald $Z = 9.61$, $p < .001$), and there was no

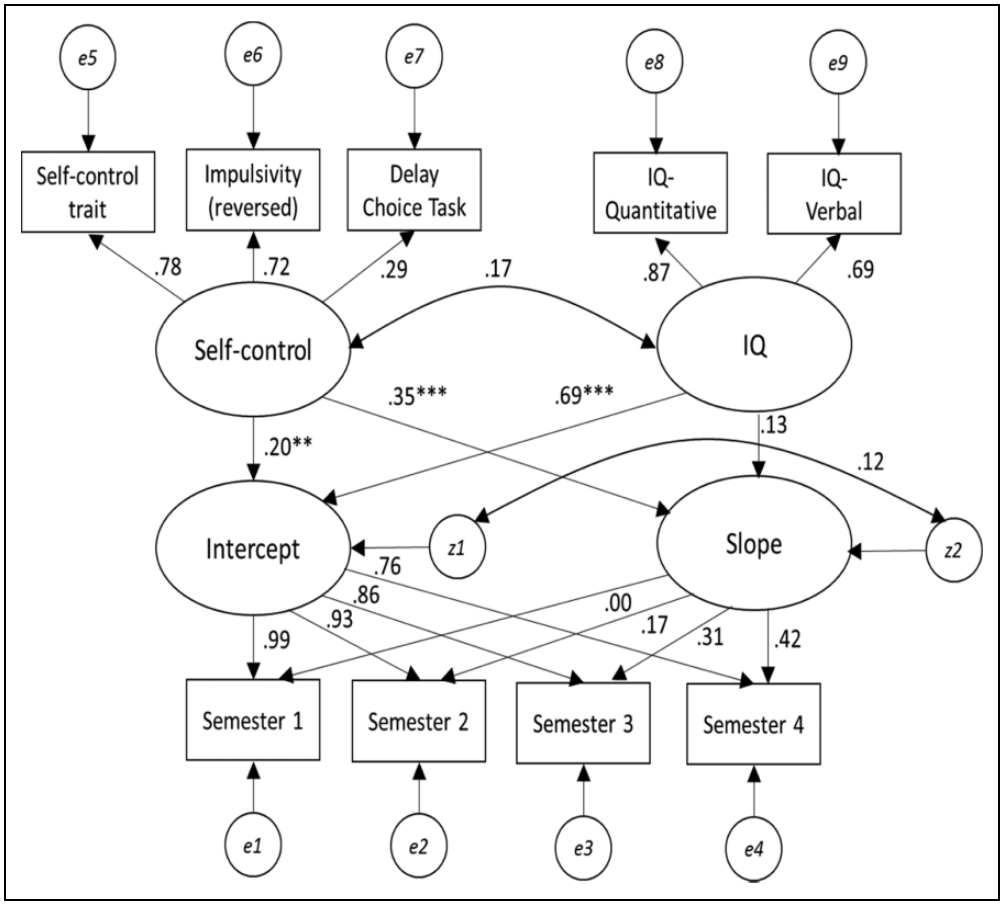

Figure 1. Latent growth curve model of students' academic performance across four semesters as a function of IQ and self-control. The letters e_1 through e_9 represent error variables reflecting imperfect measurement, and z_1 and z_2 represent unexplained variance in the two latent variables. Coefficients are standardized. Significance of the effects of the exogenous variables is included in the figure: *$p < .05$. **$p < .01$. ***$p < .001$.

nonlinear time effect, $p > .250$ (Heck, Thomas, & Tabata, 2014). The between-subject differences accounted for 91% of the total variance, suggesting that individual differences were important in influencing academic performance.

Results

Analytical Strategies

Due to the combination of between-subject predictors (e.g., self-control and gender) and within-subject dependent variables (i.e., grades at different time points), multilevel modeling is the appropriate method for analysis; more specifically, we have employed latent growth curve models (LGM) using structural equation modeling in Amos 4.0 (Arbuckle & Wothke, 1999). We created latent variables for the predictors: self-control (three indicators: self-control trait mean score, impulsivity mean score, and delay choice; $\alpha = .60$) and IQ (two indicators: verbal score and quantitative score; $r = .60$).[3] Following the standard LGM procedures (Curran, Bauer, & Willoughby, 2004; Preacher, Wichman, MacCallum, & Briggs, 2008), students' grades at the four time points were specified with a latent intercept variable (parameters set at 1) and a latent slope variable (parameter set at 0 for the grade at Time 1, 1 for Time 2, 2 for Time 3, and 3 for Time 4). The intercept represents the average student initial academic performance at Time 1 and the slope represents students' academic growth (see Figure 1). Compared to traditional methods of assessing change (e.g., linear mixed models), LGM is advantageous for testing incremental validities of predictors because the model accounts for measurement unreliability which could inflate Type I error (see Westfall et al., 2016).

IQ and Self-Control Predicting Initial and Change in Academic Performance

The aforementioned model fit the data well, $\chi^2(25) = 29.03$, $p = .263$, Root Mean Square Error of Approximation (RMSEA) = .029. Students' average initial grade (latent intercept) was 77.02 ($SE = .80$) and there was a general decline in academic growth over the course of four semesters (latent slope), $b = -1.20$, $SE = .16$, $p < .001$.

There are two major questions of interest. First, we examined if students' IQ and self-control predict their initial academic performance. Students' IQ significantly predicted initial performance, $b = 1.13$, $SE = .13$, $p < .001$, 95%

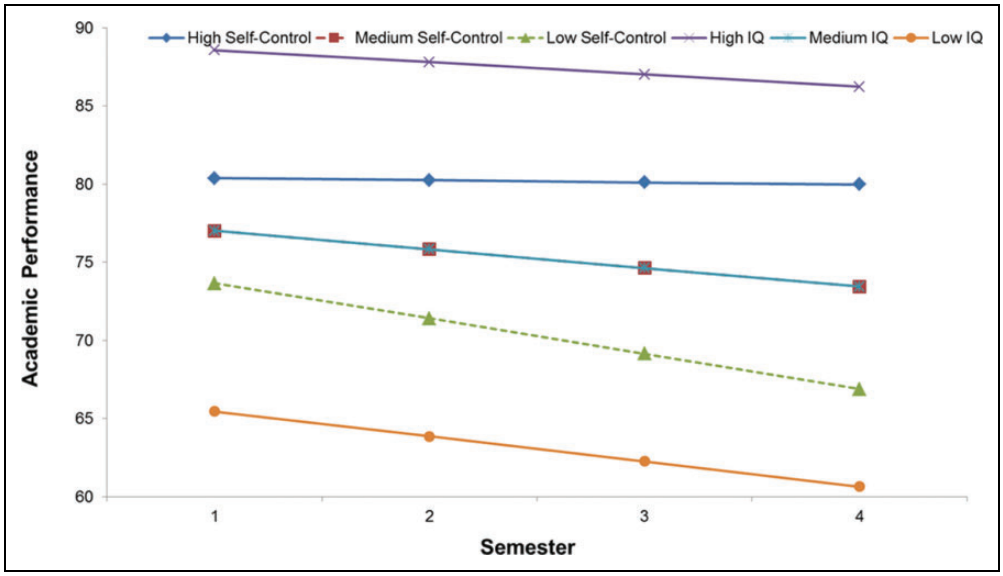

Figure 2. Academic performance across four semesters as a function of self-control (high self-control = mean + 1.5 *SD*; medium self-control = mean; low self-control = mean − 1.5 *SD*) and IQ (high IQ = mean + 1.5 *SD*, medium IQ = mean; low IQ = mean − 1.5 *SD*). The maximum academic performance (i.e., grade) is 100%.

confidence interval (CI) [0.89, 1.41],[4] so did self-control, $b = 5.17$, $SE = 1.77$, $p = .003$, 95% CI [1.60, 8.76]. To test whether the effects of IQ and self-control on the latent intercept were statistically different, we did a difference test between two models: (1) an alternative model in which the paths from IQ to the latent intercept and from self-control to the latent intercept were constrained to be equal (representing no difference between the two effects) and (2) the original model in which these paths were unconstrained. Results revealed that the models were statistically different, $\Delta\chi^2(2) = 740.82$, $p < .001$, meaning IQ ($\beta = .69$) predicted students' initial academic performance more strongly than self-control ($\beta = .20$).[5]

Next, we examine the effect of IQ and self-control on the slope. As predicted, self-control significantly predicted academic growth, $b = 1.63$, $SE = .46$, $p < .001$, 95% CI [0.57, 2.92], but students' IQ did not, $b = .04$, $SE = .03$, $p = .123$, 95% CI [−0.01, 0.10]. Similar to the difference test above, we compared an alternative model with constrained paths with the original model to test whether the two effects were statistically different. Results showed that they are, $\Delta\chi^2(2) = 85.50$, $p < .001$, indicating that self-control ($\beta = .35$) has unique predictive power of academic growth over IQ ($\beta = .13$[6]; $\varphi = .66$, a large effect size).

Besides, we also analyzed the effects of self-control and IQ on the intercept and slope of academic performance in independent models. Self-control predicted the intercept, $\beta = .32$, $p < .001$, and slope, $\beta = .34$, $p < .001$. Similarly, IQ also predicted the intercept, $\beta = .73$, $p < .001$, and slope, $\beta = .19$, $p = .029$.

To further unpack the effects of self-control and IQ on the latent slope, we conducted simple slope analyses at high (+1.5*SD*), medium (mean), and low levels (−1.5*SD*) of self-control (Curran et al., 2004; Preacher, Curran, & Bauer, 2006). As evident in Figure 2, students with low self-control suffered from an average of 2.25% decline in grade every semester, $b = -2.25$, $SE = .34$, $p < .001$, and students with medium self-control also suffered from an average of 1.20% decline in grade every semester, $b = -1.20$, $SE = .16$, $p < .001$. In contrast, results suggest students with high self-control were able to maintain their academic performance, $b = -.14$, $SE = .34$, $p > .250$. Regarding the effect of IQ, students from low to high levels of IQ suffered from a general decline in grades. Every semester, there were an average of .78% decline in grade among students with high IQ, $b = -.78$, $SE = .31$, $p = .012$, 1.20% among students with medium IQ, $b = -1.20$, $SE = .16$, $p < .001$, and 1.61% among students with low IQ, $b = -1.61$, $SE = .31$, $p < .001$. As tested in the interaction between IQ and academic growth earlier, these slopes did not statistically differ from each other, $p < .123$. Taken together, the results suggest that both IQ and self-control predicted initial academic performance, and IQ predicted more strongly; nevertheless, in face of a general decline in academic growth, high self-control but not IQ buffered the decline.

Self-Control Mediates Gender Differences in Initial and Change in Academic Performance

We investigated whether there was a gender difference in academic performance, IQ, and self-control. We specified an additional indicator variable of gender (1 = *male*; 2 = *female*), predicting the latent intercept, the latent slope, IQ, and self-control (see Figure 3). The model fits the data well, $\chi^2(28) = 31.63$, $p = .291$, RMSEA = .026. Results showed very similar patterns compared to the North American findings. Gender has a significant total effect on latent intercept, $b = 4.14$, $SE = 1.44$, $p = .020$, 95% CI [1.66, 6.55], suggesting that Taiwanese girls in our sample had better initial academic performance than boys, though the total effect of gender on academic growth

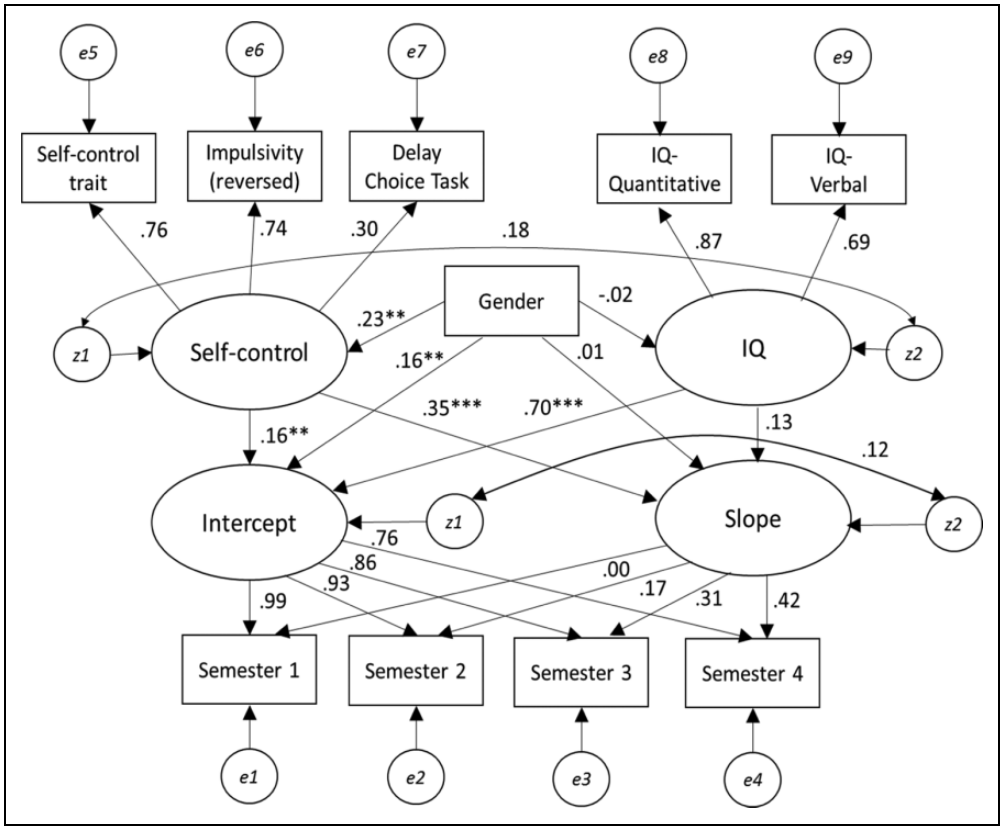

Figure 3. Latent growth curve model of gender differences in students' academic performance across four semesters as a function of IQ and self-control. The letters e_1 through e_9 represent error variables reflecting imperfect measurement, and z_1 to z_4 represent unexplained variance in the two latent variables. Coefficients are standardized. Significance of the effects of the exogenous variables is included in the figure: *p < .05. **p < .01. ***p < .001.

Table 1. Descriptive Statistics and Bivariate Correlations for All Predictor Variables, Gender, and Grades.

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Brief self-control trait	–											
2. Impulsivity	0.57**	–										
3. Delay choice task	0.19**	0.23**	–									
4. Self-control composite score	0.79**	0.81**	0.64**	–								
5. IQ—total	0.08	0.11	0.14*	0.15*	–							
6. IQ—verbal	0.06	0.07	0.14	0.12	0.88**	–						
7. IQ—quantitative	0.10	0.13	0.13	0.16*	0.91**	0.60**	–					
8. Gender	0.15*	0.17*	0.20**	0.23**	–0.02	–0.01	–0.02	–				
9. Grade—Semester 1	0.27**	0.17*	0.23**	0.30**	0.63**	0.50**	0.63**	0.18*	–			
10. Grade—Semester 2	0.31**	0.21**	0.22**	0.33**	0.61**	0.48**	0.62**	0.19**	0.97**	–		
11. Grade—Semester 3	0.31**	0.23**	0.22**	0.34**	0.59**	0.47**	0.59**	0.18*	0.94**	0.97**	–	
12. Grade—Semester 4	0.33**	0.26**	0.23**	0.37**	0.56**	0.42**	0.58**	0.19**	0.87**	0.92**	0.95**	–
Mean	3.04	3.49	0.68	0.00	57.72	27.66	30.12	–	77.07	75.60	74.73	73.42
SD	0.56	0.82	0.47	2.23	13.29	6.90	7.86	–	11.24	11.84	13.10	14.46
Internal reliability	.69	.77	–	.60[a]	–	–	–	–				
Observed range	1–5	1–5	0–1		0–100	0–50	0–50		0–100	0–100	0–100	0–100

Note. $N = 195$. Gender: 1 = *male*; 2 = *female*. Impulsivity scores were reverse-coded; and the higher the scores, the higher the self-control is. Reliability of grades (α) = .98.

[a]This is the reliability of the three self-control component mean scores; reliability of individual items across the three components = .82.

*p < .05. **p < .01.

was not significant, $b = .35$, $SE = .30$, $p > .250$. As expected, girls in our sample had greater self-control than boys, $b = .19$, $SE = .07$, $p = .019$, 95% CI [0.069, 0.30], but they did not differ in IQ, $b = -.23$, $SE = 1.04$, $p > .250$ (see Table S1 in the Supplemental Online Material for individual significance tests for each self-control measures).

Next, we turn to examine the indirect effects of gender via IQ and self-control on students' grades. To compare the distinct indirect effects of IQ and self-control, we modified the existing model and created two additional models: one contained only indirect effects via IQ controlling for self-control (IQ as the mediator) and the other contained only indirect effects via self-control controlling for IQ (self-control as the mediator). Results showed that IQ mediated neither the gender difference in initial academic performance, $b = -.26$, $SE = 1.27$, $p > .250$, nor academic growth, $b = -.01$, $SE = .05$, $p > .250$. However, as expected, self-control mediated the gender difference in initial academic performance, $b = .80$, $SE = .47$, $p = .034$, 95% CI [0.06, 2.07], and academic growth, $b = .33$, $SE = .18$, $p = .004$, 95% CI [0.07, 0.85]. Replicating findings from the United States, these findings suggest that girls' higher self-control (not IQ) could explain why girls perform better at school than boys, both through having higher initial performance and sustaining academic growth.

Discussion

During a 2-year period, the study examined the effects of IQ and self-control on academic performance in Taiwan. The results revealed that although students with higher IQs performed better initially and overall, it was the students with greater self-control who were able to withstand a general decline in grades when course material became more difficult over time. The results support effort as an explanation of academic growth (Duckworth, Eichstaedt, et al., 2015). Moreover, replicating past findings in the United States that self-control explains girls' edge in academic tests (Duckworth & Seligman, 2006), Asian female students also performed better than boys because of their greater self-control, not higher IQ. Recruiting a sample from Asia and using a longitudinal design, the study provided a timely and rigorous test of self-control—playing a unique role in predicting academic growth—and extended the findings outside of North America.

Although large-scale studies and meta-analyses have been conducted in the past to compare the predictive validity of IQ and self-control, multiwave longitudinal designs provide further insights into the dynamics of academic success (Duckworth et al., 2010; Hsin & Xie, 2014). Our study in particular highlights the role of time in understanding the effect of self-control on academic growth. In line with past theories, our findings echoed that even though cognitive ability may predict initial (and overall) performance better, it takes time for effort to grow performance (Duckworth, Eichstaedt, et al., 2015). Nevertheless, it is also noteworthy that the literature has discussed moderating factors. For example, the effect of self-control on performance growth would depend on task nature. Self-control should have a stronger effect on performance growth in tasks that require persistence, but its effect might be weaker for tasks that solely require talent and insights (Duckworth, Eichstaedt, et al., 2015).

The current study is definitely not without limitations, and the literature would benefit from future work that takes them into consideration. Despite effort into collecting a large enough sample for a longitudinal study, because the grades across semesters were pretty stable, the study has low statistical power for detecting change in academic performance. Future studies should consider collecting an even larger sample and increasing the number of time points of measurement to increase power (Hertzog et al., 2008). Moreover, there is an overall decline in academic performance at the school; though conversations with teachers at the school revealed a potential reason of the rapid advancement of the curriculum, we do not know empirically what caused the decline. Future work would certainly benefit from recruiting samples from multiple and diverse schools to increase generalizability of the (direction of) effect of self-control on academic growth.

This project also highlights one important future research direction that we need more cultural and cross-cultural work on antecedents of academic performance. Our knowledge of how students succeed in their local educational system is very limited outside of the North American context. For example, why do Asian students perform so well internationally? How do different cultures shape different strategies in promoting academic success? Some may argue that Asians perform better because they have higher IQs (Jensen, 1998), whereas many others claim that tiger moms' education of self-discipline to "tiger cubs" plays a critical role (Chua, 2011). Nonetheless, these speculations await more investigation to be validated. In sum, more future work is needed to examine nuances in academic success across cultures. To the extent that we understand how to effectively promote academic success, future students can benefit and fulfill their academic potential.

Declaration of Conflicting Interests

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Supplemental Material

The online supplements are available at http://spps.sagepub.com/supplemental.

Notes

1. Specifically, the consecutive semesters are Fall 2011, Spring 2012, Fall 2012, and Spring 2013.
2. We also collected classroom teachers' ratings of each student's self-control. However, because 50% of students' grade was based on subject teachers' assessment of everyday performance, due to potential for inflated associations between teacher ratings of self-control and students' grade, teacher ratings were not included in the analyses. With and without including teachers' ratings in the analyses produce the same pattern of results.
3. Item scores could be used as individual indicators of the latent variable; however, due to the lack of information for individual responses to intelligence quotient (IQ) items, we used the mean

scores of each subcomponent as the indicator instead. The measurement unreliability was thus accounted for at the subcomponent level of the IQ and self-control latent variables.

4. All bootstrapping used 5,000 resampling.
5. We also ran supplementary models to examine the effects of IQ and self-control on students' overall academic performance (over the four semesters) and they yielded similar results—IQ ($\beta = .66$) predicted overall performance more strongly than self-control ($\beta = .26$), $\Delta\chi^2(2) = 14.9$, $p = .001$.
6. The patterns of bivariate correlations also showed very similar patterns (see Table 1). IQ was correlated consistently and strongly with the grades across the four semesters ($r_{sem1} = .58$, $r_{sem2} = 57$, $r_{sem3} = .55$, $r_{sem4} = .51$), but self-control appeared to have increasing correlations with the grades across the four semesters ($r_{sem1} = .39$, $r_{sem2} = .44$, $r_{sem3} = .46$, $r_{sem4} = .50$).

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