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Conscientiousness and Achievement Motivation Predict Performance

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Abstract

A prospective survey was conducted to identify predictors of university students' grade point average (GPA) using separate samples of female (N = 472) and male (N = 142) students over 9 months. Big five personality traits and achievement motivation were measured. Correlations show that conscientiousness (C) and achievement motivation explained variation in GPA. Latent variable structural equation modelling showed that the effect of C on GPA is fully mediated by achievement motivation for both female and male students. Invariant factor and structural mediation models across the female and male groups are also reported. Finally, the mediation model is shown to remain significant after scholastic achievement is controlled. The findings are interpreted within the framework of Neo-Socioanalytic theory. Copyright © 2009 John Wiley & Sons, Ltd.

Key words: university students; grade point average; conscientiousness; achievement motivation; Neo-Socioanalytic theory

Psychological measures have been found to correlate with academic performance and to explain variance not captured by 'traditional', previous performance indexes, such as school grades. Student selection reduces variation in intelligence scores, especially at highly selective institutions (e.g. Furnham, Chamorro-Premuzic, & McDougall, 2003), and thereby attenuates the intelligence–university performance relationship. Identifying psychological antecedents of university students' marks can help identify dispositions and motivational processes which facilitate optimal academic performance. This could allow identification of students who may not perform well and, in the longer term, inform the design of interventions to improve particular student's performance. This is especially true in post compulsory educational settings where motivation to study is less regulated by teachers and parents. Thus university admissions and student-support policies could

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potentially benefit from the development of integrated theoretical models of psychological predictors of students' performance.

Grade point average (GPA) is the overall weighted sum of all marks contributing to a student's final degree. GPA is meaningful to students and employers. It may be provided on degree certificates and requested in references for jobs or postgraduate training courses (Naylor, Smith, & McKnight, 2002; Plant, Ericsson, Hill, & Asberg, 2005). Thus GPA provides a real-world comparative measure of performance that does not rely on self-reports.

Personality and grade point average

Personality research has focused on the *'big five'* personality traits (McCrae & Costa, 1987) and these have been found, to a greater or lesser extent, to be associated with GPA. Conscientiousness (C) is the most important of the big five predictors. This is unsurprising, since conscientious students are deemed to be more organised, careful, dependable, self-disciplined and achievement orientated (McCrae & Costa, 1987). The impact of neuroticism (N), extraversion (E), openness (O) and agreeableness (A) on academic performance is less clear because of variable findings across studies. For example, in a recent meta analytic review, O'Connor & Paunonen (2007) report a small to medium effect size estimate of conscientiousness (C) on GPA, corrected r (i.e. ρ) = .24 (see Hunter & Schmidt, 2004), $k = 23$, $N = 5878$ and modest mean weighted correlations for N, E, O and A (ρs ranging from −.05 to .06).

Achievement motivation

In a meta-analytic review, Robbins, Lauver, Le, Davis, Langley, and Carlstrom, (2004) identified 'achievement motivation' as one of the strongest correlates of GPA ($r = \pm.26$, $k = 17$, $N = 9330$). Although a combination of measures comprised the achievement motivation construct, examination of the primary articles reveals that the motivation subscale from Weinstein, Palmer, and Schulte's (1987) 'learning and study strategy inventory' (LASSI) had the highest bivariate association with GPA (Kern, Fagley, & Miller, 1998; Rugsaken, Roberston, & Jones, 1998; Stoynoff, 1997) of any measure. The items in this inventory measure student's persistence when faced with challenging or difficult course material (e.g. 'when work is difficult, I either give up or study only the easy parts'). Pintrich, Smith, Garcia, and Mckachie (1991) include items from the LASSI 'motivation' subscale in a measure they refer to as 'effort regulation' which they note 'reflects a commitment to completing one's study goals, even when there are difficulties or distractions' (Pintrich et al., 1991, p. 27). Similar persistence measures have been used by Day, Radosevich, and Chasteen (2003) (e.g. 'when I run into a difficult or complex concept, I keep working at it until I think I've understood it', p. 444) and Simons, Dewitte and Lens, (2004) (e.g. 'I give up easily when I have problems studying this course', p. 349). Hirschfeld, Lawson and Mossholder (2004) investigated 'academic achievement motivation' using related measures (e.g. 'I work persistently to achieve high levels of accomplishment in my coursework', p. 2397). All of these measures refer to a situated capacity to persist with academic work in the face of challenge. The literature is unclear as to whether this capacity is best conceptualised as a motivational, acquired self-regulatory capability or as a domain-specific personality trait but, following Robbins et al. (2004), we

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use the term 'achievement motivation' to refer to measures of this capacity to persist in the face of academic challenge.

Understanding the relationships between personality and achievement motivation in predicting GPA

Studies relating personality traits to academic achievement have rarely focused on *how* personality traits affect performance. It has been proposed that personality traits do not impact performance directly, but through more proximal constructs that are more closely related to behaviour (Burmudez, 1999; Chen, Gully, Whiteman, & Kilcullen, 2000; Kanfer, 1990; Lee, Sheldon, & Turban, 2003; Phillips & Gully, 1997). This is based on the idea that measures more psychologically proximal to behaviour share more common features with the corresponding context, tasks or outcomes.

The focus of our research was to (i) establish whether and to what extent achievement motivation mediates the relationship between conscientiousness and performance, and (ii) consider the theoretical framework within which this hypothesised mediation model is best interpreted. Pintrich (1999) originally conceptualised achievement motivation as a social cognitive or motivational construct. This corresponds to Bidjerano and Dai's (2007) interpretation of their finding that achievement motivation mediates the influence of C on GPA. Another explanation is that C encompasses achievement motivation. This is consistent with research that identifies persistence (e.g. Hough & Ones, 2001; Peabody & De Raad, 2002) and closely related traits such as industriousness (Roberts, Chernyshenko, Stark, & Goldberg, 2005) as sub-facets of C. Thus achievement motivation may be more usefully conceptualised as a mid-level, situated personality trait. In contrast to de-contextualised global measures of personality traits, such as C, achievement motivation is presumed to be based on education-specific beliefs and values which may be modifiable (Pintrich, 1999; Pintrich & DeGroot, 1990). Thus achievement motivation may be influenced by modifiable, situational factors.

This proposal is consistent with Roberts and Wood's (2006,) Neo-Socioanalytic theory which provides a theoretical framework for integrating personality factors at different levels of abstraction. In this theory, global personality factors such as C which are relatively stable across time and context are located at the apex of a personality hierarchy. Narrower traits including those that are related to specific behavioural domains (such as studying), and identities (e.g. a good student) are referred as mid-level state-like factors presumed to be less stable over time and context and influenced by situational factors in addition to more global personality factors. At the narrowest level discrete thoughts, feelings and behaviours are proposed to be influenced by mid and higher level traits in addition to more immediate environmental factors and are therefore the least stable level of generality in the hierarchy. In this hierarchical sequence, global personality factors are thought to be more strongly associated with mid level constructs than those at the narrowest level of abstraction. Importantly, lower order factors are proposed to be subsumed by those above them (in the hierarchy), and may also be the mechanism by which more global factors influence outcomes (Fleeson, 2001; Hooker & McAdams, 2003; Roberts & Wood, 2006). In this model, lower level personality factors capture unique variation not accounted for by the more global higher order factors. Thus Neo-Socioanalytic theory provides a useful framework for considering global traits such as the big five and mid-level traits such as achievement motivation which may mediate the impact of the former. This is consistent with Bidjerano and Dai's (2007) findings and with studies (e.g. Bogg, Webb, Wood, &

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Roberts, 2008) showing stronger associations between personality traits and health outcomes when personality attributes are framed within specific roles (e.g. exercise behavioural identity).

Moderate associations reported between achievement motivation measures and GPA (*r*s range from .31 to .38) across time and samples (e.g. Bidjerano & Dai, 2007; Day et al., 2003; Hirschfeld et al., 2004; Nonis & Hudson, 2006; Nonis & Wright, 2003; Simons et al., 2004) are indicative of a fairly stable capacity. This is consistent with the view that the relationship between C and performance is due to a 'strength of character' factor (Smith, 1969). Interestingly, recent surveys in the personality domain indicate that personality is malleable both in early adulthood and old age (e.g. Mroczek & Spiro, 2003). Thus, combined with the notion that mid and lower level personality factors are increasingly more malleable (e.g. Roberts & Pomerantz, 2004) achievement motivation may be a potentially useful target for personality-focused study skill interventions.

Controlling for prior educational attainment

High school GPA is often referred to as a 'traditional' correlate of GPA and is used to select university students. Therefore practical implications of identifying psychological predictors of GPA depend upon establishing increases in prediction controlling for school GPA (Robbins et al., 2004). Consequently, although high school GPA probably comprises a combination of cognitive, social cognitive and dispositional factors it is included as a statistical control (measuring pre-university academic achievement) when assessing the impact of psychological predictors on GPA. In North America a combination of standardised achievement test scores (e.g. SAT) and high school GPA explain approximately 25% of the variance in university GPA (Mathiasen, 1984; Mouw & Khanna, 1993; Robbins et al., 2004). There is less research into school and university achievement in the UK. Nonetheless, school assessments of a broader range of subjects (such as general certificate of secondary education in the UK (GCSE)) are reported to be more accurate predictors of university GPA than more specialised school examinations (e.g. advanced or 'A' levels, in the UK) (Huws, Reddy, & Talcott, 2006).

The present study

Previous research has not explored incremental validity estimates of personality traits and achievement motivation on prospective performance data. Consequently, it is unclear which of these predictors is most important or how they relate to one another. Few studies have explored the pathways by which global and relatively invariant big five personality dimensions influence academic performance. The analyses presented here explore whether achievement motivation mediates or partially mediates the impact of conscientiousness on academic performance. Scholastic achievement is included to examine whether the effects of 'psychological' factors on university achievement result in significant incremental validity estimates after controlling for pre-university achievement.

Extending the approach used by Bidjerano and Dai (2007) we explored associations between correlates of GPA using prospective and objective performance data obtained from university records. We also utilised a more homogeneous sample of students and analysed data for female and male students separately to overcome the typical female participation bias in studies on academic achievement (e.g. Phillips, Abraham, & Bond, 2003). Additionally we employed latent variable structural equation techniques to explore

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the measurement and factor structures of the constructs in the proposed models and multi-sample analysis was used to test for invariance of these models among female and male groups. Finally, the models were examined before and after controlling for the influence of scholastic achievement.

Five hypotheses were tested

First, following O'Connor and Paunonen (2007), GPA will correlate positively with C. Previous research does not clarify a pattern of association between the remaining big five factors (N, E, O & A) and GPA.

Second, following from Robbins et al. (2004), achievement motivation will correlate positively with GPA.

Third, in line with Bidjerano and Dai (2007), the effects of C on GPA will be mediated or partially mediated by achievement motivation.

Fourth, the mediation models will be invariant across female and male groups of students.

Fifth, when examined in a single model, the effects of the relevant big five personality traits and/or achievement motivation on GPA will remain significant after controlling for scholastic achievement.

METHOD

Procedure and participants

A prospective online survey was conducted of first and second year full time undergraduates studying at an English university at the beginning of their autumn term (i.e. in October). Thus independent variables were measured approximately 9 months prior to examinations on which GPA was based. Participants were recruited online using a standardised protocol that offered free entry into a prize draw to win one of four £25 cash prizes. Participants were informed that participation was voluntary and that responses would be confidential. Names were not recorded but participants were asked to consent to their personal details being used to acquire their end of year GPA from university records.

Questionnaire data were collected for 999 students and of these, 737 were matched to GPA scores held on University records. Failure to match student responses to GPA scores was primarily due to students dropping out of their degrees and to inaccurate reporting of data necessary for matching responses over time.

Forty-five 'major' programmes were studied by students in six 'schools' of study. The 'major' subjects studied by students were mostly in the schools of 'Life Sciences' (e.g. Psychology) (female $n = 218$, male $n = 44$), 'Humanities' (e.g. English) (female $n = 158$, male $n = 63$) and 'Social and Cultural Studies' (e.g. Sociology) (female $n = 96$, male $n = 35$). Therefore, only data for students in these three schools were retained to maximise the representativeness (and generalisability) of the study to life sciences, humanities and social science students. Overall, data from 472 women and 142 men were included. Ages ranged from 17 to 61 years ($M = 20.09$, SD $= 4.18$) and from 18 to 48 years ($M = 20.83$, SD $= 4.72$), for women and men, respectively.

To assess the representativeness of our samples, *t*-tests were conducted to compare GPA scores with the cohort from which they were drawn. In both groups there were significant differences in GPA:Women, $t(2885) = 5.94$, $p < .001$, $M = 63.49$, SD $= 6.98$; men,

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$t(1826) = 4.08$, $p < .001$, $M = 61.96$, SD = 8.62, compared to the cohort means (women, $M = 61.00$, SD = 7.86; men, $M = 58.98$, SD = 9.94). However, these effects were small (Cohen's $d = .22$ and .19 for women and men, respectively) (Cohen, 1992).

GPA criterion

As with most UK university students, our participants were awarded an overall end-of-year mean mark (GPA) out of 100 combining all formally assessed pieces of coursework and examinations taken that year. GPA obtained in Year 1 did not contribute to final GPA while Year 2 GPA usually comprised 40% of GPA awarded in the final year. Percentage marks are translated into degree classifications. Students with a GPA score of 70% or more should be awarded a first class classification while students scoring 60–69, 50–59 and 40–49 should be awarded 2:1, 2:2 and 3rd class classifications, respectively.

Psychological predictors

All remaining constructs were measured using Likert type scales. Multi-item scale scores were computed by averaging participants' responses across the relevant items. Table 1 shows the means, standard deviations and Cronbach's αs of the study measures.

Big Five Personality items specified by the 44 item English big five inventory (Benet-Martinez & John, 1998; Hair & Hampson, 2006; John, Donahue, & Kentle, 1991; Peterson, Casillas, & Robbins, 2006; Phillips et al., 2003; Wagerman & Funder, 2007; Wohlrab, Stahl, Rammsayer, & Kappeler, 2007) were used to measure *conscientiousness* (e.g. 'does a thorough job'), *openness* (e.g. 'is original, comes up with new ideas'), *agreeableness* ('likes to cooperate with others'), *extraversion* (e.g. 'is talkative') and *neuroticism* (e.g. 'is depressed, blue'). For each item participants were presented with a series of statements and asked to indicate the extent to which they agreed or disagreed with them on five-point scales. Anchored response options ranged from 'strongly disagree' to 'strongly agree'. These items assess the big five dimensions using prototypical trait adjectives to which elaborative information was added and verified by factor analysis (Benet-Martinez & John, 1998; John, 1990). For example, the BFI item of the persevering adjective of conscientiousness is 'perserveres until the task is finished' (Benet-Martinez & John, 1998).

Achievement motivation was measured using the eight-item 'motivation' subscale from Weinstein et al.'s (1987) LASSI. Participants were required to rate the typicality of eight statements for them, on five-point scales ('not at all typical of me' to 'very typical of me'). Individual items were designed to capture goal-related effort persistence in the face of challenge (e.g. 'when work is difficult, I either give up or study only the easy parts').

Prior educational achievement. GCSE letter grades were self-reported (e.g. A, B, C, D) and coded as follows: $A^* = 9$, A = 8, B = 7, C = 6, D = 5, E = 4, F = 3, G = 2, Fail = 1. Single letter grades were indexed to measure GCSE maths achievement, while GCSE science grade was indexed by single grades or the sum of two letter grades where reported. International participants were prompted to convert their school grades into GCSE letter grades, wherever possible but international students comprised only 8% of the total sample. Note that grades in English were also collected but not included in this aggregated measure because they did not predict GPA. These subjects and grades were selected as they are compulsory in the UK and nationally standardised thereby allowing comparative analyses between almost all UK students.

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Table 1. Means, standard deviations and Cronbach's αs of study measures

		Women					Men				
Measures	No of items	Range minimum	Range maximum	Mean	SD	α	Range minimum	Range maximum	Mean	SD	α
GPA	1	35.60	84.60	63.49	6.98	N/A	31.60	83.10	61.96	8.62	N/A
Conscientiousness	8	1.00	5.00	3.31	.62	.81	1.38	4.88	3.21	.70	.83
Extraversion	8	1.00	5.00	3.28	.75	.86	1.13	5.00	3.19	.71	.84
Neuroticism	8	1.25	5.00	3.15	.71	.82	1.00	5.00	2.78	.74	.81
Openness	10	1.33	5.00	3.56	.69	.80	1.78	5.00	3.81	.61	.70
Agreeableness	8	1.50	5.00	3.70	.61	.71	1.50	5.00	3.68	.64	.70
Achievement Motivation	8	1.38	5.00	3.56	.65	.80	1.63	5.00	3.52	.66	.81
GCSE Grade	2	1.00	9.00	7.92	.99	.50	1.00	9.00	7.73	1.25	.48

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RESULTS

Hypotheses were tested in four analytic steps. First, correlations between predictor variables and GPA were examined. Second, a two-step structural equation model (SEM; Anderson & Gerbing, 1988) was used to assess the mediation hypotheses supported by the correlation analyses. Third, to test for invariance between women and men, multiple group comparisons of mediation hypotheses were performed. Fourth, the mediation models were examined after scholastic achievement was controlled.

Table 2 presents the correlations between the study variables for women (above the diagonal) and men (below the diagonal). C was a positive correlate of GPA among women ($r = .25$) and men ($r = .35$) students while E, N, A and O were unrelated to GPA in both samples (rs ranged from $-.14$ to .09). C was highly correlated with achievement motivation in both groups (women, $r = .65$; men, $r = .66$) which in turn was significantly, and positively correlated with GPA (women, $r = .35$; men, $r = .43$). GCSE grade was a significant positive correlate of GPA in both groups (women, $r = .26$; men, $r = .20$). These results support our first hypothesis for C but add to the already-available mixed results for E, N, O and A. The results also support our second hypothesis for achievement motivation and provide initial support for the third hypothesis that achievement motivation mediates the influence of C on GPA.

Mediation analyses

According to Baron and Kenny (1986) full mediation is evident where (1) the independent and dependent variables are associated, (2) the independent and mediating variables are associated, and (3) when the dependent variable is regressed onto both the independent and proposed mediator the effect of the independent variable is reduced to non-significance.

A two-step approach to SEM was used to assess the validity and reliability of the constructs before their use in the mediation model (Anderson & Gerbing, 1988). Subsequent path models examined the proposed mediation hypotheses. Specifically, a partially mediated model (Model A) was tested to evaluate the direct and indirect effects of C on GPA. A sequential nested model of full mediation was subsequently specified

Table 2. Correlations among the big five, achievement motivation, GCSE grade and grade point average (GPA) for female and male students at a university in the UK

	1	2	3	4	5	6	7	8
1. GPA		.25**	.09	−.08	.02	.09	.35**	.26**
2. Conscientiousness	.35**		−.16**	.04	.08	.02	.65**	−.03
3. Neuroticism	.08	−.07		−.36**	.02	.01	−.07	.04
4. Extraversion	−.14	.11	−.27**		.27**	−.05	.12**	−.05
5. Openness	.09	.05	.06	.09		−.06	.13**	−.03
6. Agreeableness	.09	.00	.09	.02	−.06		.04	.02
7. Achievement Motivation	.43**	.66**	.02	.07	.24**	.01		.09
8. GCSE Grade	.20*	.11	−.04	.04	−.27**	−.07	.07	

Note: Correlations in upper triangle are for the female sample and in the lower triangle for the male sample. $N = 437$ and 133 for female and male students, respectively. All missing values for each group are entirely related to psychological construct/GCSE grade associations.
*$p < .05$; **$p < .01$.

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(Model B) by constraining the direct effect of C on GPA to zero. In this sequence of model testing, Model A provides a baseline that the fully mediated model (Model B) can be compared to in terms of model fit. The χ^2-difference test is employed to see whether Model B leads to a significant decrement in fit compared to Model A. In this scenario, non-significant difference values would indicate that the fully mediated model is a better fit to the data. The corresponding indirect effects are also tested for significance using Sobel's (1982) test.

The EQS six programme (Bentler, 2006) was used to test the mediation hypotheses and the maximum likelihood method was used for all analyses. As the χ^2 goodness of fit statistic is sensitive to sample size (Marsh, Balla & McDonald, 1988) additional recommended indexes for goodness of fit and cut offs (e.g. Hu & Bentler, 1999) were used to evaluate the adequacy of the proposed models. Specifically, in addition to the χ^2-test statistic, the comparative fit index (CFI), non-normed fit index (NNFI) and the root mean square error of approximation (RMSEA) are reported. A non-significant χ^2-value ($p > .05$), CFI and NNFI values of .90 (or above) and a RMSEA of .08 (or lower) reflect adequate model fit.

Ideally parameter loadings for each separate item on the corresponding latent factors would be estimated. However, the size of the male sample was too small for the number of estimated parameters that such a model would produced, so an item parcelling strategy (e.g. Bandalos & Finney, 2001) was adopted.

Specifically, we created three indicators for C and achievement motivation using randomly selected item parcels. Reference indicators for each latent variable were created by fixing the highest indicator's loading to 1 and as is the usual case in confirmatory factor analysis, the latent constructs were allowed to co-vary.

The GPA criterion was measured by a single score. Thus, for identification purposes the factor loadings of this indicator was set to equal 1 and corresponding error variances were fixed to a small positive value (0.05) (Bollen, 1989).

Table 3 presents the means, standard deviations and factor loadings in the CFAs. The factor loading of each indicator to its hypothesised latent factor was high and significant providing evidence of a stable structure in each group (standardised factor loadings ranged from .67 to .86 and .67 to .87 for women and men, respectively, all $p < .05$). The measurement model fitted the data well: Women, $\chi^2(12, N = 472) = 20.88$, $p = .05$, CFI = .10, NNFI = .99, RMSEA = .04 (90%CI .00–.07); men $\chi^2(12, N = 142) = 12.90$, $p = .38$, CFI = .10, NNFI = .10, RMSEA = .02 (90%CI .00–.09).

Table 3. Means, standard deviations and factor loadings in confirmatory factor analyses for conscientiousness, achievement motivation and grade point average (GPA)

	Female		Male	
Measures	Mean (SD)	Factor loading	Mean (SD)	Factor loading
Conscientiousness 1	3.51 (.71)	.85	3.35 (.91)	.87
Conscientiousness 2	3.40 (.71)	.75	3.36 (.72)	.71
Conscientiousness 3	2.83 (.75)	.68	2.77 (.86)	.67
Achievement motivation 1	3.56 (.72)	.86	3.53 (.69)	.83
Achievement motivation 2	3.57 (.74)	.67	3.53 (.74)	.85
Achievement motivation 3	3.54 (.83)	.82	3.44 (.84)	.72
GPA	63.49 (6.98)	1.0	61.96 (8.62)	1.0

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Table 4. χ^2 and fit indices for partially and fully mediated models of conscientiousness on grade point average (GPA) among female and male students at a UK university

Model	χ^2	df, N	RMSEA	90%CI for RMSEA	NNFI	CFI	$\Delta\chi^2$
A (female)	20.88, $p = .05$	12, 472	.04	.00–.07	.99	.99	
B (female)	21.00, $p = .07$	13, 472	.04	.00–.06	.10	.10	A/B $\Delta\chi^2 = .12(1)$ $p > .05$
A (male)	12.90, $p = .38$	12, 142	.02	.00–.09	.10	.10	
B (male)	13.42, $p = .42$	13, 142	.02	.00–.09	.10	.10	A/B $\Delta\chi^2 = .52(1)$ $p > .05$

RMSEA, root-mean-square error of approximation; CI, confidence interval; NNFI, non-normed fit index; CFI, comparative fit index; A/B, model A compared to Model B.

Table 4 presents the goodness of fit indexes for Models A and B and corresponding χ^2 difference statistics for both groups. The partially mediated model (Model A) fitted the data well for women and men: Women, $\chi^2(12, N = 472) = 20.88$, $p = .05$, CFI = .99, NNFI = .99, RMSEA = .04 (90%CI .00–.07); men, $\chi^2(12, N = 142) = 12.90$, $p = .38$, CFI = .10, NNFI = .10, RMSEA = .02 (90%CI .00–.09).

In this model, achievement motivation was a significant predictor of GPA (women, $\beta = .38$; men, $\beta = .35$) and C a significant predictor of achievement motivation (women, $\beta = .79$; men, $\beta = .81$). However the direct effect of C on GPA was not significant in either sample (women, $\beta = -.03$; men, $\beta = .13$, $p > .05$). Supporting this, Model B testing the fully mediated model of C on GPA (by holding the direct effect of C on GPA constant) did not lead to a significant χ^2-difference when compared to Model A (women, $\Delta\chi^2(1, N = 472) = .12$, $p > .05$; men, $\Delta\chi^2 = (1, N = 142) = .52$, $p > .05$) suggesting that the fully mediated model (Model B) is a better fit to the data than the partially mediated model of C on GPA (Model A). In these models (shown in Figure 1), achievement motivation explained 13 and 22% of the variance in GPA and C explained 63 and 66% of the variance in achievement motivation among women and men, respectively. Sobel tests examining the indirect effect of C on GPA through achievement motivation were also significant (women, $Z = 6.58$, $p < .05$; men, $Z = 4.90$, $p < .05$) (Sobel, 1982). These results provide clear support for our third hypothesis, showing mediation of C by achievement motivation. Note that the reverse causal hypothesis that C mediates the influence of achievement motivation on GPA is not supported because in Model A, C is not a significant predictor of GPA when controlling for achievement motivation which is a prerequisite of mediation (Baron & Kenny, 1986).

Multi-sample analysis

To test for the model invariance between samples, multiple group comparisons were performed. Anderson and Gerbing's (1988) two-step approach to SEM was adopted. A baseline measurement model including latent constructs of C, achievement motivation and GPA that were defined by their respective manifest indicators were specified for both groups simultaneously. Following satisfactory fit, a series of invariance hypotheses (Bentler, 2006) were conducted that constrained first the factor loadings and second the covariance matrices to be equivalent across groups. Given the adequacy of the multi-sample measurement model, we tested multi-sample invariance of the full SEM model using a similar procedure. First, for sequential multiple group comparisons, the full SEM model with no equality constraints was fitted to male and female groups simultaneously.

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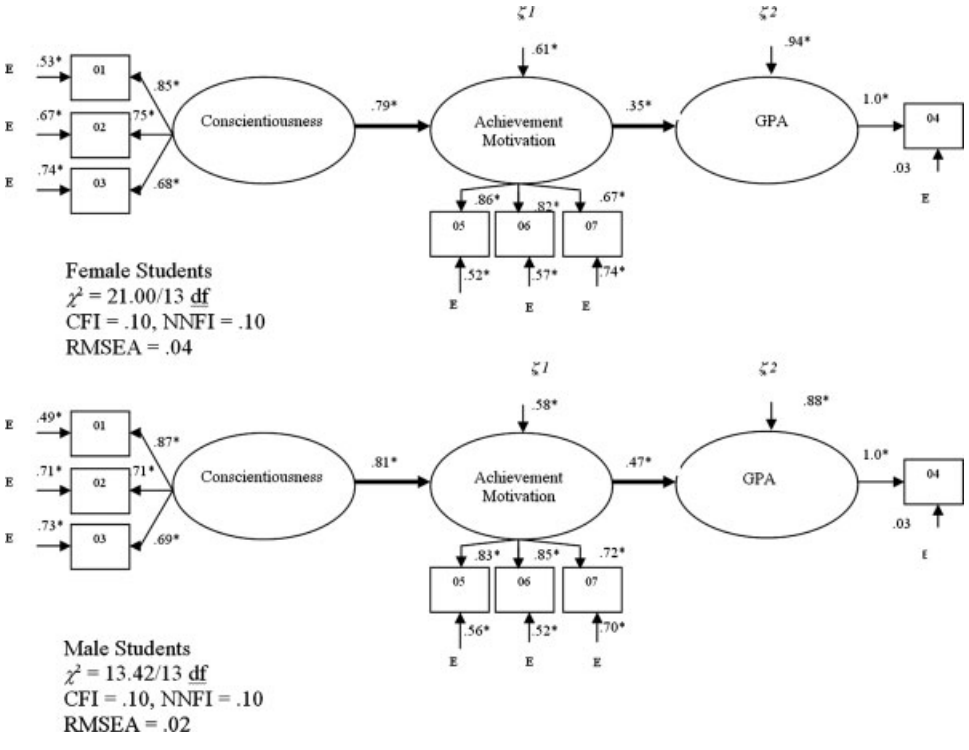

Figure 1. Standardised parameter estimates for the fully mediated model of conscientiousness on grade point average (GPA) among female and male undergraduates at a UK university. *Note*: NNFI = non-normed fit index, CFI = comparative fit index, RMSEA = root mean square error of approximation, E = error term.

More restricted models nested within the baseline model were then tested for the invariance of (a) factor loadings and (b) structural parameters.

Table 5 presents the goodness of fit analyses for the multisample invariance of the measurement and full SEM model across female and male groups. A multiple-group measurement model with no equality constraints served as a comparison for subsequent models. This model obtained acceptable fit statistics: $\chi^2(24, N = 614) = 33.78$, $p = .09$, CFI = .99, NNFI = .99, RMSEA = .03 (90%CI .00–.05). A model in which the factor structure was constrained to be equal did not lead to a significant decrement in fit, $\Delta\chi^2(4, N = 614) = 7.56$, $p > .05$. These results indicate that the factor structure was invariant across men and women students enabling testing of equal factor co-variances. This model also did not lead to a significant decrement in fit, $\Delta\chi^2(7, N = 614) = 12.78$, $p > .05$.

A multiple-group full SEM with no equality constraints served as a comparison for further models. The model placed direct paths from achievement motivation to GPA and from C to achievement motivation. This model had acceptable fit statistics: $\chi^2(26, N = 614) = 34.42$, $p = .12$, CFI = .10, NNFI = .99, RMSEA = .03 (90%CI .00–.04). A model in which the factor structures were set to be equivalent across the groups did not worsen the fit of the model compared to baseline, $\chi^2(4, N = 614) = 7.58, p > .05$, indicating that these parameters are invariant across the groups. Similarly, supporting the fourth hypothesis when the structural paths were set to be invariant no significant differences in model fit were observed, $\Delta\chi^2(6, N = 614) = 11.91$, $p > .05$ showing that the relationship between achievement motivation and GPA is invariant across men and women students.

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Table 5. Goodness of fit analyses for multi-sample analyses of partially and fully mediated models of conscientiousness on grade point average (GPA) among female and male students at a UK university

Model	χ^2	df, N	RMSEA	90%CI for RMSEA	NNFI	CFI	$\Delta\chi^2$
CFA							
Baseline	33.78, $p = .09$	24, 614	.03	.00–.05	.99	.99	
Invariant factor loadings	41.34, $p = .05$	28, 614	.03	.00–.05	.99	.99	$\Delta\chi^2 = 7.56(4)\ p > .05$
Invariant co-variances	46.56, $p = .04$	31, 614	.04	.01–.05	.99	.99	$\Delta\chi^2 = 12.78(7)\ p > .05$
Full SEM							
Baseline	34.42, $p = .12$	26, 614	.03	.00–.04	.99	.10	
Invariant factor loadings	42.00, $p = .07$	30, 614	.03	.00–.04	.99	.99	$\Delta\chi^2 = 7.58(4)\ p > .05$
Invariant paths	46.33, $p = .05$	32, 614	.03	.00–.04	.99	.99	$\Delta\chi^2 = 11.91(6)\ p > .05$

CFA, confirmatory factor analyses; RMSEA, root-mean-square error of approximation; CI, confidence interval; NNFI, non-normed fit index; CFI, comparative fit index.

Controlling for pre-university performance

To explore whether the effect of C on GPA via achievement motivation retained significance after prior scholastic achievement was controlled the fully mediated model (Model B) was conducted again after controlling for GCSE grade. As GCSE grade was measured by two single scores the combined mean scale score was used in all analyses. For identification purposes the factor loading of this indicator was set to equal 1 and the corresponding error variance was fixed to a small positive value (0.05) (Bollen, 1989).

Results show that among both female and male students achievement motivation was a significant predictor of GPA after the effects of GCSE grade had been accounted for. Among the female sample, a combination of achievement motivation ($\beta = .36$) and GCSE grade ($\beta = .24$) explained 19% of the variance in GPA while C explained ($\beta = .78$) 61% of the variance in achievement motivation, $\chi^2(18,\ N = 446) = 39.15,\ p = .00$, CFI = .98, NNFI = .98, RMSEA = .05 (90%CI .03–.07). Similarly, among the male sample achievement motivation ($\beta = .45$) and GCSE grade ($\beta = .17$) explained 25% of the variance in GPA while C explained 64% ($\beta = .80$) of the variance in achievement motivation, $\chi^2(18,\ N = 133) = 17.35,\ p = .50$, CFI = .10, NNFI = .10, RMSEA = .00 (90%CI .00–.08). Combined these findings provide support for hypothesis 5. Moreover, multi-sample full SEM analyses revealed invariant measurement and structural models between the samples. Specifically the baseline model (with no equality constraints) served as a comparison for further models. This model placed direct paths from achievement motivation and GCSE grade to GPA and from C to achievement motivation and fitted the data well: $\chi^2(36,\ N = 579) = 56.49,\ p = .02$, CFI = .99, NNFI = .98, RMSEA = .03 (90%CI .01–.05). A model in which the factor structures were set to be equivalent across the groups did not worsen the fit of the model compared to baseline, $\chi^2(4,\ N = 579) = 10.70,\ p > .05$, indicating that these parameters are invariant across the groups. Similarly, when the co-variances, $\Delta\chi^2(5, N = 579) = 12.03, p > .05$ and structural paths $\Delta\chi^2(8, N = 579) = 16.72$, $p > .05$ were set to be invariant no significant differences in model fit were observed suggesting that the relationship between achievement motivation and GPA is invariant

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across women and men students. These results provide clear support for our fifth hypothesis, showing achievement motivation to explain unique variation in GPA after the influence of scholastic achievement is accounted for.

DISCUSSION

We examined relationships between stable personality traits (specified by the big five factor model of personality), and achievement motivation among female and male students at a UK university. This is the first study to assess the independent long range predictive utility of the big five personality traits and achievement motivation on university GPA and to simultaneously test the capacity of achievement motivation to mediate the effect of C on GPA taken from university records. As hypothesised, conscientiousness and achievement motivation were positively correlated with subsequent GPA. Tests of mediation revealed that achievement motivation fully mediated the impact of C on GPA among women and men. Moreover, multi-sample analyses showed invariant measurement and structural mediation models across the women and men students, indicating no moderation of the observed predictive patterns by gender. Finally these effects remained after the variance of scholastic achievement had been accounted for.

Consistent with previous research (O'Connor & Paunonen, 2007), C was the most important big five factor in the prediction of subsequent GPA. This is unsurprising since C comprises facets (e.g. diligence) important to studying. None of the other big five factors (E, N, O, or A) were significantly correlated with GPA among female or male students. This is consistent with a review that reports non-significant effects for these personality factors on academic performance (O'Connor & Paunonen, 2007). Perhaps these broad traits incorporate facets which relate to academic performance in different or even opposed ways, thereby attenuating the predictive validity of the traits (cf., Chamorro-Premuzic & Furnham, 2003). For example self-consciousness; a sub-facet of N, has been shown to correlate positively with GPA while the anxiety component is associated with academic performance in a negative direction (Chamorro-Premuzic & Furnham, 2003). Perhaps test anxiety; shown to be a moderate correlate of academic performance (e.g. Chen et al., 2000) mediates the influence of the anxiety sub-facet on GPA in a parallel fashion to that of C and more situated achievement motivation. Research examining the sub-facets of global personality dimensions, framed in an academic context is warranted.

In line with previous research (e.g. Robbins et al., 2004) achievement motivation exhibited long-range predictive utility (i.e. over 9) among female and male students and in line with Bidjerano and Dai (2007), the effect of C on GPA was fully mediated by achievement motivation. Thus these finding suggest that conscientious students may do better because of differences in achievement motivation capacity. Notably, correlations between achievement motivation and C were high ($rs = .65$ and .66 for women and men, respectively) which is consistent with studies examining the relationships between global and mid-level personality factors (e.g. Bogg et al., 2008). Thus, contrary to previous interpretations (e.g. Bidjerano & Dai, 2007) we used Neo-Socioanalytic theory to interpret these findings within a personality framework. However, more research is needed to clarify the relationship between the entire range of facets of C when framed in relation to university performance.

The effects of achievement motivation on GPA remained significant after controlling for prior scholastic achievement indicating that psychological factors have predictive utility over and above previous school achievement. In the female sample achievement

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motivation, and GCSE grade, accounted for 19% of the variance in GPA and in the male sample 25%. These relatively large effects suggest that achievement motivation assessments and prior academic achievement could help identify students unlikely to maximise their potential at university. Moreover, it may be worth investing in re-training students to self-regulate motivation for challenging academic tasks, thereby enhancing their effort regulation capacities. If such interventions could be developed and were found to be effective they would have considerable practical application and might also shed further theoretical light on the psychological antecedents of GPA, e.g. by identifying moderators of effort-regulation re-training effectiveness.

Interestingly, the findings indicate that GCSE grade explained much less variation (approximately 4–8%) in university GPA than high school GPA (in North America) which typically explains 20% (or 22% when corrected for measurement error) (Robbins et al., 2004). It is speculated that the comparatively weaker association of scholastic achievement in the UK may be due to more standardisation of assessment than in North America (e.g. McDonald, Newton, Whetton, & Benfield, 2001). The capacity of psychological factors to differentiate between and predict students' performance over and above school performance may, therefore, be greater in the UK than the US. More research is needed to examine these hypotheses. Nonetheless variability in high school GPA/university GPA combinations is reported in North America with some reported associations that are comparable in size to those in this study (e.g. King, 2000; Parker, Hogan, Eastabrook, Oke, & Wood, 2004; Peterson et al., 2006).

The present study combined important correlates of GPA in a single model for separate samples of female and male students. Additionally, the use of latent variable SEM to explore the mediation of the effects of C on GPA allowed examination of associations that are relatively free of measurement error. Moreover, GPA was measured 9 months after measurement of psychological predictors and was obtained from university records and was uncontaminated by previous university GPA. Nonetheless, larger and more representative samples are needed in replications to demonstrate generalisability of our findings. For example, our sample only represented students studying for degrees in the life sciences, social sciences and humanities areas.

The study reported here illustrates the importance of modelling the predictors of academic performance in multivariate, theory-based models. The results provide good initial support for the idea that mid-level dispositional assessments such as achievement motivation are potentially more useful for exploring academic performance than broader personality (e.g. conscientiousness) assessments, particularly when predicting long range global measures of achievement (such as GPA). Moreover, the findings show that the global personality trait C influences GPA through self-regulatory effort which is potentially modifiable. More research is needed to establish the stability and change of achievement motivation among students over time.

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