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Cognitive ability, personality, and academic performance in adolescence

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ABSTRACT

Does positive thinking predict variance in school grades over and above that predicted by cognitive ability? Six hundred and thirty nine high school students participated in a three-year longitudinal study that predicted grades using cognitive ability and three positive thinking variables – self-esteem, hope, and attributional style. Hope, positive attributional style and cognitive ability predicted higher grades, whilst self-esteem was a less consistent predictor of academic performance. Structural equation modelling revealed significant paths from cognitive ability, gender, and a second order positive thinking factor to grades. The results suggest that intelligence, gender, and positive thinking each play a unique role in predicting academic performance in youth. Some suggestions for further research are made.

1. Introduction

Although it is clear that cognitive ability plays an important role in predicting academic achievement (Deary, Strand, Smith, & Fernandes, 2007), it is also the case that a number of personality factors help shape an individual's academic performance (e.g. Ackerman & Heggestad, 1997; O'Connor and Paunonen, 2007). The personality and cognitive ability literatures have tended to develop independently, although there have been attempts at integration. The evidence shows that some Big Five Factors such as conscientiousness and agreeableness account for unique variance in achievement after IQ has been taken into account (Conard, 2006; Farsides & Woodfield, 2003; Laidra, Pullman, & Allik, 2007). However, as many studies are conducted with university students, it is still unclear how personality and intelligence interact to influence school performance. Further, it is also unclear how well other lower-order personality variables predict academic performance, especially when accounting for the influence of intelligence.

In the present study, we focused on three lower-order personality traits, namely, self-esteem, attributional style, and trait hope. We selected these variables because, unlike broader personality traits like extraversion and neuroticism, these "positive thinking" variables are often the target of cognitive behavioural interventions (Baumeister, Campbell, Krueger, & Vohs, 2003; Ciarrochi & Bailey, in press) and are, therefore, potentially malleable. Moreover, although these variables predict quite different outcomes (Ciarrochi, Heaven, & Davies, 2007), they are all believed to be important for academic performance as well as promoting resilience and helping individuals cope with adversity (Ciarrochi et al., 2007; Feiring, Taska, & Lewis, 2002; Snyder, 2000; Umana-Taylor & Updegraff, 2007). Hence, we assessed, over three years, the extent to which cognitive ability and positive thinking variables co-determine academic achievement among high school students.

We selected high school youth for two important reasons. First, the transition to high school is a challenging time for the adolescent. Not only is the teenager dealing with the actual change to a new school, but is also dealing with maturational, educational, and new interpersonal challenges (Montemayor, Adams, & Gullotta, 1990). The teenage years have been described as a sensitive and critical time (Blackwell, Trzesniewski, & Dweck, 2007) with important implications for school achievement. However, we still do not know how personality interacts with intelligence to influence school achievement.

Secondly, many studies have been conducted with convenience samples of university students. Such samples are usually highly selected with respect to intelligence, and so personality factors increase in their relative ability to predict academic performance (Chamorro-Premuzic, Furnham, & Ackerman, 2006). It is, therefore, important to assess the impact of cognitive and non-cognitive factors on academic performance among a more diverse sample of adolescents.

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1.1. The importance of cognitive factors in educational settings

Cognitive ability is of central importance in predicting not only academic outcomes (Ackerman & Lohman, 2003; Deary et al., 2007; Sternberg, Grigorenko, & Bundy, 2001), but also wealth and socio-economic success (Zagorsky, 2007), job performance (Hunter & Hunter, 1984), and job type (Gottfredson, 2003), to mention a few. For more than a century, psychologists and educationalists have been interested in the links between various tests of mental ability and academic performance (Galton, 1883). Despite the development and revision of research ideas over this time, a crucial factor in predicting academic achievement remains an individual's level of general cognitive ability, or psychometric *g*.

Among secondary school students, cognitive ability correlates with academic performance in the order of .50 (e.g. Sternberg et al., 2001) as demonstrated by early (e.g. Springsteen, 1940) and more contemporary researchers. For example, in their impressive 5-year longitudinal study of over 70,000 British school children, Deary and colleagues obtained correlations of .69 between a standardised cognitive abilities test (CAT) and total grade (General Certificate of Secondary Education examinations), and .72 between CAT scores and students' "Best 8" exam scores (Deary et al., 2007). Colom and colleagues demonstrated that measures of fluid intelligence (e.g. abstract reasoning and inductive reasoning), short term memory (e.g. digit span and block design), and working memory (e.g. computation span and dot matrix) were all predictive of academic performance among secondary school students (Colom, Escorial, Shih, & Privado, 2007). In a cross-sectional study, Di Fabio and Busoni (2007) found fluid intelligence to explain more of the variance of academic achievement than the Big Five personality factors among high school teenagers aged 17–19 years.

1.2. The role of personality factors

A large body of evidence suggests that school achievement is related not only to major personality dimensions such as the Big Five, but also to lower-order personality traits (see Ackerman & Heggestad, 1997; Chamorro-Premuzic & Furnham, 2005). It is possible to identify various "classes" of factors associated with school performance (Johnson, McGue, & Iacono, 2006) including, for example, intelligence, family factors, peers, motivational factors, and others. We would argue that lower-order personality factors can also be grouped into various classes or categories and that "optimistic" dispositional characteristics or traits is one such class. For example, Blackwell et al. (2007) recently found that teenagers' positive beliefs about intelligence affected their school performance. Those students who believed that intelligence is malleable and can be developed, rather than fixed and unchangeable, were more likely to expend more effort at their school work, make more positive or optimistic attributions for their behaviour, and endorse higher-level learning goals. Such a motivational framework or "optimistic' outlook was found to have a significant positive impact on math achievement two years later, compared to students who did not hold these beliefs. Additionally, the authors speculated that such a motivational framework or optimistic approach is especially useful during the transition to high school. Likewise, a measure of optimism ("when bad things happen, I still look on the bright side") was found to be significantly related to school achievement (Lounsbury, Sundstrom, Loveland, & Gibson, 2003; see also Thelwell, Lane, & Weston, 2007).

In the present study, we focused on three other forms of positive thinking associated with school achievement, namely, trait hope, self-esteem and positive attributional style. Attributional style reflects the way in which individuals assess the causes of past events. Thus, a person with a positive or optimistic attributional style is likely to attribute negative events to external causes such as bad luck, whilst explaining positive outcomes in terms of internal causes (Abramson, Seligman, & Teasdale, 1978). Attributional style is, related to psychological adjustment and the ability to form and maintain healthy social relationships (Ciarrochi & Heaven, in press). Self-esteem, on the other hand, reflects the way in which an individual evaluates their self worth (Matthews, Deary, & Whiteman, 2003). Hope, in turn, taps an individual's belief in their effectiveness in obtaining desired goals (Snyder, 2000). More specifically, it reflects an individual's belief that they are able to identify potential routes to their goals and that they can initiate and maintain progress towards their goals.

It is this focus on identifying potential routes to goals that differentiates trait hope from Bandura's (1977) concept of self efficacy (Snyder, 2000). The distinction between these two constructs has also been borne out in research. For instance, Magaletta and Oliver (1999) found hope and self efficacy to be distinct in factor analysis and to explain unique variance in a measure of general well-being. Among children, cross-sectional studies have demonstrated that hope is significantly related to school performance and explains unique variance relative to other predictors such as self-esteem (Snyder et al., 1997). Further, a recent longitudinal study by Ciarrochi et al. (2007) indicated that trait hope was a significant predictor of academic grades one year later.

Although meta-analyses of cross-sectional studies have found support for the important role that self-esteem plays in predicting academic performance (Hansford & Hattie, 1982), longitudinal evidence questions these conclusions (e.g. Baumeister et al., 2003). Indeed, Baumeister and colleagues concluded that "self-esteem has no impact on subsequent achievement" (2003, p. 13). Finally, it is well established that a positive attributional style is related to elevated academic achievement (e.g. Blackwell et al., 2007; Glasgow, Dornbusch, Troyer, Steinberg, & Ritter, 1997). For example, Glasgow and colleagues (1997) found that a dysfunctional attributional style was significantly negatively related to GPA cross-sectionally as well as one year later.

1.3. Aims and rationale

The main aim of this study was to assess the longitudinal impact of hope, self-esteem, and positive attributional style on school performance after controlling for intelligence. Longitudinal research in this field among teenagers is virtually non-existent. Hence, the present study spanning three years was designed to examine this under-explored, yet highly important, area.

2. Method

2.1. Participants

The students were all participants in the Wollongong Youth Study and attended five high schools in a Catholic Diocese of New South Wales (NSW), Australia. The Diocese is centred on the city of Wollongong (population approximately 250,000), but also reaches into south-western metropolitan Sydney. Thus, the socio-economic and cultural mix of the participants is quite diverse. At Time 1 our sample represented a diverse range of key demographic indicators. For example, the spread of occupations of the fathers of our participants closely resembled national distributions (ABS, 2004): e.g., Professionals 20.4% (16.5% nationally), Associated Professionals 15.1% (12.7%), Intermediate Production and Transport 11.2% (13.4%), Tradespersons 34.3% (21%), Managers 4.8% (9.7%), Labourers 3.3% (10.8%), Advanced Clerical 1.2% (.9%), Intermediate Clerical 5.5% (8.8%), and Elementary Clerical 4.3% (6.1%). Additionally, 22% lived in non-intact families, whereas national divorce rates at the time was 29% (Australian Bureau of Statistics, ABS,

2005), and 19.77% were exposed to a language other than English in the home, whereas nationally the figure was 15.8% (ABS, 2006). Students were surveyed in the middle of their first year of high school (Grade 7) and three years later in Grade 10. At Time 1, more than 784 students (mean age = 12.30 yrs., SD = 0.49) completed the questionnaire (382 males and 394 females; 8 did not indicate their gender). We were able to directly match the data of 639 students (316 males and 323 females) across the three years, representing an 82% follow-up rate.

2.2. Materials

2.2.1. Time 1

When students were in Grade 7 they completed a test battery comprising several different measures. The following are of interest to the present report.

2.2.1.1. Measures of verbal and numerical ability. Students completed standardised numerical and verbal tests. These tests are curriculum-based, criterion-referenced tests and are administered by the NSW Department of Education and Training to all students in the State during their first year of high school. There are six numerical (numeracy, number, measurement, space, data, numeracy problem solving) and three verbal (writing achievement, reading achievement, and language achievement) subtests. Scores on the subtests were summed to provide a total verbal and total numeracy score. Cronbach's alpha coefficient for the numerical tests was .95 and .87 for the verbal tests.

2.2.1.2 Personality traits. We used the Children's Hope Scale (Snyder, Rand, & Sigmon, 2002). This is a six-item scale that includes items such as "I think I am doing pretty well", and "When I have a problem, I can come up with lots of ways to solve it". The measure has demonstrated reliability and concurrent validity (see Ciarrochi et al., 2007). Responses were indicated on a 6-point Likert scale ranging from "none of the time" (scored 1) to "all of the time" (6). Items were summed to create a total hope score. On the present occasion Cronbach's coefficient alpha was .82.

Students also completed Rosenberg's (1979) self-esteem scale. This well-known scale has been used in various populations and has excellent reliability and validity (see Baumeister et al., 2003). The scale measures global self-esteem and provides a good indication of general rather than specific views of the self (Baumeister et al., 2003). Participants were asked to indicate their agreement with statements about the self. High scores indicate high self-esteem and on this occasion Cronbach's alpha was .86. Finally, students completed the children's attributional style questionnaire (CASQ; Thompson, Kaslow, Weiss, & Nolen-Hoeksema, 1998). The CASQ is a 24 item measure designed to assess tendencies to make depressive explanations for events and has been shown to possess good criterion-related validity, satisfactory internal consistency as well as test–retest reliability. After reverse-scoring items on the negative attributional scale, they were combined with positive items to form a positive attributional scale. The alpha coefficient of this scale was .63.

2.2.2. Time 2

Students' school grades were obtained three years later at the end of Grade 10. Grades were based on formal, invigilated examinations in each subject and we obtained the grades for those subjects with the largest enrolments, namely, English, Math, Science, and History. Scores were converted to *z*-scores to facilitate comparisons across subjects. A mean *z*-score, labelled total grade, was then calculated for participants by summing the standardised score for each of these four subjects and dividing this total by four. Only those participants with grades in each of the four subjects were included in this analysis.

2.3. Procedure

We obtained consent from Diocesan authorities, schools and parents, after which students were invited to participate in a study on "Youth Issues". Administration of the questionnaire took place during regular classes under the supervision of one of the authors. Students completed the questionnaires without any discussion. At the conclusion of the session students were thanked for their participation and debriefed.

3. Results

3.1. Gender differences

Significant gender differences were found for total grades in Grade 10 ($F(639) = 25.78$, $p < .01$ with girls ($M = .21$, SD = .81) outperforming boys ($M = -.13$, SD = .91).

3.2. Correlations and regression

Table 1 illustrates the relationship between the positive thinking variables and verbal and numerical aptitude. The positive thinking variables were significantly related, but did not share more than 21% of common variance with each other. Verbal and numerical ability were highly correlated and were each significantly related to trait hope and positive attributional style, but not to self-esteem.

Table 2 shows the correlations between the Grade 7 predictor variables and Grade 10 school achievement outcomes. Verbal and numerical aptitude were the strongest and most consistent correlates of school outcomes. Nonetheless, personality measures were also significantly related to school outcomes. Trait hope was related to total grade as well as to each of the subject outcomes. Positive attributional style was significantly related to each outcome measure, with the exception of Mathematics. Of the personality measures, self-esteem was the weakest correlate of achievement, only correlating significantly with Science. As expected, the relationships of verbal and numerical ability with school performance were substantially higher than the relationships between the personality variables and performance.

Table 1
Correlations between variables

	1	2	3	4	5
1. Verbal aptitude	–				
2. Numerical aptitude	.75**	–			
3. Trait hope	.18**	.14**	–		
4. Self-esteem	.04	.07	.43**	–	
5. Positive attributional style	.20**	.10*	.45**	.37**	–

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

Table 2
Correlations between Grade 7 predictors and Grade 10 school performance

Grade 7 predictors	Grade 10 achievement				
	Math	Science	English	History	Total grade
Verbal aptitude	.57**	.67**	.71**	.59**	.73**
Numerical aptitude	.67**	.69**	.60**	.52**	.71**
Hope	.12**	.21**	.22**	.20**	.21**
Self-esteem	.03	.09*	.06	.06	.07
Positive attributional style	.06	.16**	.15**	.10*	.13**

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

A regression analysis was performed in order to determine the unique predictors of academic performance. This analysis, including measures of verbal and numerical aptitude along with the positive thinking variables and gender, revealed that only hope ($b = .09$, $t = 2.80$, $p < .01$), verbal aptitude ($b = .42$, $t = 10.39$, $p < .01$), and numerical aptitude ($b = .38$ $t = 9.82$, $p < .01$), significantly contributed to the model (F (6,603) = 155.33, $p < .01$, $R^2 = .61$).

3.3. Structural equation modelling

Noftle and Robins (2007) have suggested that personality measures, such as conscientiousness, predict academic performance even when accounting for the variance associated with IQ. In the current study, using structural equation modelling, we examined the utility of academic ability and positive thinking as predictors of academic achievement. The advantage of structural equation modelling is that it provides an assessment of measurement error and allows for the examination of the latent structure. Item parcels were used instead of individual items in order to minimise the number of parameters that needed to be estimated. Following the practice recommended by Bentler and Chou (1987), each parcel consisted of a minimum of three items, so as to minimise the risk of under-identification. Along with the positive thinking variables, the nine aptitude subtests (six numerical and three verbal) were similarly parcelled to produce a latent measure of general intellectual aptitude, or *g*.

In order to assess the impact of positive thinking on academic performance a second order factor was analysed, comprising the three positive thinking variables. Given the significant differences in academic grades between genders, it was decided to also include this variable in the model.

The model fitted the data well with NFI = .90, CFI of .93 and RMSEA of .06. $\chi^2 = 473.4$, d$f = 162$, $p < .0001$. The paths from self-esteem, attributional style, and hope to the second order positive thinking factor were significant (Fig. 1), whilst the path to grades from positive thinking was also significant. This suggests the presence of a global positive thinking variable linked to academic performance. There was also a significant path from both *g* and gender to total grades. Thus, along with *g* and gender, positive thinking also predicted academic performance.

4. Discussion

The aim of this study was to determine the relative impact of intellectual ability and positive thinking variables on school achievement over three years. The results of our analyses are quite clear: among youth both psychometric *g* and positive thinking predict school achievement.

Previous studies, many of which have been conducted among highly selected samples of university students (e.g. Noftle & Robins, 2007) as well as some studies with adolescents (e.g. Duckworth & Seligman, 2005), have argued for the importance of personality in predicting academic achievement. The current results provide further support for this claim. Our research focused on lower-order positive thinking variables that are frequently targeted in interventions (Ciarrochi & Bailey, in press). Our regression analysis with manifest variables showed that trait hope was the only personality variable to predict academic performance over three years. The generally weak longitudinal effect of self-esteem is consistent with Baumeister et al. (2003) and Ciarrochi et al. (2007). One possible explanation for the inconsistency between the current findings and those uncovered in cross-sectional research, such as Hansford and Hattie (1982), may be found in the limitations of cross-sectional design. Using such a design it is extremely difficult to unravel the impact that variables such as self-esteem and attributional style have on achievement or, conversely, that good achievement has on one's self-esteem or attributional style.

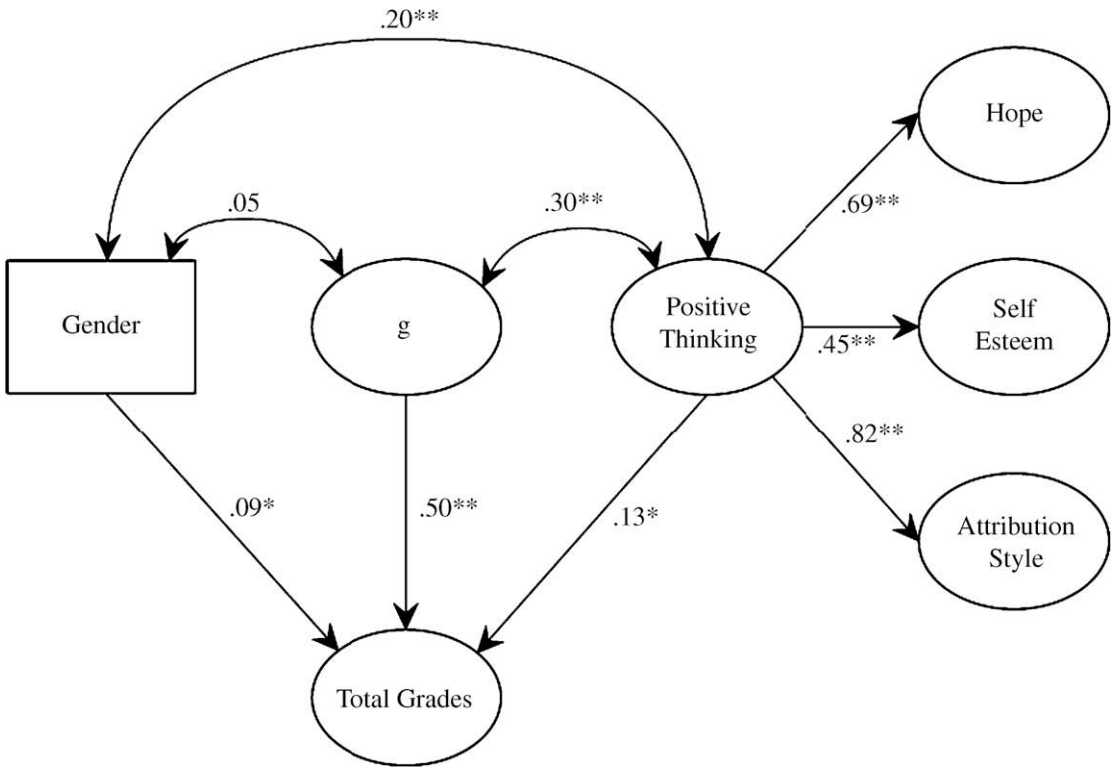

Fig. 1. Model examining the role of *g*, gender, and positive thinking variables in Grade 7 on total school grades in Grade 10.

The structural equation model revealed that self-esteem, along with hope and attributional style, were each latent indicators of a second order positive thinking factor which, in turn, was linked to grades. The model shows that self-esteem, attributional style, and hope made roughly equal contributions to the second order positive thinking factor. Nonetheless, in the regression analysis, which did not correct for measurement error, hope, along with verbal and numerical aptitude, were the only unique predictors of academic grades. This implies that the Children's Trait Hope Scale, comprised as it is of only six-items, may serve as a useful and distinctive measure of positive thinking.

5. Conclusions and future directions

Our findings offer general support for the importance of personality in predicting academic performance and support the claims of Noftle and Robins (2007, p. 116) who reported that "...personality predicts academic performance...even when intelligence and cognitive ability are controlled". Much of this work has examined conscientiousness. Given the prominent focus on achievement striving of most measures of conscientiousness, such a link is probably not surprising. The current study suggests that personality variables not directly linked to achievement striving also predict scholastic achievement.

The measure of explanatory style used here had only modest reliability, and yet was able in the structural equation model to predict academic performance over and above *g*. Future research might improve the accuracy of prediction with a more reliable measure (e.g. Hankin & Abramson, 2002).

Clearly, *g* and the personality variables we included did not explain all of the variance in school grades and it is interesting to speculate as to what other factors might be important. Future research may want to assess the impact of family factors, school environment, peer influences, and personality factors not studied here. These could include self-discipline (Duckworth & Seligman, 2005), motivation (Gagne & St Pere, 2001), intellectual engagement (Chamorro-Premuzic et al., 2006), and self-perceived ability (Blackwell et al., 2007). The current study focused on "optimistic" lower-order personality traits because we believe that these "positive thinking" variables are an appropriate target for cognitive behavioural interventions. Nonetheless, this raises the question as to what form these interventions may take? How might we assist students to raise their academic performance? It would be possible to identify students who are highly intelligent but low in positive thinking, and evaluate whether an intervention that increased their levels of positive thinking would also lead to improvements in academic performance. Given the relative stability of intelligence throughout the lifespan (Deary, Whalley, Lemmon, Crawford, & Starr, 2000), it may be extremely difficult to increase intelligence. Thus, it makes sense to direct interventions at those variables that facilitate the use of intelligence. A variable such as trait hope, for instance, lends itself readily to such an intervention (Snyder, 2000).

The study of positive thinking is a relatively new area in psychology. Nonetheless, it appears to provide important insights into human behaviour. Hence, in contrast to Benjamin Franklin's (1898, pp. 44–45) claim that "He that lives upon hope will die fasting", the current findings, concerning academic performance, add to a growing body of literature (e.g. DiPietro, Welsh, Raven, & Severt, 2007) suggesting that positive thinking is important for success in a broad variety of areas.

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