Entrance Exam Research:

I. Entrance Exam Prediction on Paramedic Student Performance

II. Affective Domain Matters: Personality Traits of Paramedic Students and Their Effect on Cognitive performance

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I. Entrance Exam Prediction on Paramedic Student Performance

Introduction

Paramedic education can be costly and time consuming. Previous allied health entrance screening tools have been shown to have little predictive value to overall paramedic student success. Employers, students and educators could benefit from accurate pre-paramedic program assessment tools to guide admission and remediation of key abilities.

Hypothesis

Paramedic entrance exams scores can positively predict performance during key unit exams.

Methodology

Paramedic programs using Fisdap, a national online testing cooperative community that measures paramedic student progress and summative competency, administered a new Fisdap Entrance Exam (EE) to new paramedic students at the beginning of their courses. The EE is designed to measure cognitive ability (CA) with breakdowns in Math, Reading, Inference/Analysis, Anatomy, Physiology, and EMT level critical thinking. The EE also measures personality traits associated with highly reliable employees.

The Fisdap Entrance Exam (EE; n=861), Airway Exam (AE; n=937), and Cardiology Exam (CE; n=821) were fit to the Rasch model (Rasch, 1960) to obtain latent trait score estimates (logits) for each of the examinees. The Rasch model estimates the probability of a correct response given the test question difficulty and the latent ability of the examinee.

The ability of a person is described as latent because it is not directly observed. To determine the reproducibility of scores, coefficient alpha was estimated for each of the three scales. George and Mallery (2003) provide the following rules of thumb; .9 = excellent; .8 = good; .7 = acceptable; .6 = questionable; >.5 poor; and <.5 = unacceptable. The alpha coefficients were .86, .88, and .90 for the Airway, Cardiology, and Entrance Exams, respectively. While this statistic provides a measure of the consistency of scores, it does not wholly represent the validity of a measure. Additional validity measures were examined and evaluated for each of the measures, including: content validity; criterion-related validity; and construct validity.

A correlational analysis of the true scores was then completed across examinees between the EE, and the two AE and CE subject tests.

Results

A total of 125 examinees completed both the EE and the AE, and 144 examinees completed both the EE and the CE. The correlations between the EE and the subjects tests were strong-to-very strong, and statistically significant (AE: r=.59; CE: r=.63, p<.001).

Table 1 displays scatterplot of the Airway logit scores and the Entrance Exam logit scores, and shows the positive linear relationship between the variables.

Table 2 displays a scatterplot of the Cardiology logit scores and the Entrance exam logit scores, and shows a positive linear relationship between the two variables.

Table 1. Scatterplot of latent Airway trait scores and latent Entrance Exam trait scores.

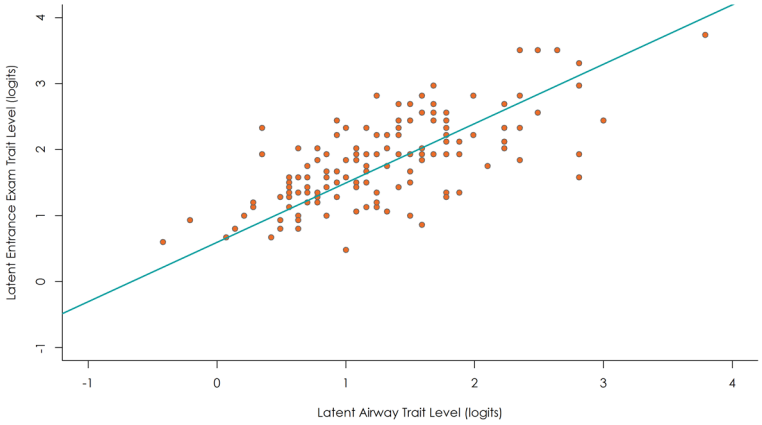
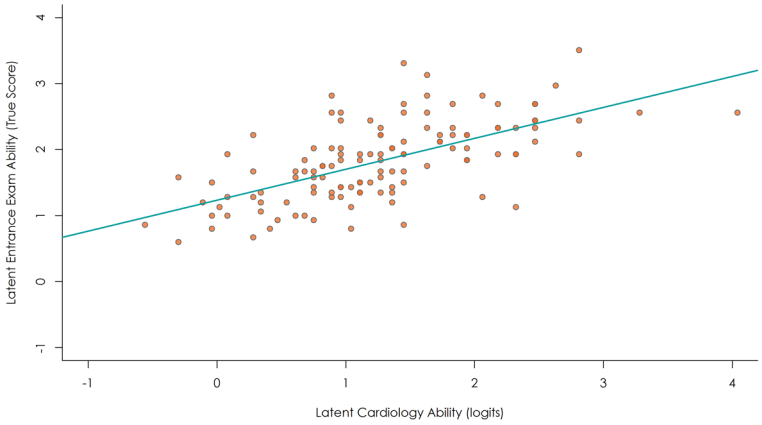


Table 2. Scatterplot of latent Cardiology trait scores and latent Entrance Exam trait scores.



Conclusion

The Fisdap Entrance Exam shows a strong association with the cardiology and airway unit exams. More research is needed to determine the practical value and accuracy of the EE in predicting overall success.

Unit Exams

The EE comes from the same test authors who have had high rates of success in unit and terminal content exams. In collaboration with these educators, Fisdap offers challenging computer based exams that mimic the National Registry cognitive exam after each unit of your curriculum. The exams expose your students to critical thinking questions early and often during their classroom training. Unit exams cover such topics as airway, medical, operations, cardiology, OB/pediatrics, and trauma.

Due to the timing of this abstract, results for only two unit exams were available in the system. Additional plans are underway to evaluate the results of the terminal exam.

Test Creation and Pilot

The Entrance Exam (EE) was created in response to EMS educators' desire for an EMS-specific entrance examination for prospective paramedic students. Existing admittance exams, such as the allied health entrance exam, were not very predictive of paramedic student readiness.

In October of 2011, a group of veteran EMS educators came together to begin creating the exam. The team included Tim Reitz (Conemaugh School of EMS), Ron Lawler and Sherm Syverson (F-M Ambulance), Todd Cage (Mayo Medical Transport), David Page (Inver Hills Community College), Gabe Romero, and Mike Bowen (Fisdap). They discussed the areas of weakness that they saw in their own classrooms and how they could best to evaluate prospective paramedic students. After these initial discussions, the conversation was opened up to the broader EMS educational community. 150 EMS educators responded to a survey about the EE's subject matter, contributing their ideas and opinions.

These final 93 test items evaluate areas of weakness that EMS educators report seeing in their classrooms on a day-to-day basis. The team also utilized the expertise of several subject matter experts, including paramedic educator Dr. Billy James (San Antonio Police Department), Luke Stanke, PhD.C, Paul Satterlee, MD (Allina Health EMS) and reading comprehension specialist Samuel Tanner (University of Minnesota).

The EE underwent a year of pilot testing in 29 states. 1,038 students participated in the pilot test phase, during which student data was collected to obtain exam content validity.

II. Affective Domain Matters: Personality Traits of Paramedic Students and Their Effect on Cognitive performance

Introduction

Educators were interested in measuring affective domain behavioral traits of previously thought to be associated with empathetic behavior. Extensive research has been performed to describe personality characteristics of high functioning employees and ideal profiles for law enforcement candidates. The M5-50 (McCord 2002), NEO Personality Inventory (NEO PI-R; P. T. Costa, Jr., & R. R. McRae, 1992) and International Personality Item Pools (IPIP; Goldberg 1999) are a validated, reliable and published or commercially available personality inventories used for these purposes. The dimensions of Agreeableness, Conscientiousness and Neuroticism, also described as Emotional Stability, appear to have particular utility in the identification and training of ideal paramedic students. These traits may also have utility in predicting elements of caring or empathetic behaviors.

Hypothesis

Personality Traits of students entering a paramedic program are correlated to cognitive performance on a paramedic entrance exam.

Methods

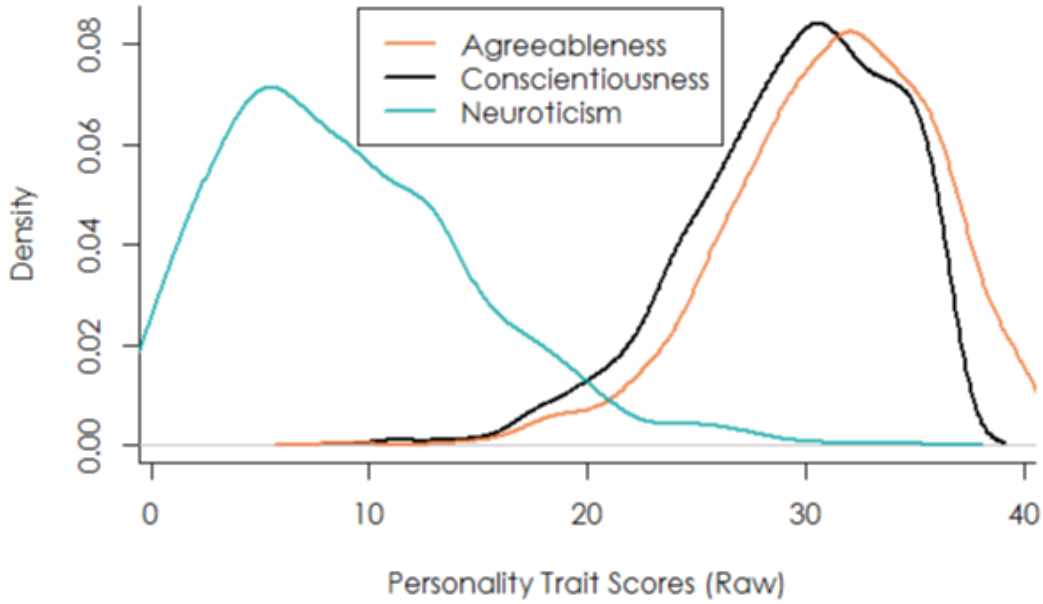
Consenting Paramedic Students (PS) beginning their educational program and enrolled in programs using Fisdap, an IRB approved prospectively collected online testing and tracking tool for EMS students, completed the new Fisdap Entrance Exam (EE; *coefficient alpha = .90). Thirty relevant affective domain elements from the M5-50 were embedded into the 126 item EE. The EE is designed to measure cognitive performance (CP) with breakdowns in Math, Reading, Inference/Analysis, Anatomy, Physiology, and EMT level critical thinking. Logit scores for the EE and the cognitive traits were obtained through item response scaling techniques using the Rasch model (Rasch, 1960). The logit scores were then converted to true scores using the test characteristic curve for each measure. A multiple regression was then completed using the estimated true scores to determine the proportion of variance accounted for by the traits on the EE.

**Previous research has shown a reliability of 0.9. The alpha coefficient represents the amount of reliability within an exam.*

Results

A total of 861 students entering 52 distinct paramedic programs across 28 states in the US completed the EE.

FIGURE 2. Density plot displaying the distribution of personality trait raw scores.



Note: Density of students located at a particular score. Higher density values equals more people having that score. Highest value equals the mode.

Statistical Analysis

The correlation matrix between the personality traits and cognitive section scores in Table 1 shows weak but statistically significant positive correlations between conscientiousness (C), agreeableness (A) and overall cognitive performance (CP).

Table 1.

	C	N	CP
A	.49	-.52	.04
C		-.53	.08
N			-.11

The matrix shows strong-to-very strong correlations between each of the personality traits. The more a student is agreeable, the more they will be conscientious and vice versa. Both C and A are inversely related to Neuroticism. Meaning students with high neuroticism scores will have low conscientious and low agreeableness scores. Further interpretation of Table 1 show that there is a positive association with A and C on CP, while there is a negative association between N and all other scores.

The regression fit is as follows: CP (Cognitive Performance) = β0 + β1(Agreeableness) + β2 (Conscientiousness) + B3(Neuroticism).

Statistical Analysis (cont'd)

Table 2 is a summary of a multiple regression using personality traits to account for cognitive performance scores and displays the multivariate regression coefficients, standard errors, and p-values for the full model. Only one personality trait, Neuroticism, shows a statistically significant association (p<.01) with overall cognitive performance scores (CP).

Table 2.

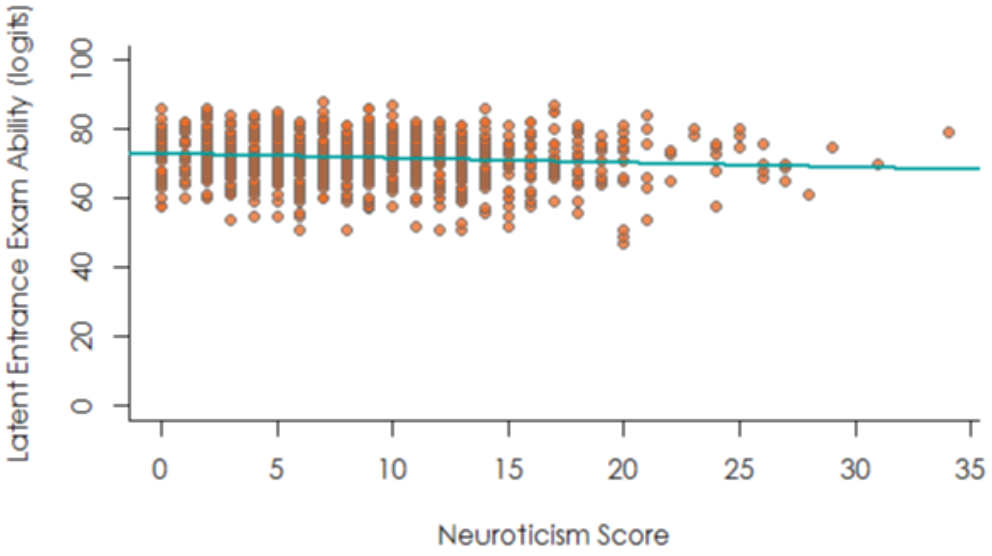
Variable	β	SE	*p*-value
Intercept (β_0)	72.80	3.58	<.01
A (β_1)	-0.04	0.09	.53
C (β_2)	0.05	0.09	.46
N (β_3)	-0.13	0.05	.01

The entire model that included all three personality traits accounted for 2% of total variance in CP scores. While only the N score from the multivariate regression showed a statistically significant association with CP scores.

Using information about the correlations between the dependent variables in Table 1, the results of this multivariate regression suggests there is multicollineary, which explains the non-significant values for the A and C variables.

On average, examinees with higher levels of neuroticism obtained lower overall cognitive performance scores (β3 = -0.13, p=.01), this suggest for a 1 point increase on the N measure, we can expect a 0.13 point decrease in cognitive performance (CP) score.

FIGURE 1. Scatterplot of N regressed on CP



Discussion

To our knowledge this is the first time the personality traits of agreeableness, conscientiousness and neuroticism have been measured using the M5-50 inventory in Emergency Medical Technicians entering a paramedic training program. Similar to other public safety professions, these personality traits would seem to be important in identifying candidate traits that may be assets or liabilities to their ability to care for patients. While it appears that overall students had low Neuroticism scores, there do appear to be some with high scores. This could represent a red flag that affects the ability for a student to succeed, or more critically, a concern for patient care. More research is needed to determine how these personality traits affect overall success and actual field performance, if at all. The statistically strong relationship between Neuroticism and poor overall performance on the EE should also be further investigated. The early indication might be that this score is a good tool to identify students who may need extra coaching or perhaps professional assistance prior to, or during paramedic school.

It is encouraging to see high levels for agreeableness and conscientiousness in this population as these traits have been previously been shown to correlated with teamwork and empathetic behaviors respectively. Traits that are critical to Emergency Medical Services.

Finally, measuring affective domain traits with a previously validated instrument and tying these measurements to cognitive domain performance in EMS education may represent a serious breakthrough in our field. These measurements present new possibilities for workforce screening, documentation and development of specific coaching strategies for success.

This group involved in this project continues to collect data hoping to uncover any predictive nature of these traits on progress and eventual graduation of these candidates. We are very thankful for the support from the EMS education community that has helped pilot test the Fisdap EE and report their results.

Conclusion

Conscientiousness and neuroticism appear to be measurable personality traits that are associated with cognitive performance in Paramedic Students. Future research is needed to correlate and predict how affective traits and cognitive performance are associated with student success such as improved retention at jobs, high patient satisfaction scores, and other important outcomes for the individual and workforce.

The Entrance Exam

The Entrance Exam (EE), created by and for EMS educators, is unique in its utilization of a personality assessment portion. To develop this portion of the exam, the team of educators who created the exam worked in collaboration with Dr. Billy James, a clinical psychologist, to adapt 30 items from the M5-50 for the personality inventory.

The M5-50 is a valid and reliable personality item set designed for the evaluation of law enforcement personnel. As the attached research shows, three areas of this inventory (specifically "agreeableness," "conscientiousness," and "neuroticism") have been shown to have particular utility in the identification of ideal paramedic students.

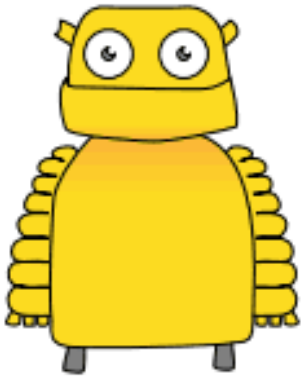
- Agreeableness: How well an individual gets along with others (also described as kindness, cooperativeness, or sympathy for/consideration of others).
- Conscientiousness: Attention to detail and understanding of right versus wrong. This element may also have utility in predicting elements of empathetic behaviors.
- Neuroticism: The inability to accept failures and deal with stress. Neurotic people tend to have more of a depressed mood.

Author Biographies

David I. Page, MS, NREMT-P — David Page is an EMS instructor at Inver Hills Community College and field paramedic with Allina EMS in the Minneapolis/St. Paul area. He's also on the board of advisors for the UCLA Prehospital Care Research Forum.

Billy James, PhD, NREMT-P — Dr. Billy James is a paramedic educator and forensic psychologist who specializes in law enforcement entrance screening. He has over 20 years experience as an EMS educator and works doing personnel screening for the San Antonio Police Department.

Luke Stanke, BS — Luke Stanke is a candidate for his PhD in Educational Psychology Quantitative Methods. His research focuses on latent variable models, mixed models, and explanatory item response models. Most of Luke's applied research has been completed in the allied health professions.



Michael Bowen, NREMT-P — Mike Bowen received his paramedic certification from Inver Hills Community College, where he now occasionally steps in as a substitute instructor. He works part-time for Lake City Ambulance Service and volunteers for the American Red Cross-Twin Cities chapter.