# Temperament and character profiles of medical students associated with tolerance of ambiguity and perfectionism

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**Background.** Certain personal attributes, such as perfectionism and tolerance of ambiguity, have been identified as influential in high achieving students. Medical students have been identified as high achievers and perfectionistic, and as such may be challenged by ambiguity. Medical students undertake a long and challenging degree. Personality has been shown to influence the well-being and coping and may equip some students to better cope with challenges. This paper examines the association between temperament and character personality profiles with measures of tolerance of ambiguity and with both adaptive and maladaptive constructs of perfectionism.

**Methods.** A self-report questionnaire collected data on a sample of 808 Australian medical students in 2014 and 2015. Personality was measured using the Temperament and Character Inventory (TCIR-140) and classified traits as profiles using a latent class analysis. Two profiles were found. Profile 1 was characterized by low-average levels of Harm Avoidance, and high to very high levels of Persistence, Self-Directedness and Cooperativeness. Moderately-high levels of Harm Avoidance and high levels of Persistence, Self-Directedness and Cooperativeness characterized Profile 2. Moderation regression analyses were conducted to examine the association between the personality profiles with levels of Tolerance of Ambiguity (MSAT-II), Perfectionism-Concern over Mistakes and Perfectionism-High Standards (FMPS), considering demographic characteristics.

**Results.** Students with Profile 1 were higher in levels of Tolerance of Ambiguity, and Perfectionism-High Standards, and lower levels of Perfectionism-Concern over Mistakes compared to Profile 2. These findings remained statistically significant after adjusting for age and gender. A significant personality by age interaction on Tolerance of Ambiguity was found. While higher levels of Tolerance of Ambiguity were associated with older age overall, it remained low across age for students with a personality Profile 2.

**Conclusions.** A particular combination of personality traits was identified to be associated with low Tolerance of Ambiguity and high levels of maladaptive Perfectionism. An intolerance of ambiguity and over concern about mistakes maybe maladaptive and underlie vulnerability to stress and poor coping. The psychobiological model of personality provides insight into traits that are stable and those that can be self-regulated through education and training. The interaction between biological mechanisms and socio-cultural learning is relevant to a sample of medical students because it accounts for interaction of the biological or innate aspects of their personal development within an intense and competitive learning environment of medical school.

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16   **Abstract**

18   **Background.** Certain personal attributes, such as perfectionism and tolerance of ambiguity, have

19   been identified as influential in high achieving students. Medical students have been identified as

20   high achievers and perfectionistic, and as such may be challenged by ambiguity. Medical

21   students undertake a long and challenging degree. Personality has been shown to influence the

22   well-being and coping and may equip some students to better cope with challenges. This paper

23   examines the association between temperament and character personality profiles with measures

24   of tolerance of ambiguity and with both adaptive and maladaptive constructs of perfectionism.

26   **Methods.** A self-report questionnaire collected data on a sample of 808 Australian medical

27   students in 2014 and 2015. Personality was measured using the Temperament and Character

28   Inventory (TCIR-140) and classified  traits as profiles using a latent class analysis.  Two profiles

29   were found. Profile 1 was characterized by low-average levels of Harm Avoidance, and high to

30   very high levels of Persistence, Self-Directedness and Cooperativeness. Moderately-high levels

31   of Harm Avoidance and high levels of Persistence, Self-Directedness and Cooperativeness

32   characterized Profile 2. Moderation regression analyses were conducted to examine the

33   association between the personality profiles with levels of Tolerance of Ambiguity (MSAT-II),

34   Perfectionism-Concern over Mistakes and Perfectionism-High Standards (FMPS), considering

35   demographic characteristics.

36

37   **Results.** Students with Profile 1 were higher in levels of Tolerance of Ambiguity, and

38   Perfectionism-High Standards, and lower levels of Perfectionism-Concern over Mistakes

39   compared to Profile 2. These findings remained statistically significant after adjusting for age

40   and gender. A significant personality by age interaction on Tolerance of Ambiguity was found.

41   While higher levels of Tolerance of Ambiguity were associated with older age overall, it

42   remained low across age for students with a personality Profile 2.

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44   **Conclusions.**

45   A particular combination of personality traits was identified to be associated with low Tolerance

46   of Ambiguity and high levels of maladaptive Perfectionism. An intolerance of ambiguity and

47   over concern about mistakes maybe maladaptive and underlie vulnerability to stress and poor

48   coping. The psychobiological model of personality provides insight into traits that are stable and

49   those that can be self-regulated through education and training. The interaction between

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52   development within an intense and competitive learning environment of medical school.

53

54

## Introduction

The health and well-being of medical students along with their successful progression through medical training is an important concern to medical educators. High levels of stress, depression and anxiety are increasingly noted in doctors and medical students,[1, 2] and are higher than their nonmedical peers in the general population [3]. In turn, this higher level of dysphoria may affect expressions of empathy, impair professional behaviour and contribute to burn-out and drop-out [4]. The many pressures and demands associated with medical training can drive students to excessive self-criticism, self-doubt and fear about making mistakes [1, 5, 6].

Comprehensive reviews have recognised personality as an influencing factor on many aspects of medical students' successful and healthy progression through medical training [7, 8]. The literature is clear that certain personality traits can influence or predict various aspects of academic performance,[9-13] including subsequent performance in postgraduate training,[14] subclinical competence,[15, 16] expression of empathy,[17, 18] subjective well-being,[19, 20] mental toughness,[21] attitudes to work, burnout and stress,[5] and career interests[22-24].

The measurement of personality across these studies differ, primarily around variants of the Five-Factor Model (FFM). [25,26,27] The Temperament and Character Inventory (TCI), developed by Cloninger,[28, 29] distinguishes between seven personality traits within the domains of temperament (Novelty Seeking, Harm Avoidance, Reward Dependence, Persistence), and character (Self-Directedness, Cooperativeness, Self-Transcendence). Japanese studies with medical students demonstrated positive associations between intrinsic academic motivation and the TCI's Persistence, Self-Directedness and Self-Transcendence, leading to better academic performance, [30] and Jiang [31] found positive associations between the TCI's Harm Avoidance and measures of anxiety. Resilience was shown to be strongly correlated with high levels of Self-Directedness, Cooperativeness and Persistence and low Harm Avoidance in Australian medical residents [32]. Furthermore, several studies in the general population have shown that high Self-Directedness and low Harm Avoidance are the strongest predictors of well-being and satisfaction with life [33-35,36].

85    Importantly, the TCI provides insight into the combination of traits from a psychobiological

86    perspective identifying aspects of personality that are relatively stable (temperament traits), and

87    those that are more amiable to change through sociocultural learning (character traits). The

88    psychobiological model of personality suggests there is interaction between biological

89    mechanisms and learning over the development of an individual within the context of his/her

90    environment. Heritable influences that refer to genetically inherited  qualities are equally great

91    on temperament and character but character plays the self-regulatory role, which is targeted in

92    parenting, teaching, and coaching. Examining profiles or combinations of trait levels affords a

93    more meaningful understanding of what drives individuals' behaviours and how they adapt to

94    life situations [26]. The individual traits of a person must interact in a complex dynamic way to

95    adapt to internal or external challenges [33, 34]. This suggests that certain personality profiles are

96    prone to being more or less vulnerable to adapting to and coping with these challenges. In

97    addition to temperament and character, many other psychological attributes can influence one's

98    capacity for coping and may influence well-being. Pertinent to medical students are the attributes

99    of ambiguity tolerance and perfectionism [38-40]. We chose these attributes as proxy measures of

100    capacity for coping and are discussed briefly below.

101

102    The early work by Budner showed that individuals with a low Tolerance of Ambiguity

103    experience anxiety or stress when they perceive new or complex situations [41]. Geller provides a

104    thoughtful perspective on Tolerance of Ambiguity among medical students [39]. She emphasises

105    the ubiquitous place of ambiguity in medical practice and the need to understand the

106    ramifications at both ends of the tolerance spectrum. Ambiguity tolerance exerts a strong

107    influence on the attitudes and behaviours of medical students. In particular, low Tolerance of

108    Ambiguity has been linked to higher perceived stress [42] and higher rates of burnout [43].

109

110    Socio-demographic characteristics such as sex and age are associated with individual differences

111    in ambiguity tolerance. Higher levels are found in men and older students, [42] in leaders, [44] and

112    in people willing to work in rural or underserved areas [45]. In contrast, low ambiguity tolerance

113    has been associated with negative attitudes to underserved groups of people, [45] burnout in

114    primary care [46] and emergency physicians, [47] higher levels of stress in medical students, [42]

115    and a fear of making mistakes [48]. Personality traits have also been associated with the way

116  physicians deal with uncertainty and their diagnostic decision making [49], but little research has
117  investigated the relationship between temperament and character traits with Tolerance of
118  Ambiguity in medical students.

119

120  Perfectionism is a common characteristic of high achieving individuals and is prevalent in
121  medical students and physicians [50, 51]. Perfectionism most commonly features the setting of
122  excessively high personal standards of performance [52] which may have important benefits to
123  medical care such as attention to detail and a strong sense of responsibility [51]. Perfectionism
124  exists on a continuum and can be either healthy and adaptive or self-defeating and maladaptive
125  [40, 53]. The major distinction is that adaptive perfectionists have a higher acceptance to allow
126  minor flaws in their work and still accept it as successful. They are driven by meaningful goals
127  and striving for achievement. In contrast, maladaptive perfectionists are simply unable to accept
128  mistakes. They set standards so unrealistically high that instead of directing their goals toward
129  striving for achievement, they are driven by fear of failure which has implications for decision
130  making. Research by Enns [40] found that medical students differed from arts students in aspects
131  of perfectionism. In medical students, adaptive perfectionism was correlated with academic
132  performance and levels of conscientiousness, whereas maladaptive perfectionism correlated with
133  symptoms of distress and levels of neuroticism which further predicted depression over time.
134  Similarly, the association between personality profiles and the different types of perfectionism in
135  medical students has not previously between examined.

136

137  The aim of this paper was to examine the relationship between personality profiles of medical
138  students and psychological attributes that may be indicative of coping with a challenging medical
139  degree. We examined the association between personality profiles with tolerance of ambiguity
140  and the two constructs of Perfectionism, (High Standards and Concern over Mistakes), and
141  whether the relationships differ by demographic characteristics. We hypothesised that there
142  would be significant relationships between medical student's personality profile and levels of
143  each coping attribute. We expected that students who fit in a personality profile that comprised a
144  temperament low in Harm Avoidance and high in Persistence, and a character high in Self
145  Directedness and Cooperativeness, would have high levels of ambiguity tolerance and adaptive
146  perfectionism.

147

## Materials & Methods

149

### Design

The study design is quantitative cross-sectional using a self-report questionnaire. Ethics was approved by the Behavioural and Social Sciences Ethical Review Committee at The University of Queensland. (Approval Number: 2015001895). Participants provided written consent which was documented on the questionnaire and approved by this ethics committee.

155

### Participants and setting

Data were collected in 2014 and 2015 at The University of Queensland School of Medicine, Australia. The questionnaire was identical in both years and was accessed via an online link (Survey Monkey©). Students were invited to complete the questionnaire via an email invitation to access the link. The 2014 collection invited all students in the four-year medical program to participate through an invitation to access the link on the student community website. However, this method failed to reliably reach all students. In 2015 the data collection involved only Year 1 students who were invited to participate during a regularly scheduled activity. All participants were graduate entry medical students and completed the survey only once. The overall response rate was 62%. The final sample size was N = 808. The mean age was 24.88 years (SD=4.00), median age was 24 (IQR=5). The modal age was 23, but the distribution was skewed to the right (skewness = 2.87), due to the mature age entry students. Due to the distribution, age was not able to be analyzed as a continuous variable. Therefore, based on the mean value, the age variable was split into under 25 years, and 25 year or older because this is largely in line with the phases of training in the medical degree.

171

### Measures

#### *Temperament and character personality profiles*

Personality profiles were measured using the 140-item Temperament and Character Inventory [28, 29]. The four temperament traits measure basic emotional drives, are heritable and do not change significantly over the life course. Novelty Seeking reflects a heritable bias observed as exploratory activity in response to novelty, impulsiveness, and extravagance in approach to cues

178 of reward. Harm Avoidance involves a heritable bias observed as anxiety proneness, and

179 pessimistic worry in anticipation of problems. Reward Dependence is behaviour in response to

180 cues of social reward and is observed as social sensitivity and dependence on approval by others.

181 Persistence is the maintenance of behaviour despite frustration, fatigue and reinforcement. It

182 reflects industriousness and determination. The three character traits are developmental and

183 influenced by learning, the environment and life experiences. Self-Directedness measures intra-

184 personal character strengths, such as being responsible, purposeful, goal-oriented and self-

185 confident. Cooperativeness measures inter-personal character strengths, such as tolerance,

186 empathy, and respectful acceptance of the opinions and behaviours of others. Self-transcendence

187 measures transpersonal character strengths. It quantifies the extent to which individuals conceive

188 themselves as integral parts of the universe as a whole.

189

190 The TCIR-140 uses a five point Likert scale (1=absolutely false to 5=absolutely true). Internal

191 reliability (Cronbach alphas) of each trait ranged from 0.86 to 0.89 for the character and 0.69 to

192 0.91 for temperament scales. The scales are multifaceted with high and low descriptors of each

193 trait see [37]. Details on the interpretation of low and high scores of the seven TCI subscales are

194 available in Appendix A.

195

196 From the TCI subscales, two personality profiles were classified based on clusters of individuals

197 with distinctive combinations of the seven traits revealed in a latent profile analysis. Further

198 details of the classification methods are available in Appendix B. Profile 1 was characterized by

199 low to average levels of Harm Avoidance, and high to very high levels of Persistence, Self-

200 Directedness and Cooperativeness (see Figure 1), In comparison, Profile 2 was characterised by

201 average-high levels of Harm Avoidance and high levels of Persistence, Self-Directedness and

202 Cooperativeness, as determined by comparison to normal range percentiles of the population [63].

203 In other words, medical students in both profiles describe themselves as healthier and more

204 mature than average.  However , the medical students in Profile 1 are even more confident and

205 resilient than the other medical students and the general population, whereas those in Profile 2

206 are slightly more anxious and worried than most people in the general population.

207 <Figure 1>

208

209    ***Tolerance of ambiguity***

210    The Multiple Stimulus Types Ambiguity Tolerance Scale-II (MSTAT-II) [55] is based on the

211    theory that an individual's perception of ambiguity is an orientation ranging from attraction to

212    aversion toward stimuli that are uncertain, insoluble or unfamiliar. The MSTAT-II consists of 13

213    items and uses a Likert response scale of 1= definitely false to 5=definitely true. Items were

214    summed, with a low score indicating a low, and high score, a high Tolerance of Ambiguity,

215    alpha = 0.82.

216

217    ***Perfectionism***

218    Two dimensions of the Frost Multi-dimensional Perfectionism Scale (FMPS) [53, 56] were used;

219    Concern over Mistakes (8 items; maladaptive) is central to the concept of perfectionism and a

220    major component of other measures which tend toward psychological distress including

221    procrastination and fear of mistakes, and High Standards (5 items; adaptive) which reflects

222    positive and healthy striving toward goals. Each item was presented as a five point Likert scale

223    from 1= strongly disagree to 5=strongly agree. Items were summed to derive scores for the two

224    subscales, with higher scores indicative of higher levels of perfectionism. The alphas for each are

225    0.89 and 0.80 respectively.

226

227    **Analysis**

228    Independent samples t-tests were conducted, with eta ($\eta$) for assessing effect sizes, comparing

229    the means of the coping attributes (Tolerance of Ambiguity, perfectionism high standards and

230    concern over mistakes), by the two personality profiles. Generalized linear models were used to

231    examine the main effects of personality profile on the coping attributes after including age and

232    gender in the analysis. The coping attributes were the dependent variables in the models. In

233    addition, interaction terms between personality profile with age and gender were included to

234    examine if the association between profiles and the coping attributes differ by demographic

235    characteristics. All analyses were conducted using SPSS 24.

236

237    # Results

238    **Sample characteristics**

239  Descriptive statistics of the participants are presented in Table 1. Slightly over half were under

240  25 years of age, 54.3% were male. These proportions are not different to the cohorts from which

241  our sample was taken. Over half of the students fit into personality Profile 1 (59.8%).

242

243  The 25 or older age group had slightly higher level of Tolerance of ambiguity and perfectionism

244  high standards than the under 25 years group, though the effect sizes were very small (see Table

245  2).  Males had slightly higher levels of Tolerance of Ambiguity but lower levels of perfectionism

246  concern over mistakes than female, though the effect sizes were very small. There were no

247  significant differences by Year of medical school, therefore it was not included in further

248  analyses.

249

250  **Coping attributes by personality profiles**

251  Independent t-tests results showed that students with the Profile 1 had significantly higher levels

252  of Tolerance of Ambiguity (t=12.73, η=.58, p<.001), perfectionism high standards (t=6.02,

253  η=.21, p<.001), and lower levels of Perfectionism-Concern over Mistakes (t=-11.19, η=.37,

254  p<.001; see Figure 2).

255

256  Results from the generalized linear models showed that personality profiles remained

257  significantly associated with Tolerance of Ambiguity, Perfectionism-Concern over Mistakes, and

258  Perfectionism-High Standards, after taking into consideration the age and gender of the students

259  (see Table 3). A significant Profile by age interaction was found on Tolerance of Ambiguity. The

260  association between profile and Tolerance of Ambiguity was stronger in the older age group.

261  That is, the positive effects of having personality Profile 1 on higher levels of Tolerance of

262  Ambiguity was especially significant for the students aged 25 years or older (see Figure 3).

263

264

265  **Discussion**

266  This study examined Tolerance of Ambiguity, and Perfectionism and their association with

267  temperament and character personality profiles in a sample of medical students. We found that

268  students with the combination of traits identified in Profile 1 (characterized by low to average

269  levels of Harm Avoidance, and high to very high levels of Persistence, Self-Directedness and

270    Cooperativeness) had significantly higher levels of Tolerance of Ambiguity and lower levels of
271    Perfectionism-Concern over Mistakes compared to those in Profile 2 (characterized by average-
272    high levels of Harm Avoidance and high levels of Persistence, Self-Directedness and
273    Cooperativeness). We identified that students with the particular combinations of personality
274    traits fitting in Profile 2 are implied to be a risk of lower ability to cope in the medical setting. In
275    testing for moderation effects by age, our study highlighted that while Tolerance of ambiguity
276    may increase with age, it did not do so for students with personality Profile 2, for which
277    Tolerance of Ambiguity remained low across age.
278
279    The difference between the Profiles in Perfectionism-High Standards was slight with a small
280    effect size and suggests that medical students in general have high standards and strive for high
281    achievement. This concurs with Enns [40] who found medical students to be significantly higher
282    in levels of Perfectionism-High Standards compared to general arts students. Across the whole
283    sample, irrespective of Profile, older students and males had higher levels of Tolerance of
284    Ambiguity [42].
285
286    As noted in a previous study, [37] both personality profiles are similar in the trend of their trait
287    levels and it is primarily the levels of two temperament and one character trait that differentiates
288    them. Looking at the two temperament traits; Persistence (higher in Profile 1) is strongly
289    associated with perfectionism and can contribute to maladaptive characteristics [54]. This is
290    because of the persistent need for perfection and drive to attain unreasonable standards, self-
291    criticism, and self-doubt is defeatist [40]. These feelings may lead to maladaptive behaviours such
292    as procrastination or even cheating. However, despite higher levels of Persistence, compared to
293    Profile 2, Profile 1 students still showed lower levels of maladaptive perfectionism (Concern
294    over Mistakes). This effect may be explained by the lower levels of another temperament trait,
295    Harm Avoidance. Low Harm Avoidance enables confidence and optimism along with a degree
296    of comfort with uncertainty. Along with very high Self-Directedness, portrayed as being
297    conscientiousness and goal directed, these two traits act to temper the potential harm of very high
298    Persistence. Rather than a collection of separate parts, these three traits, (low Harm Avoidance
299    and high Self-Directedness and Persistence) demonstrate that multiple dimensions of personality

300    interact as components of a complex adaptive system [33, 54] to influence levels of perfectionism

301    [40] and ultimately through more effective coping and levels of resilience [32].

302

303    This same combination of temperament and character traits (Profile 1) strengthens our

304    understanding of ambiguity tolerance. To put it in the context of our study, the ubiquitous

305    ambiguity present in medicine, [39] implies a need for more consideration on how to address low

306    ambiguity tolerance and its possible association with stress, burnout, quality of patient care, [42, 43,

307    45] and not surprisingly an over concern for mistakes [48].

308

309    Our study design only allows us to suggest the utility of the knowing the associations we have

310    found in the data. Nevertheless, we posit that knowing you are low in Tolerance of Ambiguity,

311    or excessively concerned about mistakes may not be as helpful as understanding why you tend

312    towards those feelings and attitudes. As suggested by Epstein, [57] understanding one's own

313    personality helps build self-awareness, to recognise when stressors occur, and self-reflection on

314    how to react or self-monitor one's feelings and coping response. Our study was only cross-

315    sectional and exploratory. A longitudinal prospective design would be the only way to determine

316    if a better understanding of one's personality heightens self-awareness and better equips them to

317    perceive and deal with challenges and hardships. It would also enable us to further examine how

318    personality and coping interacts overtime as the students age and transition into medical practice.

319    Our data is fed back to students, both individually on request, and in aggregate to help stimulate

320    an interest in reflecting on how they personally cope (or not), with what they find challenging in

321    medical school. Further research will follow students' through medical school to examine

322    changes in personality profiles and measures of coping attributes over time.

323

324    There are limitations to this study which include the inherent bias in self-report data collection

325    and the cross-sectional design with one medical school, which may reduce generalisability of our

326    results. The majority of respondents were in their first year of medicine, and therefore their

327    limited exposure to medical training may have influenced their responses. However, there was

328    no differences in the age or gender distribution among responders across the four years or

329    differences in individual TCI trait levels. Certainly this study should be repeated with other

330    medical student cohorts to see if profile patterns are similar. The present data are cross-sectional

331    so they do not demonstrate causal relations or the ability to change personality. However, other

332    experimental research shows that it is possible to help a person grow in self-awareness and

333    thereby change in personality and improve well-being [33, 58, 59]. Strengths of the study include a

334    large sample of students and the use of well validated measures of our variables.

335

336

337    **Conclusions**

338    This research identified a particular combinations of personality traits associated with low

339    Tolerance of Ambiguity and high levels of maladaptive Perfectionism. These findings have

340    implications for well-being in the medical setting, as they reduce the coping ability of medical

341    students in this challenging profession. The psychobiological model of personality provides

342    insight into traits that are stable and those that are amenable to self-regulation through learning,

343    hence can be targeted in education and training settings. The interaction between biological

344    mechanisms and socio-cultural learning is relevant to a sample of medical students because it

345    accounts for interaction of the biological or innate aspects of their personal development within

346    an intense and competitive learning environment of medical school.

347    **References**

348

349    1. Firth-Cozens J. Doctors, their well-being, and stress. *BMJ 2003*; **326**:670-671.

350

351    2. Dyrbye L, Shanafelt, TD. Systematic review of depression, anxiety and other indicators of

352    psychologic distress among US and Canadian medical students. *Academic Medicine 2006;*

353    **81**(4):354-73.

354

355    3. Dyrbye LN, Harper W. Durning SJ, Moutier C, Thomas MR, Stanford Massie Jr F, Eacker A,

356    Power DV, Szydlo DW, Sloan JA, Shanafelt TD. Patterns of distress in US medical students.

357    *Medical Teacher 2011*; **33**:834-9.

358

359    4. Brazeau CMLR, Schroeder R, Rovi S, Boyd, L. Relationships Between Medical Student

360    Burnout, Empathy, and Professionalism Climate. *Academic Medicine 2010*; **85**(10 Supplement):

361    S33-S36.

362

363    5. McManus I, Keeling A, Paice E. Stress, burnout and doctors' attitudes to work are determined

364    by personality and learning style: A twelve-year longitudinal study of UK medical graduates.

365    *BMC Medical Education 2004*; 2(29). doi;10.1186/1741-7015-2-29.

366

367    6. Rogers ME, Creed PA, Searle J. Person and environmental factors associated with well-being

368    in medical students. *Personality and Individual Differences 2012*; **52**(4): 472-477.

369

370    7. Doherty EM, Nugent E. Personality factors and medical training: a review of the literature.

371    *Medical Education 20*11; **45**(2):132-40.

372

373    8. Hojat M, Erdman JB, J. Gonnella. Personality assessment and outcomes in medical education

374    and the practice of medicine: AMEE Guide No. 79. *Medical Teacher 2*013;DOI:

375    10.3109/0142159X.2013.785654:1-35.

376

377   9. Hojat M, Gonnella JS, Erdmann JB, Vogel WH. Medical students' cognitive appraisal of

378   stressful life events as related to personality, physical well-being, and academic performance: a

379   longitudinal study. *Personality and Individual Differences 2003*; **35**:219-235.

380

381   10. Haight S, Chibnall JT, Schindler DL. Associations of medical student personality and

382   health/wellness characteristics with their medical school performance across the curriculum.

383   *Academic Medicine 2012*; **87**(4):476-485.

384

385   11. Lievens F, Coetsier P, De Fruyt F, Maeseneer D. Medical students' personality characteristics

386   and academic performance: a five-factor model perspective. *Medical Education 2002*;

387   **36**(11):1050.

388

389   12. Ferguson E, James D, Madeley L. Factors associated with success in medical school:

390   systematic review of the literature. *BMJ 2002*;324.

391

392   13. McManus C, Powis D. Testing medical school selection tests. *Medical Journal of Australia*

393   *2007*; **186**(3):118-9.

394

395   14. Hodgson CS, Teherani A, Gough HG, Bradley P, Papadakis MA. The Relationship between

396   Measures of Unprofessional Behaviour during Medical School and Indices on the California

397   Psychological Inventory. *Academic Medicine 2007*; **82**(10):S4-S7.

398

399   15. Ferguson E, James D, O'Hehir F, Sanders A. Pilot study of the roles of personality,

400   references and personal statements in relation to performance over the five years of a medical

401   degree. *BMJ 2*003; **326**:429-432.

402

403   16. Hojat M, Callahan C, Gonnella JS. Students' personality and ratings of clinical competence

404   in medical school clerkships: a longitudinal study. *Psychological Health & Medicine 2004*;

405   **9**:247-252.

406

407    17. Hojat M, Axelrod D, Spandorfer J, Mangione S. Enhancing and sustaining empathy in

408    medical students. *Medical Teacher 2013*; **35**:996-1001.

409

410    18. Hojat M, Mann D, Massello D, Calabrese LH. Overlap between empathy, teamwork and

411    integrative approach to patient care. *Medical Teacher 2014*; Early Online:1-4. doi:

412    10.3109/0142159X.2014.

413

414    19. Diener E, Lucas RE. Personality and subjective well-being. In D. Kahnemann, E. Diener, &

415    N. Schwarz (Eds.), 1999. The foundations of hedonic psychology. 213–229. New York: Russell

416    Sage.

417

418    20. Haslam N, Whelan J, Bastian B. Big five traits mediate associations between values and

419    subjective well-being. *Personality and Individual Differences 2009*; **46**:40-2.

420

421    21. Horsburgh VA, Schermer JA, Veselka L, P. V. A behavioural genetic study of mental

422    toughness and personality. *Personality and Individual Differences 20*09; **46**:100-5.

423

424    22. Borges NJ, Osmon WR. Personality and medical specialty choice: technique orientation

425    versus people orientation. *Journal of Vocational Behaviour 2001*; **58**(1):22-35.

426

427    23. Hojat, M. Zuckerman M. Personality and specialty interest in medical students. *Medical*

428    *Teacher 2008*; **30**(4):400 - 406.

429

430    24. Duffy RD, Borges N, Harthung P. Personality, Vocational Interests, and Work Values of

431    Medical Students. *Journal of Career Assessment 2009*; **17**:189.

432

433    25. Costa PT, McCrae RR. Revised NEO Personality Inventory (NEO-PI-R) and NEO Five

434    Factor Inventory (NEO-FFI) Professional Manual. 1992; Odessa, Florida: Psychological

435    Assessment Resources.

436

437 26. Tyssen RD, Rovik FC, Thorkildsen JO, Ekeberg RT, Hem O, Gude T, Gronbold NT,

438 Baglum, P. Personality traits and types predict medical school stress: a six year longitudinal and

439 nationwide study. *Medical Education 2007*; **4**:781-787.

440

441 27. Knights JA, Kennedy BJ. Medical school selection: impact of dysfunctional tendencies on

442 academic performance. *Medical Education. 2007*; **41**(4):362-368.

443

444 28. Cloninger CR, Svrakic DM, Pryzbeck TR. A psychobiological model of temperament and

445 character. *Archives of General Psychiatry 1993*; **50**:975-990.

446

447 29. Cloninger CR, Svrakic DM, Wetzel RD. The temperament and character inventory: A guide

448 to its development and use. 1994; St Louis, Missouri: Center for Psychobiology of Personality,

449 Washington University in St Louis.

450

451 30. Tanaka K, Mizuno K, Fukuda s, Tajima S, Watanabe Y. Personality traits associated with

452 intrinsic academic motivation in medical students. *Medical Education 2009*; **43**:384-7.

453

454 31. Jiang N, Sato T, Hara T, Takedomi Y, Ozaki I, Yamada S. Correlations between trait anxiety,

455 personality and fatigue: Study based on the Temperament and Character Inventory. *Journal of*

456 *Psychosomatic Research 2003*; **55**(6):493-500. doi: Doi: 10.1016/s0022-3999(03)00021-7.

457

458 32. Eley DS, Cloninger CR, Walters L, Laurence C, Synnott R. Wilkinson, D. The relationship

459 between resilience and personality traits in doctors: implications for enhancing well-being.

460 *PeerJ. 2013*; **1**(e216):1-16. doi: DOI 10.7717/peerj.216.

461

462 33. Cloninger CR, Zohar AH. Personality and the perception of health and happiness. *Journal of*

463 *Affective Disorders. 2011*; **128**(1-2):131-134.

464

465 34. Cloninger CR, Salloum IM, Mezzich JE. The dynamic origins of positive health and well-

466 being. *The International Journal of Person Centred Medicine 2012; 2*(1):1-9.

467

468   35. Sievert M, Zwir I, Cloninger KM, Lester N, Rozsa S, Cloninger CR. The influence of

469   temperament and character profiles on specialty choice and well-being in medical residents.

470   *PeerJ. 2016*; **4**:e2319;DOI 10.7717/peerj.2319.

471

472   36. Grucza RA, Goldberg LR. The comparative validity of 11 modern personality inventories:

473   predictions of behavioral acts, informant reports, and clinical indicators. *Journal of Personality*

474   *Assessment 2007*; **89**(2):167-87.

475

476   37. Eley DS, Leung J, Hong B, Cloninger K, Cloninger CR. Identifying the Dominant

477   Personality Profiles in Medical Students: Implications for Their Well-Being and Resilience.

478   *PLoS ONE. 2016*; **11**(8): e0160028. doi:10.1371/journal.pone.0160028

479

480   38. Howe A, Smajdor A, Stockl A. Towards an understanding of resilience and its relevance to

481   medical training. *Medical Education 2005*; **46**:349-356.

482

483   39. Geller G. Tolerance for ambiguity: an ethics-based criterion for medical student selection.

484   *Academic Medicine 2013*; **88**: 581-584.

485

486   40. Enns MW, Cox BJ, Sareen J, Freeman Adaptive and maladaptive perfectionism in medical

487   students: a longitudinal investigation. *Medical Education 2001*; **35**:1034 1042.

488

489   41. Budner S. InTolerance of Ambiguity as a personality variable. *Journal of Personality1962*;

490   **30**:29-50

491

492   42. Caulfield M, Andolsek K, Grbic D, Roskovensky L. Ambiguity tolerance of students

493   matriculating to U.S. medical schools. *Academic Medicine 2014*; **89**(11):1526-1532.

494

495   43. Cooke GP, Doust JA, Steele MC. A survey of resilience, burnout, and tolerance of

496   uncertainty in Australian general practice registrars. *BMC Med Education 2013*; **13**: 2.

497

498    44. Sherrill WW. Tolerance of ambiguity among MD/MBA students: Implications for

499    management potential. *Journal of Continuing Education for Health Professions 2001*; **21**:1117-

500    1122.

501

502    45. Wayne S, Dellmore D, Serna L, Jerabek R, Timm C, Kalishman S. The association between

503    inTolerance of Ambiguity and decline in medical students' attitudes towards the underserved.

504    *Academic Medicine 2011*; **86**:877-882.

505

506    46. Bachman K, Freeborn DK. HMO physicians' use of referrals. *Social Science in Medicine*

507    *1999*; **48**(4):547-557.

508

509    47. Kuhn G, Goldberg R, Compton S. Tolerance for uncertainty, burnout, and satisfaction with

510    the career of emergency medicine. *Annals of Emergency Medicine 2009*; **54**:106-113.e106.

511

512    48. West C, Tan AD, Habermann TM, Sloan, JA, Shanafelt, TD. Association of resident fatigue

513    and distress with perceived medical errors. *JAMA 2009*; **302**(12): 1294-1300.

514

515    49. Schneider AWM, Linde K, Buhner M. Communicating and dealing with uncertainty in

516    general practice: The association with neuroticism. *PLoS ONE 2014*; **9**;7 e102780):1-7.

517

518    50. Feinmann J. Disruptive doctors are often found to be perfectionists. *BMJ 2011*; **342**: (d876).

519

520    51. Peters M, King K. Perfectionism in doctors. *BMJ 2012*; **3** 34:(e1674).

521

522    52. Flett G, Hewitt PL. Perfectionism: theory, research and treatment. *American Psychological*

523    *Association. 2002*; **464**.

524

525    53. Frost R, Marten P, Lahart C, Rosenblate R. The dimensions of perfectionism. *Cognitive*

526    *Therapy & Research 1990*; **14**:449-468.

527

528    54. Cloninger C., Zohar AH, Hirschmann S, Dahan D. The psychological costs and benefits of

529    being highly persistent: Personality profiles distinguish mood disorders from anxiety disorders.

530    *Journal of Affective Disorders 2012*; **136**:758-766.

531

532    55. Mclain DI. Evidence of the properties of an ambiguity tolerance measure: the Multiple

533    Stimulus Types Ambiguity Tolerance Scale-II (MSTAT-II). *Psychological Reports 2009*; **105**; 3:

534    975-988. doi: 10.2466/pr0.105.3.975-988

535

536    56. Stallman HM. The factor structure of the Frost Multidimensional Perfectionism Scale in

537    University Students. *Australian Psychologist 2011*; **1**-8. doi: 10:1111/j.1742-9544.2010.00010.x.

538

539    57. Epstein RM, Krasner, MD. Physician Resilience: What It Means, Why It Matters, and How

540    to Promote It. *Academic Medicine 2013*; **88**(3): 301-303.

541

542    58. Krasner MS, Epstein RM, Beckman H, Suchman AL, Chapman B, Mooney CJ, Quill TE.

543    Association of an educational program in mindful communication with burnout, empathy, and

544    attitudes among primary care physicians. *JAMA 2009*; **302**(12):1284-1293.

545

546    59. Campanella FC, Crescentini C, Urgesi. Fabbro F. Mindfulness-oriented meditation improves

547    self-related character scales in healthy individuals. *Comprehensive Psychiatry 2014*; **55**(5):1269-

548    1278.

549

Table 1: Descriptive statistics of the whole sample (N = 808)

1       **Table 1:**

3       **Descriptive statistics of the whole sample (N = 808).**

|  | **n** | **%** |
|---|---|---|
| **Age** |  |  |
|     Under 25 years | 443 | 54.8 |
|     25 or older | 349 | 43.2 |
| **Gender** |  |  |
|     Male | 439 | 54.3 |
|     Female | 368 | 45.5 |
| **Year medical school** |  |  |
|     Year 1 | 599 | 74.1 |
|     Year 2 | 75 | 9.3 |
|     Year 3 | 67 | 8.3 |
|     Year 4 | 66 | 8.2 |
| **TCI personality profile†** |  |  |
|     Profile 1 | 483 | 59.8 |
|     Profile 2 | 325 | 40.2 |
| **Coping mechanisms** | **Mean** | **SD** |
|     Tolerance of Ambiguity | 43.55 | 7.58 |
|     Maladaptive perfectionism (concern over mistakes) | 20.63 | 6.14 |
|     Adaptive perfectionism (high standards) | 18.46 | 3.84 |
| †Profile 1 was characterized by low to average levels of Harm Avoidance, and high to very high levels of Persistence, Self-Directedness and Cooperativeness. Profile 2 was characterized by average-high levels of Harm Avoidance and high levels of Persistence, Self-Directedness and Cooperativeness | | |

Table 2: Table of independent t-tests results of Tolerance of ambiguity and Perfectionism by age, gender and year of study (N=808).

2  **Table 2**

3  **Table of independent t-tests results of Tolerance of ambiguity and Perfectionism by age,**

4  **gender and year of study (N=808).**

| | Tolerance of Ambiguity | | Perfectionism - Concern over mistakes | | Perfectionism - High Standards | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD |
| **Age** | | | | | | |
| Under 25 years | 42.85 | 7.14 | 20.50 | 6.02 | 18.14 | 3.93 |
| 25 or older | 44.42 | 8.09 | 20.78 | 6.36 | 18.93 | 3.67 |
| | t=2.90, p=0.004 eta-sq=0.01 | | t=0.63, p=0.530 eta-sq=0.00 | | t=2.89, p=0.004 eta-sq=0.01 | |
| **Gender** | | | | | | |
| Male | 44.23 | 7.40 | 20.08 | 6.01 | 18.26 | 3.90 |
| Female | 42.74 | 7.73 | 21.28 | 6.25 | 18.71 | 3.77 |
| | t=2.78, p=0.006 eta-sq=0.01 | | t=2.77, p=0.006 eta-sq=0.01 | | t=1.64, p=0.101 eta-sq=0.00 | |
| **Year medical school** | | | | | | |
| Year 1 | 43.82 | 7.64 | 20.38 | 5.92 | 18.54 | 3.93 |
| Year 2 | 43.67 | 7.35 | 21.10 | 6.96 | 18.04 | 3.36 |
| Year 3 | 42.04 | 7.15 | 20.81 | 5.92 | 18.43 | 3.84 |
| Year 4 | 42.14 | 7.25 | 22.23 | 7.24 | 18.29 | 3.62 |
| | t=1.39, p=0.123 eta-sq=0.01 | | t=1.41, p=0.114 eta-sq=0.01 | | t=0.66, p=0.729 eta-sq=0.00 | |

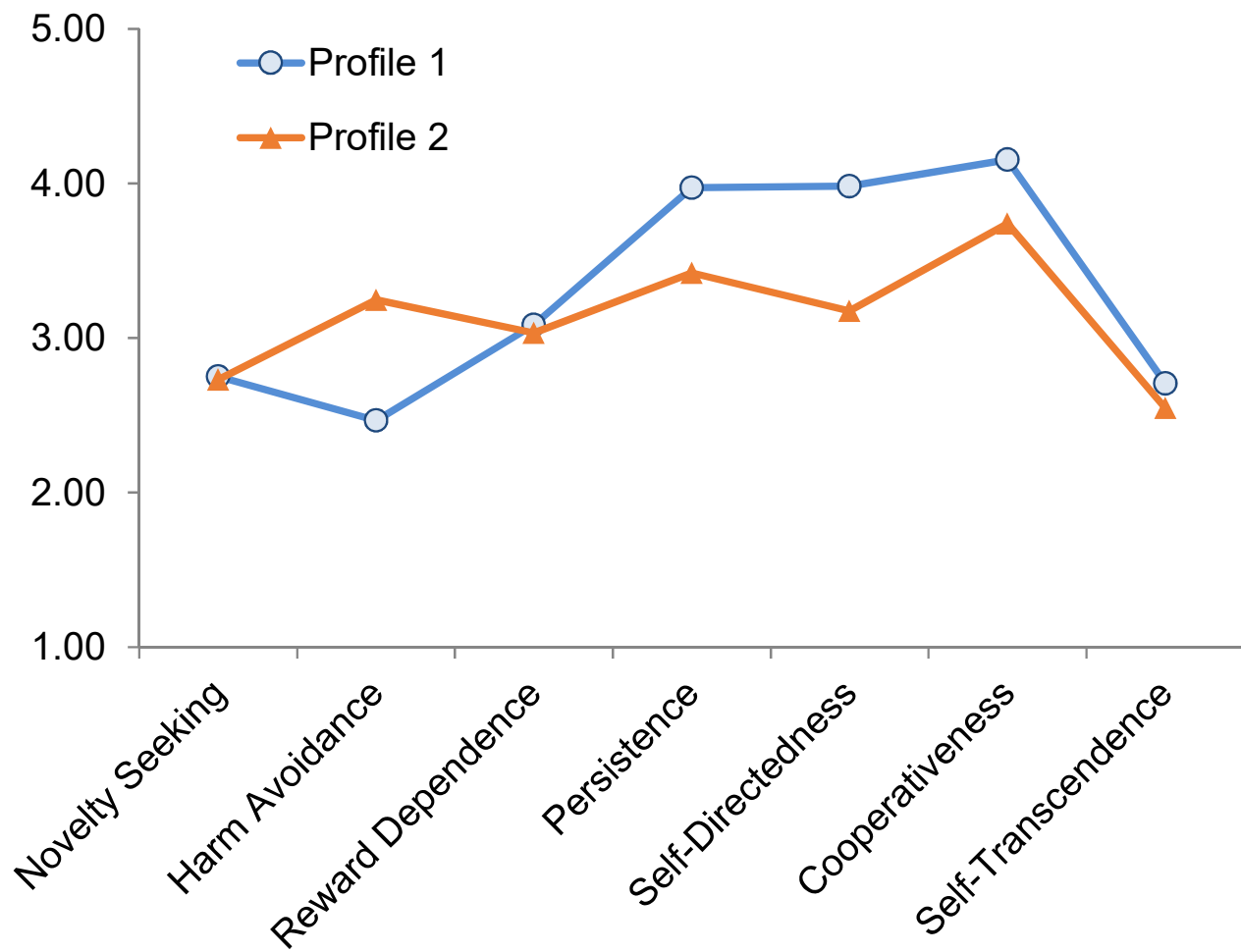
Table 3: Generalized linear models with the main effects of personality profiles† and its interaction with age and gender on tolerance of ambiguity and perfectionism

**Table 3**

**Generalized linear models with the main effects of personality profiles† and its interaction with age and gender on tolerance of ambiguity and perfectionism**

|  | B | SE | p |
|---|---|---|---|
| **Model 1: Tolerance of ambiguity** | | | |
| Personality profile | 7.42 | 0.96 | <0.001 |
| Age | -0.21 | 0.78 | 0.789 |
| Gender | 1.26 | 0.77 | 0.103 |
| Personality profile x Age interaction | -2.33 | 1.00 | 0.020 |
| Personality profile x Gender interaction | 0.58 | 1.00 | 0.564 |
| **Model 2: Maladaptive perfectionism (concern over mistakes)** | | | |
| Personality profile | -5.11 | 0.80 | <0.001 |
| Age | 1.24 | 0.65 | 0.056 |
| Gender | -1.18 | 0.64 | 0.068 |
| Personality profile x Age interaction | 1.12 | 0.84 | 0.182 |
| Personality profile x Gender interaction | -0.34 | 0.83 | 0.681 |
| **Model 3: Adaptive perfectionism (high standards)** | | | |
| Personality profile | 1.10 | 0.52 | 0.035 |
| Age | 1.28 | 0.43 | 0.003 |
| Gender | -0.36 | 0.42 | 0.393 |
| Personality profile x Age interaction | 0.90 | 0.55 | 0.099 |
| Personality profile x Gender interaction | -0.11 | 0.54 | 0.845 |

*Note.* Reference groups in the models were personality profile 2, under 25 years age group, and female gender.
†Profile 1 was characterized by low to average levels of Harm Avoidance, and high to very high levels of Persistence, Self-Directedness and Cooperativeness. Profile 2 was characterized by average-high levels of Harm Avoidance and high levels of Persistence, Self-Directedness and Cooperativeness

Figure 1 - The two personality profiles classified based on the seven TCI subscales (N = 808)

Levels of ambiguity tolerance and perfectionism by the two personality profiles (N = 808)

Students with the Profile 1 had significantly higher levels of Tolerance of Ambiguity (t=12.73, η=.58, p<.001), Perfectionism-High Standards (t=6.02, <!--[if !supportLists]-->250 <!--[endif]-->η=.21, p<.001), and lower levels of Perfectionism-Concern over Mistakes (t=-11.19, η=.37, p<.001).

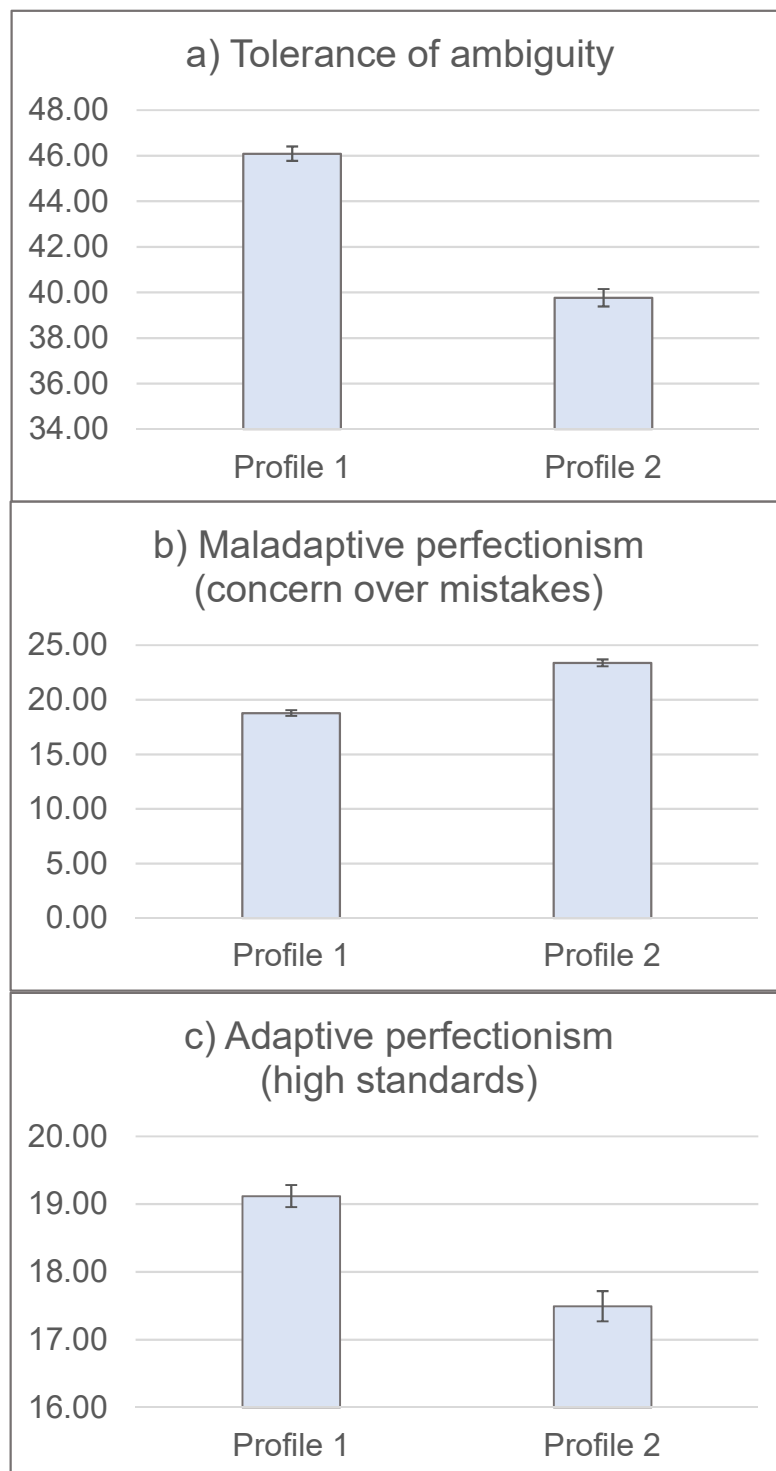



Figure 3 - Interaction effects of personality profile and age on tolerance of ambiguity