

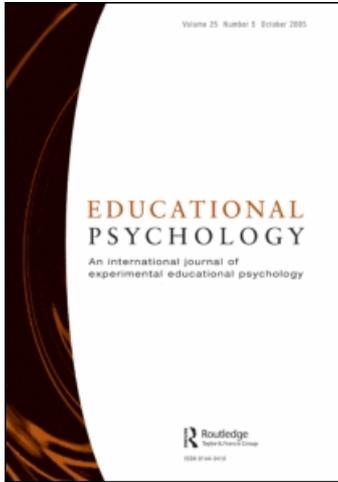
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### Personality, approaches to learning and achievement

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## Personality, approaches to learning and achievement

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The present study investigated the relationships between the five-factor model of personality, approaches to learning and academic achievement. Based on the previous research, we expected approaches to have a mediating effect between personality and academic achievement. Six hundred and eighty-seven business students participated in a survey; 56% were female and 44% were male. Their average age was 24.8 years. The results showed that conscientiousness and openness were mediated by the strategic and the deep approach, respectively, in relation to achievement. Additionally, neuroticism had both a direct and an indirect effect on achievement through the surface approach. We also found that the three approaches to learning explained variance in achievement beyond personality when using hierarchical regression analysis. Limitations and implications for future research are discussed.

**Keywords:** learning styles; learning approaches; personality; academic achievement; mediator effects

### Introduction

In this study, we seek to develop and test a model for the relationship between the five-factor model of personality, learning styles and academic achievement. While the style construct has been claimed to have a dubious nature (Coffield, Moseley, Hall, & Ecclestone, 2004; Furnham, 1992; Jackson & Lawty-Jones, 1996; Martinsen, 1997), recent attempts to re-establish the style construct have proved fruitful (Kozhevnikov, 2007; Zhang & Sternberg, 2001, 2006), although the nature of cognitive and learning styles remains multifaceted and complex.

Among the several unresolved issues, some have argued that the relationship between styles and personality is unclear and difficult to conceptualise (Zhang & Sternberg, 2006), while others have argued that the style construct is associated both with profiles of abilities (e.g. McKenna, 1984) and, quite strongly, with personality traits (Furnham, 1992; Gelade, 2002; Jackson & Lawty-Jones, 1996). As regards, the functional relationship between personality and styles, Messick (1994) convincingly argued that style, among other things, can be seen as a conceptual bridge between cognition and personality which implies that styles can act as mediators and/or moderators on performance. Indeed, studies have indicated that learning styles may have mediator effects between personality and

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learning outcomes (Blickle, 1996; Diseth, 2003). However, since personality traits are commonly defined as stable dispositions whereas approaches to learning have been considered as partly situationally determined (Curry, 1983; Struyven, Dochy, Janssens, & Gielen, 2006; Trigwell & Prosser, 1991), it seems important to disentangle further the theoretical and empirical relationships between these two sets of variables. On this background, our study seeks to investigate the association between personality, approaches to learning and learning outcomes.

### *Approaches to studying and learning*

In the plethora of style constructs, one line of research has focused on the concept of approaches to studying and learning. Approaches to studying and learning derives from Marton and Säljö's (1976) work on deep and surface learning approaches, and was later combined with Entwistle and Ramsden's (1983) conceptualisation of a strategic approach to studying and learning. In brief, a student with a surface approach to studying and learning is described as concerned with reproducing knowledge, a student with a deep approach is concerned with understanding and the meaning of the subject matter and a student with a strategic approach is concerned with achieving high grades through adapting to the assessment demands. The concept has traditionally relied on the assumption that the same student learns differently in different situations, i.e. the student's approaches to studying and learning vary according to subject area and academic task (Ramsden, 2003). However, it should be noted that we consider approaches to studying and learning under the general style construct and that we see approaches as a partially stable and coherent personal attribute rather than as a fully situationally determined strategic construct. The relatively strong correlations between approaches and personality that have been identified in the previous studies (Diseth, 2003; Duff, Boyle, Dunleay, & Ferguson, 2004; Furnham, 1992) support the existence of a trait-like component in our stylistically oriented view of approaches.

In their seminal qualitative study, Marton and Säljö (1976) identified a positive association between a deep approach and academic success. Subsequent quantitative studies have further supported their findings, and approaches to studying and learning have, more generally speaking, predicted academic achievement (Diseth, 2003; Diseth & Martinsen, 2003; Drew & Watkins, 1998; Entwistle & Ramsden, 1983; Newstead, 1992; Sadler-Smith, 1997). The relationships between the deep and strategic approaches and academic achievement have typically been positive, while the relationship between the surface approach and achievement has typically been negative. Despite the expectation that the deep approach to studying and learning facilitates high-quality learning, some studies, however, indicate that a deep approach does not necessarily correlate with good course grades (Busato, Prins, Elshout, & Hamaker, 2000; Diseth, 2003; Entwistle, Tait, & McCune, 2000). Duff (2003) found that approaches to studying and learning were good predictors of academic performance in continuous assessment tasks, but poor predictors of performance in examinations and oral presentations.

Clearly, there seem to be significant and meaningful relationships between approaches to studying and learning and academic achievement. In addition to this, and as we show below, there also seem to be relatively predictable relationships between personality traits and learning.

### ***Personality and academic performance***

Subsequent to the conceptualisation of the five-factor model of personality, often referred to as the 'Big Five' (Costa & McCrae, 1992; Digman, 1990), the relationship between personality and learning has emerged as important. Diseth (2003) found that academic achievement was positively related to the big five domains' openness and conscientiousness, and negatively related to extroversion. In two other studies, the relationship between extroversion and grade was dependent on the type of assessment method where oral exams, short multiple-choice tests and group work favoured students with high levels of extroversion (Chamorro-Premuzic, Furnham, Dissou, & Heaven, 2005; Furnham, Christopher, Garwood, & Martin, 2008). Furthermore, Gray and Watson (2002) found that openness was a significant predictor of college GPA (grade point average), while the relationship between openness and academic achievement could be understood in terms of the correlation between openness and intelligence that normally ranges between  $r = .20$  and  $.40$  (McCrae & Costa, 1985). Neuroticism has often been negatively associated with academic performance. According to De Raad and Schouwenburg (1996), correlations between test anxiety and academic performance often show low values,  $.10$ – $.20$ . At the university level, however, neuroticism has had varying effects on grade, from positive to negative and from not being significant to being significant (Busato et al., 2000; Diseth, 2003; Nofle & Robins, 2007; Trapmann, Hell, Hirn, & Schuler, 2007). The unstable influence of neuroticism on grades may be explained by the moderating effects of variables such as the type of assessment method, the levels of aroused stress and intelligence (Chamorro-Premuzic et al., 2005; Furnham et al., 2008). Beyond such modifications, Nofle and Robins (2007), in a summary of previous findings on personality and academic outcomes, concluded that personality traits 'have independent and incremental effects on academic outcomes' (p. 116). According to their analysis, conscientiousness stands out as the most robust predictor of college grades, while they found openness to predict SAT (scholastic achievement test) verbal scores, but not GPA. The particularly consistent effect of conscientiousness on academic success was further supported in a recent meta-analysis by Trapmann et al. (2007). They reported how the influence of personality traits depended on whether the success criterion was grade, retention or satisfaction, e.g. neuroticism was found to correlate with satisfaction and conscientiousness correlated with grades.

Taken together, it is quite evident that both approaches to studying and learning and several personality traits, but in particular openness and conscientiousness, should be related to learning. Yet, moving beyond these one-to-one relationships, we may legitimately ask how we can conceptualise the relationship between approaches, personality and learning.

### ***Approaches to studying and learning, personality and achievement***

Under the general umbrella of style constructs, we find cognitive styles, learning styles, and also approaches to studying and learning, conceptualised as typical ways of approaching learning tasks. Based on Messick's (1987, 1994) theory, several style constructs may be seen as originating from personality and representing an accumulated personality influence on cognition, learning and studying. Actually, since the earliest research efforts (Smith & Klein, 1953), styles have been seen as personality influences on information processing, but as moderated by experience and situation

influences. In their 'model of person' McCrae and Costa (1995, p. 237) use the term 'characteristic adaptation' to explain those personal dispositions or preferences that are not basic tendencies such as the five personality trait constructs in the five-factor model. Characteristic adaptations are developed over time when personality traits interact with environment, and these characteristics include attitudes, motives, skills, values and habits. The style construct, as we see it, might be one such characteristic adaptation.

Following from this reasoning, it may be a legitimate expectation that styles and approaches act as mediators or as indirect influences of personality traits on performance and that the relationship between the two classes of constructs is quite strong. This way of reasoning also leads to an expectation that each style or approach may originate from more than one personality trait, since styles have been posited to represent accumulated personality influences on cognition (Martinsen, forthcoming; Messick, 1994). However, we may nevertheless expect that some personality traits will be more strongly related to some approaches than others. In particular, it seems relevant that the surface approach, which includes the sub-scale fear of failure, should be related to neuroticism. Openness, which is associated with curiosity and intellectual values, should be related to a deep approach, and it seems evident that conscientiousness should be related to the goal-oriented nature of a strategic approach.

Diseth (2003) found that each of the three approaches to learning described above was predicted by a mixture of personality factors, and not by a single trait. The deep approach was, however, mainly related to openness, the surface approach was mainly related to neuroticism, and the strategic approach was mainly related to conscientiousness. According to Blicke (1996), the relationship between personality and achievement is mediated by learning strategies. His study did not, however, demonstrate this relationship as clearly as Diseth's study did. Diseth studied the relationship between personality, approaches and achievement in two student samples. In one of his samples ( $N = 162$ ) Diseth found evidence that a deep approach to learning had a mediating effect on the relationship between openness and achievement. This result was later confirmed by Furnham et al. (2008) using a student sample of 430. Duff et al. (2004) found that personality and learning approaches were poor predictors of academic performance. Anyhow, their structural model indicated that learning approaches were partially explained by personality, giving some support to Furnham's (1992) position that there is a strong relationship between the two classes of constructs. Jackson and Lawty-Jones (1996) found evidence that learning styles could be fully explained by personality scales and that all learning styles had at least one significant correlation with one personality trait. Thus, it seems well established that there is a relationship between personality and approaches to studying and learning. Nevertheless, important questions remain about the structural relationship between the two groups of constructs and whether learning approaches have any validity beyond their relationship to personality when predicting academic achievement.

To sum up, our expectations about the relationships between personality, learning approaches and academic achievement (grades) are as follows:

- (1) Approaches to studying and learning should be related to course grade. The deep and strategic approaches should be positively related and the surface approach should be negatively related to academic achievement. The strategic and surface approaches should be stronger predictors than the deep approach (Diseth, 2003; Duff et al., 2004).

- (2) The deep approach should mainly be predicted by openness, and can be expected to mediate the relationship between openness and achievement. The strategic approach should mainly be related to conscientiousness, and the surface approach should mainly be related to neuroticism (Diseth, 2003; Duff et al., 2004).
- (3) Conscientiousness is expected to have an independent effect on course grade (Noftle & Robins, 2007; Trapmann et al., 2007), but this is expected to disappear when the strategic approach is introduced as a mediator variable.
- (4) The surface approach is expected to mediate the relationship between neuroticism and achievement.

Our main hypothesis is concerned with how approaches to studying and learning influence the relationship between personality and learning outcomes. Messick (1994) suggested that personal style (e.g. learning style) is the bridge between personality and performance, which implies that personality either has indirect effects through approaches on achievement, or that learning approaches mediate the effects of personality on learning. Previous research (Blickle, 1996; Diseth, 2003; Furnham et al., 2008) indicates, but only partly supports, the existence of such mediator effects. This study replicates and expands on these studies by using a larger sample size and a different sample. According to Kline (2004), it is important to replicate findings in different samples in order to strengthen empirical findings.

## **Method**

### ***Sample***

A survey questionnaire was distributed by email to approximately 2300 students enrolling in 13 parallel classes on the organisational psychology and leadership course at BI Norwegian School of Management in 2006. It was estimated that 10–15% of the requests were not received by the students due to incorrect email addresses. Seven hundred and seventy-seven students responded to the questionnaire which gave a response rate of between 35% and 40%. The average age for the first-year BA student population was 24.5. Of these 777 students, 687 completed their course exam and represent the sample in this study. The average age in this sample was 24.8 years, and it was made up of 56% females and 44% males. The questionnaire was based on self-selection and self-report.

### ***Instruments***

The Approaches to Study Skills Inventory for Students (ASSIST; Entwistle, 1997; Norwegian translation by Diseth, 2001) was used to measure the students' preferred ways of learning. The instrument includes the three major constructs of deep, surface and strategic approaches to studying and learning. There are four sub-scales included in the deep approach: meaning-seeking, relating ideas, use of evidence and interest in ideas. There are also four sub-scales included in the surface approach: unrelated memorising, lack of purpose, syllabus-boundedness and fear of failure. Finally, there are five sub-scales included in the strategic approach: organised studying, time management, monitoring effectiveness, achievement motivation and alertness to assessment demands. The inventory has 52 items with a five-point response scale on

Table 1. Descriptive data and internal consistency for the eight constructs and grade.

|                    | <i>M</i> | SD    | $\alpha$ | No. of items |
|--------------------|----------|-------|----------|--------------|
| Deep approach      | 62.37    | 8.08  | .81      | 16           |
| Strategic approach | 72.68    | 11.25 | .84      | 20           |
| Surface approach   | 45.35    | 9.81  | .78      | 16           |
| Neuroticism        | 19.12    | 7.74  | .84      | 12           |
| Extroversion       | 33.52    | 6.09  | .80      | 12           |
| Openness           | 28.66    | 6.23  | .75      | 12           |
| Agreeableness      | 31.37    | 5.56  | .71      | 12           |
| Conscientiousness  | 31.69    | 6.35  | .83      | 12           |
| Grade              | 3.23     | 1.43  |          |              |

Note:  $N = 687$ ;  $M$  = mean; SD = standard deviation;  $\alpha$  = Cronbach's alpha.

each item (1 = disagree, 5 = agree). The alpha scores for the ASSIST test instrument on this sample are reported in Table 1.

The NEO FFI (Costa & McCrae, 1992; Norwegian translation by Martinsen, Nordvik, & Østbø, 2003) was used to measure the students' personalities. In this inventory, the five traits of neuroticism, extroversion, openness to experience, agreeableness and conscientiousness are measured with 60 items, where each item has a five-point response scale (0 = strongly disagree, 4 = strongly agree) and where each factor is represented by 12 items. Alpha scores are reported in Table 1.

Academic achievement was operationalised as grade in a written exam. The course grade was assessed by two independent examiners, and the average grade was used. The grades ranged from A through F, where 4.5% received an A, 15.9% a B, 26.2% a C, 20.2% a D, 17.9 an E and 15.3% received an F (fail).

### *Procedure*

Data were collected through an online voluntary self-report questionnaire. The questionnaire was mailed to the students during the first part of the course and the students were reminded twice. The students received generalised feedback on their personal scores on the ASSIST inventory two to four weeks after responding. A written exam was arranged approximately three months later. The software tool used to collect the survey data was Confirmit 10.0 (FIRM ASA, 2006), and data were exported to SPSS version 14 for the data analyses.

## **Results**

### *Descriptive statistics*

Table 1 displays mean ( $M$ ), standard deviation (SD) and internal consistency (Cronbach's alpha) for the constructs measured in this study.

### *Correlation analysis*

Correlations between all variables are reported in Table 2. As can be seen here, all three approaches to studying and learning correlate significantly with grade: deep and

Table 2. Correlations between learning approaches, personality traits and grade.

| Variable          | De | St     | Su     | N      | E      | O      | A     | C      | Gr     |
|-------------------|----|--------|--------|--------|--------|--------|-------|--------|--------|
| Deep              | —  | .52**  | -.37** | -.15** | .12**  | .52**  | .01   | .25**  | .16**  |
| Strategic         | —  | -.41** | -.19** | .19**  | .20**  | .09*   | .64** | .28**  |        |
| Surface           |    |        | —      | .48**  | -.11** | -.24** | -.08* | -.39** | -.25** |
| Neuroticism       |    |        |        | —      | -.33** | .00    | -.04  | -.36** | -.05   |
| Extroversion      |    |        |        |        | —      | .07    | .13** | .24**  | .04    |
| Openness          |    |        |        |        |        | —      | .07   | .04    | .08*   |
| Agreeableness     |    |        |        |        |        |        | —     | .13**  | .04    |
| Conscientiousness |    |        |        |        |        |        |       | —      | .23**  |
| Grade             |    |        |        |        |        |        |       |        | —      |

Note:  $N = 687$ ; \* $p < .05$ ; \*\* $p < .001$ .

strategic approaches positively, and surface approach negatively. There are moderately high correlations between the three approaches to studying and learning, where the deep and the strategic approaches correlate positively with each other, and the surface approach correlates negatively with both the deep and the strategic approaches. Neuroticism correlates positively and quite strongly with the surface approach, openness with the deep approach and conscientiousness with the strategic approach.

### Regression analysis

A regression analysis was carried out to investigate whether the three approaches explained variance beyond the effect of personality. A hierarchical regression analysis was done, with the five personality traits in Step 1 and the three approaches to studying and learning in Step 2. Change statistics showed a significant change in  $R^2$  from Step 1 to Step 2, where  $R^2$  increased from .060 to .113 ( $F(3, 678) = 10.748, p = .000$ ). Clearly, the approaches to studying and learning explained a significant proportion of the variance in grades beyond personality (Table 3). There were three significant predictors of grade in this analysis: neuroticism, strategic approach and surface approach.

A second regression analysis was carried out to control for high school GPA, age and gender. These three variables were added to the model as a new first step. The second step was the five personality traits and the third step the three approaches (Table 4). The variables included in this model explain approximately 21% of the variance in grade:  $R^2 = .209, F(3, 611) = 14.672$ . The direct effect of neuroticism on grade disappeared in this extended model, and the four significant predictors of grade were identified to be gender, high school GPA, strategic approach and surface approach. Curvilinear relationships between grade and each of the personality traits and each of the learning approaches were investigated. A significant curvilinear relationship was found between grade and surface approach when regressing the surface<sup>2</sup> to grade ( $\Delta R^2 = .006, p = 0.031, \beta = 574, t = 2.166$ ).

### Mediation tests

In order to investigate whether one or more of the approaches to studying and learning explain the relationship between the personality traits and grade, tests of mediation were carried out based on Baron and Kenny's (1986) three-step procedure. According

Table 3. Regression of the five personality traits and three learning approaches on grade.

|                   | Step 1 | Step 2  |
|-------------------|--------|---------|
| Neuroticism       | .03    | .11*    |
| Extroversion      | -.02   | .00     |
| Openness          | .07    | -.01    |
| Agreeableness     | .01    | .00     |
| Conscientiousness | .24*** | .09     |
| Deep              |        | -.00    |
| Strategic         |        | .17**   |
| Surface           |        | -.21*** |
| $\Delta R^2$      |        | .05***  |
| $R^2$             | .06    | .11     |
| $F$               | 8.739  | 10.748  |

Note: Standardised regression coefficients are shown; \* $p < .05$ ; \*\* $p < 0.1$ ; \*\*\* $p < .001$ .

Table 4. Hierarchical regression of background variables, personality traits and learning approaches on grade.

|                   | Step 1  | Step 2  | Step 3  |
|-------------------|---------|---------|---------|
| Age               | .13***  | .09*    | .06     |
| Gender            | -.16*** | -.17*** | -.14*** |
| GPA (high school) | .33***  | .30***  | .30***  |
| Neuroticism       |         | -.02    | .05     |
| Extroversion      |         | -.01    | .00     |
| Openness          |         | .06     | -.00    |
| Agreeableness     |         | .06     | -.05    |
| Conscientiousness |         | .18***  | .06     |
| Deep              |         |         | .00     |
| Strategic         |         |         | .15**   |
| Surface           |         |         | -.17*** |
| $\Delta R^2$      | .04***  | .04***  |         |
| $R^2$             | .13     | .17     | .21     |
| $F$               | 31.841  | 15.932  | 14.672  |

Note: Standardised regression coefficients are shown; \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

to Baron and Kenny, a premise to confirm a mediator effect is that the independent effect of the predictor on the dependent variable must show a significant reduction, or disappear, when the mediator variable is introduced. The first step in the test procedure requires that the independent variable, in our Study 1 of the personality traits, is significantly correlated to the dependent variable, in this case grade. In the second step, this personality trait must be significantly correlated to the proposed mediator variable, in our Study 1 of the approaches. Finally, the introduction of the mediator variable must result in a significant decrease in or the disappearance of the direct effect of the personality trait on grade. The two personality traits of conscientiousness

and openness correlated significantly with grade. Conscientiousness correlated significantly with the strategic approach (at .001 level), and openness with the deep approach (at .05 level). In the regression analyses described above, the direct effect of conscientiousness disappeared when introducing the strategic approach. A stepwise regression of openness and deep approach on grade also showed that the direct effect of openness disappeared when adding the deep approach. These relationships indicate that learning approaches may have a mediator effect on the relationship between personality and learning outcomes.

In order to more explicitly test mediation effects, we used the Sobel test (Baron & Kenny, 1986; Sobel, 1982). In this regard, we tested whether openness was mediated by a deep approach in relation to grades, and whether conscientiousness was mediated by a strategic approach in relation to grades. The test was performed independently for each mediation path. Test statistics from the Sobel test show that the effect of openness on grade mediated by a deep approach was significantly different from zero ( $Z = 3.54, p < .001$ ), and that the effect of conscientiousness on grade mediated by a strategic approach was significantly different from zero ( $Z = 4.56, p < .001$ ). According to the correlation analysis in Table 2, neuroticism was not qualified to enter this step in the mediation analysis due to a non-significant correlation with grade. These results at least partly support our expectation that the relationship between personality and grade is mediated by approaches to studying and learning.

### ***Structural equation modelling (SEM)***

SEM is an alternative way of testing mediation effects and subsequent to the analyses above we developed a model for the complex relationship between personality, approaches to studying and learning, and academic achievement. Our aim was to develop a model that can be further tested in future research, and we used SEM and EQS 6.1 (Bentler & Wu, 2006) for this purpose. The model was specified so that the five personality variables predicted the three approaches to studying and learning, and where the strategic and surface approaches predicted grade in addition to a direct effect from neuroticism. The latter was based on initial analyses and use of modification indices. A second-order latent variable was specified to account for the covariance between the three approaches to studying. The SEM model can be seen in Figure 1.

$R^2$  for the strategic and surface approaches and neuroticism in this model was .106. Extroversion and agreeableness did not correlate significantly with grade in this sample (Table 2). Extroversion did, however, relate to approaches in the SEM model and had an indirect effect through the surface approach, and the same was the case for neuroticism. Based on the SEM model (neuroticism on surface;  $\beta = .73$ ), we suspected that neuroticism might have been suppressed by the other personality traits and a new Sobel test was conducted. Thus, to control for such effects, extroversion, openness, agreeableness and conscientiousness were entered in the first step of the regression analysis; neuroticism and surface approach in the second step (Table 5). This regression analysis shows that when surface approach is introduced to the model, neuroticism shows a predictive effect on grade. The result of the Sobel test supported that neuroticism was partly mediated by a surface approach ( $Z = -4.63, p < .001$ ) in addition to the direct effect on grade.

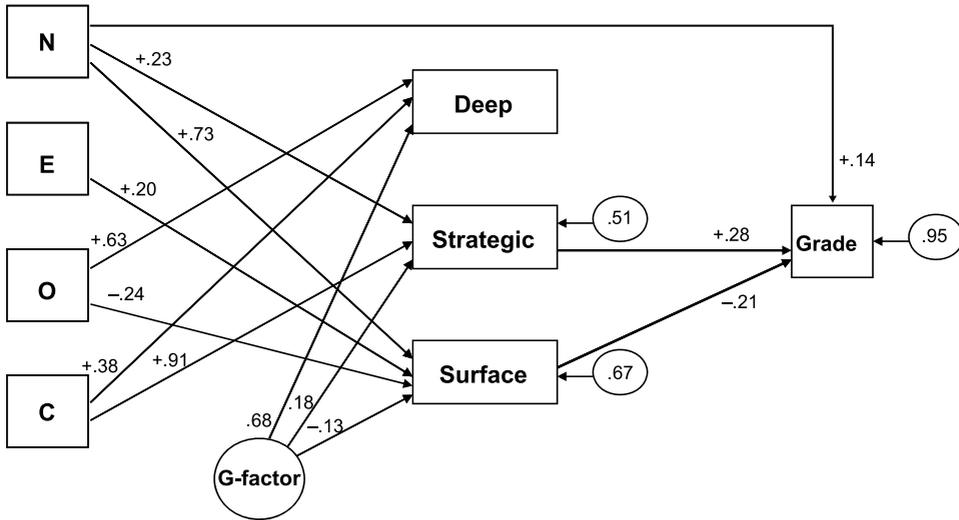


Figure 1. Structural equation model where personality, through approaches to studying, predicts academic achievement (grade). Note: A latent factor (G-factor) is expressing the correlations among the three approaches. N = neuroticism, E = extroversion, O = openness and C = conscientiousness. Numbers in circles refer to disturbance terms. Model fit indices: RMSEA = .042, Chi-square = 710.441/ $p = .000$ , d.f. = 324, NNFI = .938, CFI = .948, GFI = .932, RMR = .032, Std. RMR = .052,  $R^2 = .106$ .

Table 5. Regression analysis to measure predictive effect of neuroticism and surface approach on grade.

|                   | Step 1 | Step 2  |
|-------------------|--------|---------|
| Extroversion      | -.02   | .01     |
| Openness          | .07    | .01     |
| Agreeableness     | .01    | .00     |
| Conscientiousness | .24*** | .19***  |
| Neuroticism       |        | .14**   |
| Surface           |        | -.24*** |
| $\Delta R^2$      |        | .04***  |
| $R^2$             | .06    | .10     |
| $F$               | 10.787 | 12.363  |

Note: Standardised regression coefficients are shown; \*\* $p < 0.1$ ; \*\*\* $p < .001$ .

## Discussion

In this study, we sought to shed further light on the relationship between the five-factor model of personality, approaches to learning and studying, and the effects of these variables on academic achievement. There are three results we want to highlight from the study. Firstly, our results showed that there was a strong positive relationship between conscientiousness and the strategic approach, a strong positive relationship between openness to experience and the deep approach, and a strong positive

relationship between neuroticism and the surface approach. There were also relationships between the other personality traits and the three approaches. Secondly, the analyses confirmed and elaborated the previous findings of Diseth (2003) and Furnham et al. (2008), where approaches to studying and learning mediated the effects of personality on achievement (the relationship between openness and achievement was mediated by a deep approach to learning in both studies). In the multivariate SEM model, however, the strategic approach seemed to mediate the relationship between conscientiousness and grade, although we did not test that explicitly using SEM, while the Sobel test proved two mediator relationships: the strategic approach mediated conscientiousness in relation to grade, and the deep approach mediated openness in relation to grade. Even if no significant correlation is observed between neuroticism and grade, the Sobel test also indicated that their relationship is partly mediated by the surface approach when controlling for the other four personality traits. Finally, our results showed that approaches to learning and studying contributed significantly to the explained variance in achievement beyond the effect of personality, which is a finding that further supports the discriminating validity of the approaches to learning construct and expands on previous findings.

In several previous studies, the hypothesis has been advanced that personality is related to learning. Conscientiousness, in particular, has consistently been found to predict grades at university and college levels (Noftle & Robins, 2007; Trapmann et al., 2007), and a recent meta-analysis by Poropat (2009) shows that correlations between conscientiousness and academic achievement were independent of intelligence. Based on our mediator analyses, the results indicate that the effects of personality were not direct, but indirect effects or effects that were mediated by stylistic properties on achievement. The only direct effect is the one of neuroticism on grade in our SEM model. According to Baron and Kenny (1986), the central premise of a mediator model is 'that the effects of stimuli on behaviour are mediated by various transformation processes internal to the organism' (p. 1176), and approaches may represent such transformation processes for personality on academic achievement. The findings in our study clearly expand on Diseth's (2003) findings as we found that the relationship between conscientiousness and grade was mediated by a strategic approach to studying and learning. In addition, neuroticism demonstrated both an independent and a mediated effect on achievement through the surface approach. Finally, extroversion had an indirect effect through the surface approach, while agreeableness had no direct, indirect or mediated effect on achievement.

Based on this, our findings can be interpreted to support Messick's (1987, 1994) seminal theory that styles act as bridges between personality and cognition. From this perspective, our findings may add to the understanding of both personality influences and the approaches to learning construct. In fact, we would suggest that personality may be seen as an important foundation for the development of approaches to learning and studying, while moderating or supporting experiences such as influences from parents, teachers, fellow students and school practices may contribute to the development of these approaches. Consequently, we posit that personality, learning experiences and situational constraints together influence learning, and that approaches to learning and studying include a significant part of these influences.

Research on individual differences in learning is concerned with understanding how students learn. Putting educational theory into practice does not provide us with direct answers to pedagogical problems. New knowledge rather helps students and teachers to understand which factors influence the student learning outcomes.

Students in higher education are traditionally left to take responsibility for their own learning. This tradition, however, should never leave the teachers to assume that the students actually are able to take this responsibility. One recommendation for teaching and learning based on the results in this study is that higher education institutions should aim at teaching according to how the students learn.

A few limitations associated with this study should be noted. The examination method and learning situation might favour certain approaches to study or certain personality traits and this may have affected our findings. In the previous studies, extraversion has been found to favour short multiple-choice tests, oral exams and group work, but to disfavour longer essays and coursework (Chamorro-Premuzic et al., 2005; Furnham et al., 2008). Furthermore, Duff (2003) found that approaches to studying were good predictors of academic performance in continuous assessment tasks, but poor predictors of performance in examinations and oral presentations. In our study, academic achievement was operationalised as grade achieved in a written, essay type of exam. This type of exam may have disfavoured the extroverted students and favoured those with high scores on openness to experience and conscientiousness. Additionally, the presently used exam evaluations may have somewhat rewarded rote learning, since the course was an introductory course in psychology that typically presents the students with many new concepts. Rote learning is the typical approach of the surface-oriented students. Rote learning may actually be an advantageous approach when exams focus on what and how much the students remembered in contrast to understanding the subject matter. The lack of significant relationship between the deep approach and grade in our SEM model might thus be attributable to the exam method. Future studies are therefore necessary to focus on the impact of students' approaches to studying on different examination methods. We found a curvilinear relationship between the surface approach and grade. The relationship indicates that students with a high surface approach to learning and students with a low surface approach to learning receive better grades than students with a medium surface approach. To our knowledge, no theory is yet written on this relationship and we would suggest more research is needed to focus on this issue in particular.

Since sample characteristics may influence research findings, such as effect size (e.g. Kline, 2004), it seems important to continue replicating the presently identified mediator effects for other samples and using alternative instruments. The concept of approaches to studying and learning is classified within the group of learning style concepts, and other style instruments should be applied to investigate any analogous mediator effects.

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