# Medical students' personality characteristics and academic performance: a five-factor model perspective

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*Objectives* This study investigates: (1) which personality traits are typical of medical students as compared to other students, and (2) which personality traits predict medical student performance in pre-clinical years.

*Design* This paper reports a cross-sectional inventory study of students in nine academic majors and a prospective longitudinal study of one cohort of medical students assessed by inventory during their first pre-clinical year and by university examination at the end of each pre-clinical year.

*Subjects and methods* In 1997, a combined total of 785 students entered medical studies courses in five Flemish universities. Of these, 631 (80·4%) completed the NEO-PI-R (i.e. a measure of the Five-Factor Model of Personality). This was also completed by 914 Year 1 students of seven other academic majors at Ghent University. Year end scores for medical students were obtained for 607 students in Year 1, for 413 in Year 2, and for 341 in Year 3.

*Results* Medical studies falls into the group of majors where students score highest on *extraversion* and *agreeableness*. *Conscientiousness* (i.e. self-achievement and self-discipline) significantly predicts final scores in each pre-clinical year. Medical students who score low on *conscientiousness* and high on *gregariousness* and *excitement-seeking* are significantly less likely to sit examinations successfully.

*Conclusions* The higher scores for *extraversion* and *agreeableness*, two dimensions defining the interpersonal dynamic, may be beneficial for doctors' collaboration and communication skills in future professional practice. Because *conscientiousness* affects examination results and can be reliably assessed at the start of a medical study career, personality assessment may be a useful tool in student counselling and guidance.

*Keywords* education, medical undergraduate/*psychology; clinical competence/*standards; *personality; educational measurement; Belgium.

## Introduction

It is often asserted that, besides cognitive abilities, a blend of personality characteristics is necessary for people to be successful in medical studies and eventually in the medical profession. However, there is further debate as to which personality traits are typical of students in medical studies as compared to students in other academic majors[1–3] and which specific personality traits predict medical student performance in

the pre-clinical years.[4,5] An important reason for the difficulty in drawing generalizable and robust conclusions is that previous studies have used a variety of personality inventories (e.g. the California Psychological Inventory,[7–9] the Eysenck Personality Inventory,[10,11] the 16 Personality Factor Questionnaire,[10,12,13] the Myers-Briggs Type Indicator,[14,15] the Edwards Personal Preference Schedule[16] and the Comrey Personality Scales[3,6]) to measure a very divergent set of personality traits.

In recent years, there has been emerging consensus among personality psychologists that the myriad of personality characteristics measured by various personality inventories can be grouped under five higher-order personality factors: *extraversion*, *agreeableness*, *conscientiousness*, *emotional stability* and *openness to experience*.[17,18] An overview of the structure of this Five-Factor Model (FFM), also known as the 'Big Five', is found in Table 1. The FFM dimensions, which

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## Key learning points

Medical studies are in a group of majors that score highest on *extraversion* and *agreeableness*.

Medical students scoring high on *conscientiousness* (i.e. 'self-achievement' and 'self-discipline') are more likely to succeed in the pre-clinical years.

Students scoring low on *conscientiousness* and high on both 'gregariousness' and 'excitement-seeking' are significantly less likely to successfully pass the preclinical years.

Personality assessment may be a useful tool for medical student guidance and counselling rather than for medical student selection *per se*.

**Table 1** Domains and facets of the Five-Factor Model of Personality

| Factor/domain | Facets | |
| --- | --- | --- |
| 1 Neuroticism (N) | N1: | Anxiety |
| | N2: | Angry hostility |
| | N3: | Depression |
| | N4: | Self-consciousness |
| | N5: | Impulsiveness |
| | N6: | Vulnerability |
| 2 Extraversion (E) | E1: | Warmth |
| | E2: | Gregariousness |
| | E3: | Assertiveness |
| | E4: | Activity |
| | E5: | Excitement-seeking |
| | E6: | Positive emotions |
| 3 Openness to experience (O) | O1: | Fantasy |
| | O2: | Aesthetics |
| | O3: | Feelings |
| | O4: | Actions |
| | O5: | Ideas |
| | O6: | Values |
| 4 Agreeableness (A) | A1: | Trust |
| | A2: | Straightforwardness |
| | A3: | Altruism |
| | A4: | Compliance |
| | A5: | Modesty |
| | A6: | Tender-mindedness |
| 5 Conscientiousness (C) | C1: | Competence |
| | C2: | Order |
| | C3: | Dutifulness |
| | C4: | Achievement striving |
| | C5: | Self-discipline |
| | C6: | Deliberation |

define the underlying qualities of the diversity of personality traits, have been replicated in an impressive series of studies, across raters and rating scales, but also in different countries and cultures.[17,19] The FFM dimensions and their operational manifestations primarily represent the normal range of individual differences, contrary to many clinically developed personality descriptive models, making the model suitable for studying traits and samples derived from the general population. Although the FFM has been largely ignored in the medical literature, it may serve as a uniform, comprehensive and robust framework for describing medical students' personality characteristics and for substantially advancing our understanding of whether these traits relate to academic success.[20]

Therefore, this study uses the FFM of personality to compare medical students with students of seven other academic majors. This allows us to investigate which personality traits are relatively typical of medical students. As a second objective, we investigate which of the FFM dimensions predict students' final scores in the pre-clinical years of medical studies. It should be emphasised that we investigate these two objectives at both the FFM domain and FFM facet levels. To ensure the generalisability of the results, criterion data are not restricted to the first year of medical training but to the first 3 years. In addition, these data have been gathered in all five universities providing medical studies in the Flemish community.

On the basis of prior research in the medical,[20] occupational[21] and educational fields,[22] we hypothesise that the second-order factor *conscientiousness* in general and the facets associated with *conscientiousness* (i.e. competence, order, dutifulness, achievement, self-discipline and deliberation) in particular will be consistent predictors of medical student performance across the pre-clinical years.

## Methods

### Participants

In 1997, a total of 785 students entered medical studies courses at the five Flemish universities. All of these students had successfully passed the Flemish admission examination in Medical and Dental Studies. This admission examination, which was organised by the Flemish government, included cognitive ability measures (e.g. reasoning tests) and video-based situational tests (e.g. videotaped interaction between doctor and patient).

During classes at the start of the first academic year of medical studies, a personality inventory was administered to the medical students at all Flemish universities. Students were informed about the purpose of the study and were told they would receive individual

feedback, made available through their student number, which was the only identification they were required to submit. They were assured that the results served only research purposes and would not influence examination results. The administration of the personality inventory lasted between 30 and 50 minutes. A total of 631 medical students (399 women; 232 men; mean age = 18 years, 2 months) filled in the inventory, yielding a response rate of 80·4%. Across the universities the response rates varied from 67·8% to 84·2%. The 4 : 6 male : female ratio was typical of the situation in Flemish medical schools.

In light of our first research objective, the inventory was also administered to 914 Year 1 students of seven other academic majors (i.e. law, economics, sciences, psychology and pedagogical sciences, political and social sciences, engineering, and philosophy, languages and history). All of these students were enrolled at Ghent University and at the Industrial Engineering School. The male : female ratios across these seven academic majors were as follows: law (5 : 5), economics (5 : 5), sciences (4 : 6), psychology and pedagogical sciences (3 : 7), political and social sciences (5 : 5), engineering (8 : 2), and philosophy, languages and history (3 : 7).

In view of our second research objective, the medical students who had started their studies in one of the Flemish universities in 1997 were followed for 3 years. In particular, their final scores at the end of each of the 3 pre-clinical years were obtained from all Flemish universities. Year end scores were obtained for 607 medical students in Year 1, for 413 in Year 2, and for 341 in Year 3. The lower student numbers for the latter years are due to student attrition (i.e. students failing to pass the final examinations).

### Personality inventory

The authorized Flemish translation[23] of the NEO-PI-R[17] was used. As shown in Table 1, the NEO-PI-R measures the 5 domains of personality and 30 more specific facets, with 6 facets hierarchically structured under each of the 5 domains. The inventory includes 240 items, with 8 items per facet, with domain scale scores computed through aggregation of its composing facets. The item response scale ranged from 1 (*strongly agree*) to 5 (*strongly disagree*). A principal components analysis, followed by varimax-rotation, showed 5 clearly interpretable factors with eigenvalues from 2·8 to 4·0, explaining 60·5% of the variance. Twenty-nine of the 30 facets had their primary loading on the factor they were purported to measure. The only exception was the facet 'impulsiveness', which primarily loaded on

*extraversion* instead of on *neuroticism*. The latter deviance from the US normative structure is usually observed in analyses on Dutch/Flemish data sets.[24] The internal consistency coefficients for domains (varying from 0·87 to 0·91) and facets (varying from 0·64 to 0·82) were comparable to the normative US and Dutch/Flemish data.[17,23]

### Year end scores

The year end score of a student at the end of each pre-clinical year was derived from the average of the scores obtained by the student on the various courses in that year. Year end scores could range from 0 to 20. The courses taught in the pre-clinical years were typically basic science courses (e.g. biology, physics, chemistry, etc.) and courses dealing with the various basic medical disciplines (e.g. anatomy, physiology, epidemiology, etc.). Although the actual content of the preclinical years differed somewhat across universities in terms of courses taught, closer inspection across universities showed major similarities. Therefore, we decided to use students' year end scores as a global criterion measure. The internal consistency of the year end score with the scores on the specific courses as items was satisfactory (e.g. Cronbach's alpha's varied from 0·87 to 0·91 across the various universities; a principal components analysis showed evidence for one general factor), confirming that the courses taught in the pre-clinical years required similar knowledge/skills.

### Analyses

Regarding the first objective, means of each of the FFM domain scores were computed for the medical students and for the students of the other academic majors. Next, a multivariate analysis of variance was conducted to determine whether there existed differences between the majors across FFM domains. The multivariate analysis was followed-up by one-way analyses of variance per FFM domain. Differences between the specific academic majors were then assessed with Tukey's Honestly Significant Differences test.

The second research objective was examined by conducting multiple regression analyses. In each regression analysis, the FFM domain scores served as independent variables and the final score in the respective pre-clinical year was the dependent variable. We also conducted regression analyses controlling for gender. Next, we computed Pearson correlations between the FFM domain and facet scores on the one hand and the final student scores in the three pre-clinical

years on the other hand. Because of the attrition in the medical student pool over the years, these correlations were corrected for direct restriction of range.[25] All analyses were conducted with SPSS 9·0.

## Results

### Comparison of medical students' personality traits with those of other students

Table 2 presents the means and standard deviations per FFM domain across the academic majors. The MANOVA showed a significant main effect of academic major across all FFM domains: $F (35, 5576) = 7·42$, $P < 0·001$, Wilks lambda = 0·83. To determine whether the differences across majors in terms of personality were not due to gender differences, we also conducted a MANCOVA with gender as a covariate and the FFM domains as dependent variables. As could be expected, gender was a significant covariate. However, even when the variation due to gender was removed from the dependent variable, the academic majors still had a significant effect.

Consistent with the multivariate result, the univariate ANOVAS showed significant differences among academic majors for all FFM dimensions. The letter indices in Table 2 indicate between-faculty differences ($P < 0·05$). Scale means with the same letter indices are not significantly different. For example, medical students scored on average high on *extraversion* but Tukey's Honestly Significant Differences test placed them in the same group as people studying law, economics, psychology and pedagogical sciences, and political and social sciences. Conversely, medical students' *extraversion* scores were significantly different from those of students of other academic majors such as sciences and applied sciences (engineering). On average, medical students also fell into the high-scoring group for *agreeableness*. With regard to scores for *conscientiousness*, medical students were located in the middle of the range. Similar results were found for the *openness to experience* and *neuroticism* dimensions.

### Predictive validity of FFM dimensions in preclinical years

The results of the regression analyses in Table 3 show that *conscientiousness* significantly predicted the final scores in each of the preclinical years (beta = 0·24, $P < 0·001$, beta = 0·17, $P < 0·01$, and beta = 0·19, $P < 0·01$). *Extraversion* was a significant predictor in the first year. However, the regression weight of *extraversion* was negative (beta = −0·12, $P < 0·01$), which means that people scoring high on *extraversion* obtained lower final scores. Finally, *openness* significantly predicted the

**Table 2** Mean NEO-PI-R domain scores per academic major

| Academic major | n | Neuroticism | | Extraversion | | Openness to experience | | Agreeableness | | Conscientiousness | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | mean | SD | mean | SD | mean | SD | mean | SD | mean | SD |
| Medical Studies | 631 | 138·04$_{a,b,c}$ | 22·11 | 166·16$_c$ | 19·80 | 169·32$_{a,b,c}$ | 18·71 | 170·27$_b$ | 19·52 | 166·29$_{b,c}$ | 20·14 |
| Applied Sciences (engineering) | 308 | 131·91$_{a,b}$ | 19·77 | 157·62$_b$ | 18·57 | 165·43$_a$ | 17·36 | 167·19$_{a,b}$ | 16·43 | 169·36$_c$ | 17·27 |
| Philosophy, Languages and History | 153 | 145·39$_c$ | 20·47 | 149·50$_a$ | 19·26 | 176·43$_c$ | 15·21 | 162·71$_{a,b}$ | 19·51 | 156·39$_a$ | 21·33 |
| Law | 121 | 130·97$_a$ | 21·27 | 161·11$_{b,c}$ | 20·12 | 168·14$_{a,b}$ | 16·34 | 164·48$_{a,b}$ | 19·06 | 169·67$_c$ | 18·93 |
| Sciences | 63 | 134·84$_{a,b}$ | 20·02 | 155·54$_{a,b}$ | 18·93 | 165·39$_a$ | 19·10 | 170·21$_b$ | 17·92 | 168·69$_c$ | 17·44 |
| Economics | 71 | 136·42$_{a,b}$ | 20·37 | 163·45$_{b,c}$ | 18·27 | 165·58$_a$ | 16·23 | 161·67$_a$ | 19·91 | 171·74$_c$ | 16·35 |
| Psychology and Pedagogical Sciences | 96 | 140·11$_{b,c}$ | 22·59 | 161·62$_{b,c}$ | 14·70 | 175·92$_c$ | 17·77 | 167·26$_{a,b}$ | 16·69 | 160·29$_{a,b}$ | 19·56 |
| Political and Social Sciences | 102 | 136·71$_{a,b,c}$ | 20·71 | 160·01$_{b,c}$ | 20·95 | 174·49$_{b,c}$ | 18·74 | 160·76$_a$ | 15·88 | 163·86$_{a,b,c}$ | 19·02 |
| F ratio | | 7·41* | | 15·60* | | 9·08* | | 6·76* | | 9·3* | |

Letter indices indicate between-faculty differences, $P < 0·05$; scale means with the same letter indices are not significantly different.
Differences between the specific academic majors were assessed with Tukey's Honestly Significant Differences test.
*$P < 0·001$.

final scores in Year 3 (beta = 0·15, $P < 0·05$). The Pearson correlations (corrected for direct restriction of range) between FFM domain scores and final year scores yielded the same results as the regression analyses. When we ran the regression analysis controlling for the gender of the students, gender explained 0% of the variance.

Because *conscientiousness* was found to be the most important FFM domain, it was interesting to inspect the Pearson correlations between the *conscientiousness* facets and final scores in each of the preclinical years (Table 4). There were correlations between the final scores and the facets of 'achievement striving' ($r = 0·15$, $P < 0·001$, $r = 0·19$, $P < 0·001$, and $r = 0·15$, $P < 0·01$) and 'self-discipline' ($r = 0·23$, $P < 0·001$, $r = 0·24$, $P < 0·001$, and $r = 0·18$, $P < 0·001$) in each of the 3 pre-clinical years. 'Competence' and 'deliberation' were correlated with scores in Years 1 and 3. 'Order' and 'dutifulness' were only correlated with Year 1 final scores.

**Table 3** Results of multiple regression analyses with final scores in pre-clinical years of Medical Studies as dependent variables and FFM domain scores as predictors

| FFM domain | Year 1 (n = 607) | Year 2 (n = 413) | Year 3 (n = 341) |
|---|---|---|---|
| Neuroticism | 0·06 | 0·03 | 0·03 |
| Extraversion | − 0·12† | − 0·02 | − 0·04 |
| Openness to experience | 0·09 | 0·08 | 0·15* |
| Agreeableness | − 0·05 | − 0·08 | − 0·10 |
| Conscientiousness | 0·24‡ | 0·17† | 0·19† |
| R | 0·25‡ | 0·17* | 0·22† |
| R² | 0·06 | 0·03 | 0·05 |
| Adjusted R² | 0·06 | 0·02 | 0·04 |

*$P < 0 05$; †$P < 0·01$; ‡$P < 0·001$

## Personality differences between unsuccessful and successful medical students

Because only 341 of the 785 (43·4%) medical students had successfully (i.e. without failing one of the 3 final examinations) passed the 3 pre-clinical years, we conducted a logistic regression analysis with 'passing the 3 years of medical studies successfully' as a dependent variable and the FFM dimensions as independent variables. Again, gender was controlled in these analyses. *Conscientiousness* was the only FFM dimension that had a significant regression weight. *Conscientiousness* scores were higher for successful (mean = 168·08, SD = 19·44, n = 341) than for unsuccessful medical students (mean = 164·19, SD = 20·77, n = 290).

Additional *t*-tests indicated that there were significant differences between successful and unsuccessful students in terms of three *conscientiousness* facets, namely 'dutifulness' ($t = 2·30$, 629 d.f., $P < 0·05$), 'achievement striving' ($t = 2·32$, 629 d.f., $P < 0·05$), and 'self-discipline' ($t = 3·96$, 629 d.f., $P < 0·001$). Successful medical students rated themselves higher on each of these facets. There were also significant differences between successful and unsuccessful medical students for two *extraversion* facets, namely 'gregariousness' (t = −2·08, 629 d.f., $P < 0·05$) and 'excitement-seeking' (t = −2·18, 629 d.f., $P < 0·05$). Successful medical students rated themselves lower on these two *extraversion* facets than unsuccessful medical students. These results in terms of the facets should be interpreted with caution because we used *t*-tests to make multiple comparisons, increasing the risk of Type-1 error. When we applied the Bonferroni correction, only the difference between successful and unsuccessful students in terms of the 'self-discipline' facet was truly significant.

**Table 4** Correlations between facets of conscientiousness and final scores in pre-clinical years of Medical Studies

| Conscientiousness facet | Year 1 (n = 607) | Year 2 (n = 413) | Year 3 (n = 341) |
|---|---|---|---|
| C1: Competence | 0·17‡ (0·17) | 0·09 (0·09) | 0·17† (0·17) |
| C2: Order | 0·09* (0·09) | 0·01 (0·01) | 0·03 (0·03) |
| C3: Dutifulness | 0·12† (0·12) | 0·04 (0·04) | 0·07 (0·07) |
| C4: Achievement striving | 0·15‡ (0·15) | 0·19‡ (0·19) | 0·15† (0·15) |
| C5: Self-discipline | 0·23‡ (0·23) | 0·24‡ (0·25) | 0·18‡ (0·18) |
| C6: Deliberation | 0·15‡ (0·15) | 0·05 (0·05) | 0·13* (0·14) |

* $P < 0·05$; † $P < 0·01$; ‡ $P < 0·001$
Correlations with final scores in preclinical years were corrected for direct restriction of range. These correlations are between brackets. Statistical significance was determined prior to range restriction correction.

## Discussion

This study has important conclusions in terms of personality differences between medical students and other academic majors (between-group differences) and in terms of personality differences within the group of medical students (within-group differences).

Firstly, this study shows that differences between academic majors in terms of personality are significant. However, as might be expected, there is no unique personality pattern that distinguishes medical students from students of other academic majors. For example, compared to other students, medical students score highest on *extraversion* and *agreeableness* but they share these high scores with students from other academic majors (e.g. psychology students). In any case, we believe it is encouraging that medical studies falls into a group of majors that score high on *extraversion* and *agreeableness*. These 2 domains define the so-called interpersonal sphere, describing interpersonal relationships among individuals. *Extraversion* is indicative of the frequency of social interaction ('shy, introverted' versus 'sociable, extraverted'), whereas *agreeableness* describes the quality ('warm, friendly, empathic' versus 'cold, aloof') of interpersonal behaviour. These higher mean scores on *extraversion and agreeableness* might be beneficial for doctors' future professional practice[10,26] including team and interpersonal work, and for people choosing to become family practitioners in particular, as this medical specialty is characterised by a high level of orientation towards people.[27]

Secondly, this study shows that there is large variation within the group of medical students in terms of personality and that these differences matter. In particular, students scoring high on *conscientiousness* are more likely to succeed in the preclinical years. The latter is a robust finding as *conscientiousness* is a strong and continuous predictor of students' academic performance in each of the 3 pre-clinical years. It is also congruent with results in the occupational and educational fields.[21,22] Another important finding is that more proactive *conscientiousness* traits such as 'self-discipline' and 'achievement striving' predict better medical student performance than more inhibitory and regulatory *conscientiousness* traits like 'order', 'deliberation' and 'dutifulness'. *Extraversion* is only a (negative) significant predictor of examination results in Year 1, suggesting that the effect of this trait is restricted to the beginning of the academic career. The analysis of drop-outs further demonstrates that differences in terms of personality within a group of medical students may have important effects. Drop-outs have on average higher 'gregariousness' and 'excitement-seeking' (i.e. two *extraversion* facets) scores and lower *conscientiousness* scores (especially for the proactive facets such as 'achievement striving' and 'self-discipline'). These findings are important and suggest that students low in 'self-achievement' and 'self-discipline', combined with high 'gregariousness' and 'excitement-seeking' scores, are at risk of failing to take examinations successfully.

Some may argue that personality traits explain only a small amount of the variance in each of the academic years (6%, 3% and 5%, respectively). These variance percentages should be framed in the context that only one instrument was used (a personality inventory) and that the students in this study had already passed an admission examination that consisted of cognitive ability tests and video-based simulations. Accordingly, the percentages of variance explained by personality should be considered rather as incremental variance accounted for over and above this comprehensive admission examination.

Taken together, we do not believe that the present study provides sufficient arguments to select out student applicants on the basis of their personality scores. However, the present findings do suggest that personality traits can be reliably assessed at the beginning of the academic study and that *conscientiousness* affects students' academic performance. Therefore, personality assessment may be a useful tool for student guidance and counselling throughout the academic career.

## Contributors

FL and PC acted as main co-ordinators of this study. FL was responsible for data analysis and for writing a first draft of the paper. PC supervised practical organization of the data collection in universities. FdF gathered and analysed cross-sectional data and contributed to the Discussion section. JdM facilitated collection of longitudinal data at Ghent University. He also read and commented on drafts of the paper.

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