

# **The Influence of Background and External Exposures on Non-Cognitive Traits in Doctor of Physical Therapy Applicants: An Expanded Review of the Literature**

**By Conor J. McClure**

## **Non-Cognitive Traits: Definitions, History, and Overview**

Non-cognitive traits refer to a variety of skills and aspects of one's personality including emotional intelligence (EI), psychological flexibility, motivations, and goals.<sup>1</sup> These traits are often synonymously referred to as non-cognitive skills, personality traits, or soft skills in the literature and in colloquial speech. An abundance of existing research seeks to correlate various cognitive measures, such as IQ and grade point average (GPA), to academic and occupational success, with ambiguous results and questionable validity.<sup>2</sup> Some researchers have suggested that non-cognitive traits might play an additional mediating role in predicting academic and occupational success, although the large variability of measurement tools often makes objectively measuring these traits difficult.<sup>2</sup>

Non-cognitive traits, by their very definition, refer to aspects of one's personality not measurable by existing cognitive metrics. Attempts to correlate existing cognitive measures, such as IQ, to personality traits have been largely ineffective, leading psychology researchers to develop independent tools which attempt to measure more narrowly defined aspects of personality.<sup>3-5</sup> The most well-known and well-validated instrument in this domain is the Big Five model, which measures five personality dimensions including extraversion, emotional stability, agreeableness, conscientiousness, and openness to experience.<sup>6</sup> Many of these five personality

dimensions were correlated with academic performance in meta-analyses conducted by Richardson et al<sup>7</sup> and Poropat<sup>8</sup>, while Barrick and Mount<sup>9</sup> identified correlations with occupational performance.

Additional research has identified some relationships between various non-cognitive traits and success in graduate school and medical school. Academic success has been defined by GPA, exam pass rates, graduate rate, and other metrics, and these varying definitions might explain the heterogeneity in the outcomes of some systematic reviews.<sup>10</sup> EI has been correlated with some aspects of academic success in medical students, such as continuous assessment and examination performance, though this same review found no significant relationship with admission rates.<sup>10</sup> In nursing students, EI is significantly associated with many positive behaviors and personality traits, including perception of stress and professional competency, though varying associations have been found with GPA, with some researchers finding strong positive correlations and others failing to reach statistical significance.<sup>11-14</sup> Additional evidence can be found in small, positive correlations between EI and exam performance in first and fifth year medical students,<sup>15,16</sup> although neither Carr<sup>17</sup>, nor Newsome et al<sup>17,18</sup> were able to find a significant association between EI and GPA in similar cohorts.

Wilmot and Ones<sup>19</sup> identify conscientiousness as the “most potent noncognitive construct for occupational performance” and observe that the effect size of conscientiousness on occupational variables is moderated by occupational complexity. Interestingly, the authors identified the strongest effect size with the narrowest credibility interval in the health care field. Richardson et al<sup>7</sup> found strong correlations between conscientiousness and academic performance independent of cognitive intelligence measures, and Poropat<sup>8</sup> came to similar

conclusions. In a 2007 review on procrastination as a personality trait, Steel<sup>20</sup> suggests that low measures of conscientiousness are associated with high procrastination, low motivation, and poor self-regulatory capabilities. Additional research on the influence of personality traits and occupational performance is limited.

### **The Influence of Environment versus Genetics and Heritability on Non-Cognitive Traits**

The relative contributions of genetics and environmental factors in the development of non-cognitive traits remains hotly debated, as most research on genetic influence has focused on cognitive traits.<sup>21</sup> Traditional measures of cognitive intelligence appears to largely heritable and genetically influenced, though it remains largely malleable throughout the lifespan.<sup>22</sup> Personality traits appear to be largely influenced by genetic influences as well, though the exact contribution of this is yet to be determined.<sup>23</sup> Advances in genomic and psychological research has revealed more nuanced to once was traditionally viewed as a stark dichotomy. Large studies on siblings, twins, and adoptees perhaps best answer this question. Research on siblings has found larger variation in non-cognitive traits compared to cognitive traits, implying a smaller genetic contribution to personality traits.<sup>24</sup> Additional research comparing like-sex twins and adopted siblings and their families found that both genetic and environmental influences contributed to differences in future college attainment, though the authors were unable to identify additional background or environmental influences that could explain this.<sup>25</sup> This cohort revealed significant heritability correlations in some non-cognitive traits. For example, academic effort and academic problems had .82 and .81 correlations respectively in monozygotic twins, with only .12 and .00 correlations in adopted siblings. Environmental

influences, on the other hand, appeared to strongly influence traits such as aggression, alienation, control, and externalizing.<sup>25</sup> Environmental influences appear to influence personality development to varying degrees depending on one's age and the significance of the influence itself; in some studies, small and innocuous environmental factors seem to play a large role, whereas in others, familial and parental influences or large-scale life-changing events play a more significant role. The sum of the literature on this topic suggests relatively equal contributions of genetics and environmental factors. Therefore, it is perhaps best to examine the influence of background, individual characteristics, and external exposures through three separate lenses: non-modifiable personal characteristics, modifiable personal characteristics, and specific environmental characteristics.

### **Association of Individual Characteristics to Non-Cognitive Traits**

#### **Age**

As much of the existing literature on non-cognitive traits is cross-sectional, it is not entirely clear how non-cognitive traits change or evolve over time as one ages.<sup>26</sup> Consistency between non-cognitive measurements is higher when measures are obtained closer in time, although consistency across measures is relatively weak over time. This suggests high measurement error or appreciable variability in non-cognitive traits as we age. Recent longitudinal data have shown steady and consistent increases in non-cognitive skills from adolescence into adulthood.<sup>27</sup> These findings suggest a positive correlation between age and non-cognitive traits.

In medical students and healthcare professionals, EI has been positively correlated with age. Ravikumar et al<sup>28</sup> identified a weak positive correlation ( $r = 0.187$ ) that was statistically significant ( $p = 0.008$ ) in a study of 200 postgraduate medical students as measured with the Schutte Self Report Emotional Intelligence Test. Faye et al<sup>29</sup> found similar results in a study of 150 postgraduate medical students, identifying significantly better scores in self-control ( $p = 0.04$ ) and empathy ( $p = 0.03$ ) in older subjects. Several authors have observed improvements in emotional flexibility and adaptive strategy usage in older adults when compared to their younger counterparts.<sup>30</sup> One study has examined the relationship between age and intolerance of uncertainty, as measured by the scale of the same name, where a small but significant association was determined.<sup>31</sup> Another study found age to be an independent predictor of the same trait in physicians and surgeons, measured using the Intolerance of Ambiguity scale.<sup>32</sup>

### **Prior Applicant to DPT Program**

Grbic et al<sup>33</sup> examined factors associated with repeat applicant status to medical schools and found three primary influences, none of which directly related to non-cognitive measurements. These include the applicant's age, in which those over the age of 23 were significantly less likely to apply; the applicant's accumulated educational debt, in which those with greater than \$20,000 in loan debt were less likely to reapply; and applicants with an alternative career path consideration in a separate field of study were less likely to reapply. It can be inferred that medical school applicants who do not have a "plan B" enjoy studying medicine more than their counterparts. Wijekoon et al<sup>34</sup> found a significant association between EI and medical undergraduate students who reported enjoying studying medicine ( $p =$

0.007). Higher EI is also found in those who report satisfaction with facilities available for learning, which might play a role in reapplication status. Additional literature directly examining the role of non-cognitive traits on the likelihood to reapply to graduate school programs is extremely limited.

### **Low High School Graduation Rate**

A 2018 study of 207 medical students who graduated from government schools had significantly higher EI scores compared to peers who graduated from private schools<sup>35</sup> although detailed information regarding graduation rates was not available. These authors note that students who graduate from high schools in rural areas tend to express higher scores of adaptability, improved teamwork skills, and more emotional maturity, crediting this to differences in collective versus individualistic attitudes, which relates directly to social intelligence measured in our non-cognitive tool.

The effects of non-cognitive traits on dropout rates appear conflicting. Students admitted to medical school based on non-cognitive admissions procedures tend to drop out at a higher rate than peers admitted based on cognitive traits alone.<sup>36</sup> Students admitted to medical students from waiting lists are significantly more likely to drop out than students admitted directly, and this is thought to be caused by lower comparative high school academic performance and extended delay between graduation of secondary schools and initiation of medical education.<sup>37</sup> However, in this same cohort, predictors of future success include a more ambitious personality and higher scores of conscientiousness.<sup>38</sup> This is in line with previously-cited research associating conscientiousness with motivation, procrastination, and grit.<sup>20,39</sup>

Additional research has associated conscientiousness and grit with retention rates in high school, college, military, and occupational environments.<sup>40–42</sup>

### **Undergraduate Ranking**

In our cohort, an applicant's undergraduate school ranking, as stratified by the US News and World Report rankings, was significantly associated with the student's baseline engagement score (0.20,  $p < 0.05$ ). The engagement domain combines measurements of empathy and psychological flexibility.

The validity of third-party college ranking has been hotly debated by many authors.<sup>43,44</sup> What exactly these ratings precisely measure remains ambiguous and varies between programs and areas of focus. For example, schools of pharmacy rankings appear to be primarily associated with scholastic productivity, age of institution, and association with a hospital or health center.<sup>45</sup> Tsugaawa et al<sup>46</sup> found no relationship between a physician's school ranking and future patient mortality or readmission rate. However, nurses who graduated from top-ranked US News and World Report programs had a significantly higher occupational productivity (OR = 3.18,  $p < 0.001$ ) compared to their peers from lower-ranked schools.<sup>46</sup> In this study, occupational productivity was a measurement of the nurse's overall contribution to their patient's individual clinical condition.

Previously-cited research identified associations between the rurality of school location and non-cognitive adaptability scores in graduates<sup>35</sup> though there does not appear to be a notable association between rurality and school ranking.<sup>47</sup> Longitudinal studies have observed variation and development of some personality traits and relative stability of others during

college, leading to ambiguous conclusions as to whether non-cognitive traits are affected in college.<sup>48</sup> The question, then, is whether engagement-related domains are strengthened by high-ranking colleges, or if those colleges select for those traits.

Research directly examining this question is unfortunately limited. Some unique insights can be drawn from a 2000 study from Carrothers et al,<sup>50</sup> who assessed EI, compassion, and sociability using a proprietary instrument. Among other findings, the authors found the highest EI in applicants whose undergraduate universities had strong arts, social science, and humanities programs. Furthermore, admissions criteria were similar between colleges included in this study, leading one to conclude that selection criteria were not dominant factors in selecting for EI. Similar findings were seen by Wijekoon et al,<sup>34</sup> where high EI scores were seen in those who participated in arts, music, literature, and other “aesthetic” activities in their undergraduate schooling. Unfortunately, there does not appear to be a notable relationship between a school’s ranking and its relative emphasis on the arts or associated aesthetic activities.

### **Military Experience**

Both cognitive and non-cognitive traits have been used to predict success in military academy students, with cognitive ability predicting grades and non-cognitive traits better predicting long-term achievement, including completion of training and graduation rate.<sup>49</sup> Most research on military-related non-cognitive traits has focused on grit, which has been discussed at length in previous sections of this review. Non-cognitive traits including grit, hardiness, and resilience appear numerous times in the literature surrounding the selection and training of



competence military personnel.<sup>50–52</sup> Eskreis-Winkler et al<sup>40</sup> assessed retention in Army Special Operations Forces soldiers and identified grit, defined as passion and perseverance towards long-term goals and measured using the eight-item Short Grit Scale, as an independent predictor of completion of military-specific tasks.

However, grit, as defined in the intuitiveness domain of our tool, showed only weak (0.09) and non-significant associations with military experience. Much less literature exists exploring the role of adaptability in military experience, although Haufler et al<sup>55</sup> recently developed the Soldier Performance and Effective, Adaptable Response (SPEAR) task to specifically measure adaptive problem-solving behavior in military settings. Other authors have examined adaptability in the military as it relates to coping strategies and social support systems.<sup>53</sup> Associations were found in military trainees with stronger support systems from external (familial) sources, from their instructors, and from their peers.

### **Extreme Non-Cognitive Traits and Extreme Response Style**

The survey instrument used to assess non-cognitive domains in DPT applicants was designed and presented as a Likert-type scale. Answer choices were assigned values between 1 and 5 or occasionally 1 and 6, often accompanied with descriptions such as “Strongly Disagree”, “Disagree”, “Neutral”, “Agree”, and “Strongly Agree”. Responses were assessed in an ordinal, linear manner. Proper and improper use of Likert-type scales have long been documented and discussed. Notably, it has been observed that extreme Likert responses (e.g., “Strongly Agree” or “Not at all characteristic of me”) tend to be used less than central choices.<sup>54</sup>

The top 15% and bottom 15% of applicants were determined to be representative of extreme non-cognitive domains. That is, these applicants were willing to consistently choose extreme responses in the survey, a pattern previously determined to be relatively rare. Additional significant associations between non-cognitive domains and additional background characteristics were found in this population that were not seen in the baseline sample population.

Psychological literature often refers to the tendency to select extreme responses in Likert-type surveys as extreme response style (ERS).<sup>55</sup> Furthermore, psychologist John Hurley has proposed that excessive timidity often results in a mild response style, i.e. the tendency to avoid extreme responses and instead select middle choices.<sup>56</sup> Respondents' tendencies towards ERS or mild response style have been explored through survey design influences, such as the inclusion of a sixth response item, and therefore no definite middle response category, as opposed to a traditional five-category design, with similarities and differences both observed between the two designs.<sup>57</sup>

Non-cognitive traits have also been found to influence one's likelihood to exhibit an extreme response style. As previously mentioned, timidity is implicated in one's willingness to select extreme responses. Additional predictors of extreme response style include simplistic thinking patterns and low tolerance of ambiguity.<sup>55</sup> The relationship between intolerance of ambiguity and extreme response style is particularly interesting, as the inclusion of the Intolerance of Uncertainty Scale in our latent Adaptability domain would suggest strong correlations here. Surprisingly, this does not appear to be the case; the majority of strong and

significant associations with extreme response styles were found in the Intuitiveness domain, which includes traits such as EI and empathy.

While research has established that extreme response style is relatively rare in the general population, it is not yet clear if this is a desirable or undesirable trait. It is known that one's tendency towards or away from extreme response style can be influenced by a variety of factors, including the design and phrasing of survey items and the amount of options in a Likert scale, as well as certain aspects of one's personality. There is undoubtedly an opportunity for future exploratory research in this area. For the purposes of our study, no strong conclusions can be drawn about the significance of extreme non-cognitive domain correlations.

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