

2020

Grit and Medicine: Practicing Physicians, Residents, and Medical Students

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Repository Citation

Bamisile, M. (2020). Grit and Medicine: Practicing Physicians, Residents, and Medical Students. Wright State University. Dayton, Ohio.

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Abstract

Introduction: Since 2012, researchers have focused on understanding the relationship between grit and the successful completion of medical school¹. This study seeks to determine how grit levels, measured by survey at matriculation, relate to first year medical school academic performance. This study also seeks to address the discrepancy concerning measurement of grit and implications of grit in medical students before and during COVID-19 and the shift from in-class to on-line instruction. **Methods:** The data from this study were collected from Wright State University Boonshoft School of Medicine (WSUBSOM), a Midwestern allopathic medical school in the United States. Data were collected from 117 medical students in the class of 2023 for the 2019-2020 academic school year. Grit-S scores and MCAT percentiles were collected and used in this study. A two-way analysis of variance (ANOVA) was used for each final exam grade to determine the main effects of Grit-S category, the main effects of MCAT percentile category, and the interaction between the two variables. **Results and Discussion:** Results suggest that there is no significant difference between the three Grit-S categories and final exam performance. Results also suggest that there is a significant difference between the three MCAT categories and scoring on the Origins Final Exam, the Human Architecture Final Exam, and the Staying Alive Final Exam. **Conclusion:** MCAT percentile, not Grit Score, is a significant predictor of academic success in medical school. Additionally, there is no significant association between Grit-S categories and MCAT percentiles categories.

Key Words: Grit, Medical School, Medical Education, Academic Performance, COVID-19, in-class, on-line class, MCAT, Academic Success

Introduction

Addressing Burn Out- Grit

In the last decade, a popular notion believed to address burn out in stressful occupations is the positive, non-cognitive trait, grit. Duckworth et al first defined this concept “grit” as “perseverance and passion for long-term goals”.² Grit is thought to provide counterbalance to burn-out, and the grittiest of individuals continue to persist and progress onward when confronted by weariness or arduous undertakings. This concept of grit has been applied to various fields and achievements: completion of military trainings, high ranking at National Spelling Bees, high academic achievement at Ivy League schools, becoming a professional sport athlete, and even becoming a successful musical artist.² Although talent may be considered a necessity for any ambition, grit seems to be the vigor to continue and complete any mission. Without grit, susceptibility to burn out increases; but with grit, resistance to burn out increases.

The beneficial effects of grit also extend to mental health. Grit has been associated with lower levels of depression and anxiety. Studies also suggest that grit may also have protective effects against other psychological conditions. This has encouraged mental health professionals to seek ways to foster grit in more susceptible groups like adolescents, young adults, and chronically ill patients.^{3,4} Grit is a character trait that is desirable to possess for overall happiness. In recent years researchers have designed experiments to understand the exact role of grit in stressful careers such as medicine.

Grit and Medicine: Practicing Physicians, Residents, and Medical Students

A career in medicine is demanding. Medical students are advised early in their careers to focus on the great reward: becoming a practicing physician. However, burn out is a frequent consequence of the many sacrifices medical students, residents, and practicing physicians make to attain their goal. A study concerning physician burn out in the United States estimates that over 50% of practicing physicians are experiencing professional burn out.⁵ Burn out is associated with numerous undesirable outcomes such as making medical errors which impair patient care⁵⁻¹⁰. Although there are various explanations for physician burn out, research suggest that grit can be considered a learned character trait which can combat feelings of burn out.¹⁰ People appear to be born with different grit levels, but experience may increase or decrease these levels. In fact, studies also reveal that more experienced (not necessarily older) physicians tend to be more grittier and happier than younger physicians, which suggests that the application of grit for a prolonged period may increase grit level.¹¹

Residents, are known to bear significant stressors (personal and social) alongside the stresses of their medical training. Stressors are so high, that attrition rate in residency programs has been increasing steadily over the years.^{12,13} Of all residents, emergency medicine and neurosurgery residents are amongst the trainees typically perceived as most susceptible to burnout; however, research suggests that higher grit levels in these residents are associated with lower risk of burn out.^{7,9} Emphasizing the importance of grit is not only an effective strategy for addressing burn out in residency; in addition, emphasis is also advantageous for increasing the likelihood of passing future board examinations and for enhancing overall health and well-being.^{9,14,15} Increasing grit levels appears like a productive approach to prepare and combat against the immeasurable and inevitable stressors of residency; conversely, it perhaps may be

more constructive to address grit levels in the most upstream portion of a physician's journey: medical school.

Since 2012, researchers has focused on understanding the relationship between grit and the successful completion of medical school since the stressors in medical school are immense¹. Based on-studies regarding the benefits of grit, grit in medical education is associated with increased optimism.⁶ The benefits of grit actually extends to all health students: medical, nursing, and pharmacology students. Health students with higher grit levels tend to outperform those with lower grit levels in both academic and clinical scenarios.^{16,17} There are a variety of factors which can affect medical student's grit levels. For example, studies suggest that being a member of a sports team, the competitiveness of that sports team, and the years playing sports either on a team or recreationally can influence grit levels during medical school.¹⁸ Ultimately, thinking of factors that impact grit levels is valuable because grit levels appear to influence perceptions regarding medical school and overall quality of life.¹⁹ A better understanding of grit in medical students may increase our understanding of how to reduce burn out in the later years of training and in the practice of medicine.

Addressing Previous Discrepancies and the Conception of this Investigation

There is agreement amongst scholars that assessing grit levels is important for predicting burn out and success in medical school; however, conflict arises regarding its assessment. According to studies in 2018, higher grit levels corresponded to higher performance on the Medical College Admission Test (MCAT), medical school grades, and the United States Medical Licensing Examination (USMLE) Step 1.^{9,20} On the contrary, a study also from 2018 suggest that

grit levels and USMLE Step 1 scores are negatively correlated.²¹ The results and implications from this study are consistent with Duckworth's results that intelligence, which is often measured by standardized tests, and high grit levels tend to be inversely correlated.² Grit in the medical community tends to be measured by either self-reported surveys or previous academic performance/standardized test scores. Regarding surveys, recent studies suggest that self-assessment surveys, not assessment surveys by preceptors, may be a more accurate means to assess grit levels.²²

This study seeks to determine how grit levels, measured by survey at matriculation, relate to first year medical school academic performance. This study also seeks to address the discrepancy concerning measurement of grit and implications of grit in medical students. Of particular interest is that the first-year experience under this study was drastically altered by COVID-19 and the shift from in-class to on-line instruction. Students were most likely challenged by the changes to their social structures with peers and families as well as having to adapt to a new way of learning. Results of this study may provide further and valuable information on the relationship of grit and medical student academic performance.

Methods

For this study, we collected data from Wright State University Boonshoft School of Medicine (WSUBSOM), a Midwestern allopathic medical school in the United States. This study was reviewed by Wright State University's Institutional Review Board and was deemed exempt. WSUBSOM's curriculum, known as the WrightCurriculum, is a "lecture free" curriculum that emphasizes student collaboration and problem-based learning. Data were collected from 117

medical students in the class of 2023 for the 2019-2020 academic school year. The study was conducted within the auspices of the Office of Medical Education with appropriate ethical approval. Anonymity of all participants was maintained. Before starting medical school classes in July 2019, the class of 2023 took a self-assessment survey on personal grit levels using the Short Grit Scale (Grit-S) (*See Appendix A*). Grit scores were recorded and reported. For categorizing students as having low, medium, or high grit, Grit-S scores were converted to percentiles and divided into the lower, middle, and upper third percentiles. Based off mean grit scores for this specific medical school class, students were classified as either having low grit, medium grit, or high grit.

All MCAT percentiles for the class of 2023 were also collected and used in this study. MCAT percentiles were then grouped into three categories: low MCAT, middle MCAT, and high MCAT based on MCAT percentile rankings relative to the class mean percentile. Final exam grades for the course modules Origins (biochemistry), Human Architecture (human anatomy), Host and Defense (microbiology and immunology), and Staying Alive (cardiovascular, renal, and respiratory system) were also collected. The first three courses were completed in person, and Staying Alive was completed half in person and half online due to mandatory regulations for Covid-19. Of interest is whether differences in academic performance between the two grit groups are seen before COVID-19 and during COVID-19.

Once the group based on grit survey and the group based on MCAT percentiles was established, a two-way analysis of variance (ANOVA) and Bonferonni posthoc was used for each final exam grade. This allowed us to determine the main effects of Grit-S category, the main effects of MCAT percentile category, and the interaction between the two variables. Based on the results of the two-way ANOVAs (no effects of Grit-S category and no interaction), one-

way ANOVA followed by Bonferroni multiple comparisons tests was used to compare final exam grades between MCAT percentile groups. All analyses were conducted with SPSS v26.0 for Windows. A table regarding demographics for the Class of 2023 and Wright State University Boonshoft School of Medicine is provided.

Results

Table 1: Grit and Demographics

Table 1 compares the Grit score categories with regard to gender, race, and MCAT categories. There is no association between Grit Score category and gender, race, or MCAT percentile category. Specifically, there is no significant difference in grit scores between students that classified as female or male ($p= 0.798$). There is also no significant difference in grit scores amongst students that classified as White, Black, Asian, or other race ($p= 0.513$). Additionally, there is no significant difference in grit scores amongst students classified as having a low, medium, or high MCAT percentile ($p= 0.229$).

Table 2: MCAT and Demographics

Table 2 compares the MCAT categories with regard to gender, and race. There is no association between MCAT percentile category and gender. However, MCAT percentile is associated with race: the percent of White and Asian students increases across the MCAT percentile categories, while the percent of Black students decreases. Specifically, there is no significant difference in MCAT percentile groups between students that classified as female or

male ($p= 0.058$) and a significant difference between the MCAT percentile groups and race ($p < 0.001$).

Table 3: Grit Scores and Final Exam Performance

Table 3 compares the Grit Score categories based on final exam performance. Students were classified as having low, medium, or high grit from their grit scores. There was no significant difference in scoring on the Origins Final Exam ($p= 0.860$), the Human Architecture Final Exam ($p= 0.907$), the Host and Defense Final Exam ($p= 0.475$), and the Staying Alive Final Exam ($p= 0.754$).

Table 4: MCAT Percentiles and Final Exam Performance

Table 4 compares the MCAT categories with regard to final exam performance. Students were classified as being in the low, middle, or high MCAT percentile based off the Association of American Medical Colleges (AAMC) MCAT scoring report. There was a significant difference in scoring on the Origins Final Exam ($p < 0.001$), the Human Architecture Final Exam ($p < 0.001$), and the Staying Alive Final Exam ($p < 0.001$). Students in each MCAT group scored differently on all final exams except for the Host and Defense Final Exam ($p= 0.119$).

Table 5: Grit Scores, MCAT Percentiles, and Final Exam Performance

Table 5 shows the final exam scores broken down by MCAT percentile group within each Grit-S category. There were no significant interactions between Grit-S and MCAT

percentile categories with regard to final exam scores, indicating that the differences in exam scores among the MCAT percentile groups were consistent across the Grit-S categories.

Discussion

Grit and Demographics (Table 1)

Grit scores are not associated with gender, race and MCAT categories (Table 1), which is not surprising because it is generally assumed that medical students tend to be individuals with higher grit levels than the average person. Regardless of gender, race, or MCAT category, we predicted that all groups should score similarly in terms of grit. This is consistent with previous research that claims that medical students in general have high grit levels.²⁰ This finding is important because in terms of academic performance, it implies that grit may not be a variable to consider especially with regards to gender or racial differences in medical school.

MCAT and Demographics (Table 2)

Results from Table 2 suggest that MCAT categories are not associated with gender but are significantly associated with race. Regarding gender, these results were expected because medical students tend to be individual's with higher grit levels than the average person. Regardless of gender, it was predicted that females and males will score similarly on MCAT. This is consistent with previous research that claims that medical students in general have high grit levels.²⁰ Regarding race, these results were also expected based on years of medical student matriculant data from the AAMC. It is well known that students classified as Black on average

have lower MCAT scores than students classified as White or Asian. Data from this sample is consistent with previous literature and research on medical student matriculants.

Grit Scores and Final Exam Performance (Table 3)

Results from Table 3 suggest that there is no significant difference between the three grit scoring categories and final exam performance. All students in each grit group performed similarly on each final exam. These results were unexpected. Medical students with high grit were expected to score higher on each final exam compared to all groups, especially on the Staying Alive Final Exam which was taken during the COVID-19 pandemic. However, results suggest grit is not a good predictor of academic performance in medical school and may have no relationship with academic performance in medical school. Results also imply that variables other than grit are more of an influence of medical student academic performance. This is contrary to research regarding high grit levels associated with high academic performance^{9,20} and also contrary to research suggesting that an inverse relationship between grit and academic performance exist^{2,21}. This finding addresses a current discrepancy regarding grit and medical students.

MCAT percentiles and Final Exam Performance (Table 4)

Results from Table 4 suggest that there is not a significant difference between MCAT categories and Host and Defense final exam scoring; however, a significant difference in scoring on the Origins Final Exam, the Human Architecture Final Exam, and the Staying Alive Final Exam exist. Students in each MCAT group scored differently on all final exams except for the

Host and Defense Final Exam. These results were expected. Students in the higher MCAT percentile were expected to score higher on each final exam. It is well known that, medical students classified in the high MCAT percentile tend to have higher academic performance in medical school. These results are consistent with research regarding MCAT performance as a good predictor of academic performance in medical school.²³. Regarding the Host and Defense final exam performance, results remain unclear; however, differences in study strategies amongst the majority students may have been minimized (i.e. most students using the same resources and study strategies). Further research on the Host and Defense final exam performance results is needed to understand this occurrence.

Grit Scores, MCAT Percentiles, and Final Exam Performance (Table 5)

Results from Table 5 shows that all grit groups for each final exam scored similarly; however, within each grit group there was a significant difference in final exam performance depending on which MCAT percentile groups students were classified in. Regardless of grit groups, students in the higher MCAT percentile group scored the highest followed by the middle MCAT percentile and lastly the lower MCAT percentile. These results suggest that MCAT percentile, not Grit Scores, is the better predictor of academic performance in medical students. These results were not expected. Those classified as having high grit were expected to also be classified as having high MCAT percentiles and scoring highest on all final exams. Although not significant, the trend from these results show that the high grit medical students had lower MCAT scores and that the low grit medical students had higher MCAT scores. According to this trend, medical students with high grit scores tend to perform lower academically and medical students with low grit scores tend to perform high academically, which is consistent with

previous research suggesting there is a negative correlation between grit and academic performance^{2,21}.

Conclusion

The purpose of this study was to address the discrepancy concerning the measurement of grit and the implications of grit in medical students. Additionally, an important outcome of this study is unraveling how the grittiest of medical students in the class of 2023 performed academically during COVID-19 and the abrupt switch to an online class platform during the 2019-2020 academic school year. To address these concerns, three distinct sets of analysis were performed: comparisons among students based on Grit-S categories (comparing demographics, MCAT scores, and final exam scores), comparisons among students based on MCAT percentile categories (comparing demographics, Grit-S scores, and final exam scores), and comparisons among students based on the combination of Grit-S category and MCAT percentile category. Results from this study suggest that there is no significant association between grit scores and final exam performance, suggesting that grit is not a good predictor of academic performance in medical school. Results from this study also suggest that MCAT percentile category is significantly associated with final exam performance, suggesting that MCAT percentile category is a good predictor of academic performance in medical school. Finally, results from this study also suggest that there is no significant association between grit categories and MCAT percentiles categories. Although not significant, trends in the data reveal that high grit students scored the lowest on final exams and low grit students scored the highest on final exams before and during the COVID-19 pandemic. The most significant predictor on high and low final exam performance for the 2019-2020 academic school year is upper and lower MCAT percentile

categories respectively. In conclusion, grit may be an important variable in medical education; however, in this study, grit is not a predictor of academic performance during the first year of medical school. Grit does not predict academic performance in medical school.

Limitations and Future Studies

The primary limitation for this study is that sample size was taken from a single class consisting of 117 medical students from Wright State University Boonshoft School of Medicine, a Midwestern school located in Dayton, Ohio. The uniqueness and previous experiences of the individuals in the Class of 2023 could have greatly impacted the results of this study, which may cause results to not be generalizable to other medical schools. The self-report surveys collected from the class of 2023 to measure grit scores could also have impacted the results of this study. Students could have reported incorrectly on the survey and that could have skewed the data for this study. Final exams at Boonshoft School of Medicine is a potential variable that could have skewed results, but this is highly unlikely. The level of difficulty for the final exams at this medical school is comparable to other medical schools in the United States since performance on the USMLE is always near the national mean.

Future studies should examine how grit scores for the Class of 2023 at WSUBSOM changes overtime. This will give insight into whether grit levels change overtime and whether these changes affect future final exam performance and USMLE STEP 1 performance. Future studies should also address the relationship between grit scores and clinical performance. This could be studied by either examining OSCE performance or USMLE STEP 2 performance in the future. Future studies should also address the exact role and benefit of grit in medical education

if it is not significantly associated with academic performance. Finally, future studies should address how grit levels affects residency preferences.

References

1. Howe A, Smajdor A, Stöckl A. Towards an understanding of resilience and its relevance to medical training. *Med Educ.* 2012;46(4):349-356. doi:10.1111/j.1365-2923.2011.04188.x
2. Duckworth AL, Peterson C, Matthews MD, Kelly DR. PERSONALITY PROCESSES AND INDIVIDUAL DIFFERENCES Grit: Perseverance and Passion for Long-Term Goals. Published online 2007. doi:10.1037/0022-3514.92.6.1087
3. Musumari PM, Tangmunkongvorakul A, Srithanaviboonchai K, et al. Grit is associated with lower level of depression and anxiety among university students in Chiang Mai, Thailand: A cross-sectional study. *PLoS One.* 2018;13(12). doi:10.1371/journal.pone.0209121
4. Sharkey CM, Bakula DM, Baraldi AN, et al. Grit, Illness-Related Distress, and Psychosocial Outcomes in College Students With a Chronic Medical Condition: A Path Analysis. *J Pediatr Psychol.* 2018;43(5):552-560. doi:10.1093/jpepsy/jsx145
5. Shanafelt TD, Hasan O, Dyrbye LN, et al. Changes in Burnout and Satisfaction With Work-Life Balance in Physicians and the General US Working Population Between 2011 and 2014. doi:10.1016/j.mayocp.2015.08.023
6. Loftus TJ, Filiberto AC, Rosenthal MD, et al. Performance advantages for grit and optimism. Published online 2020. doi:10.1016/j.amjsurg.2020.01.057
7. Shakir HJ, Cappuzzo JM, Shallwani H, et al. Relationship of Grit and Resilience to Burnout Among U.S. Neurosurgery Residents. *World Neurosurg.* 2020;134:e224-e236.

doi:10.1016/j.wneu.2019.10.043

8. Underdahl L, Jones-Meineke T, Duthely LM. Reframing Physician Engagement: An Analysis of Physician Resilience, Grit, and Retention Article in. *Int J Healthc Manag*. Published online 2017. doi:10.1080/20479700.2017.1389478
9. Dam A, Perera T, Jones M, Haughey M, Gaeta T. The Relationship Between Grit, Burnout, and Well-being in Emergency Medicine Residents. Published online 2018. doi:10.1002/aet2.10311
10. Vickers SM, Vickers AL. Lessons Learned from Mentors and Heroes on Leadership and Surgical Resilience. *J Gastrointest Surg*. 2017;21(1):1-11. doi:10.1007/s11605-016-3257-1
11. Walker A, Hines J, Brecknell J. Survival of the Grittiest? Consultant Surgeons Are Significantly Grittier Than Their Junior Trainees. *J Surg Educ*. 2016;73:730-734. doi:10.1016/j.jsurg.2016.01.012
12. Burkhart RA, Tholey RM, Guinto D, Yeo CJ, Chojnacki KA. Grit: A marker of residents at risk for attrition? Published online 2014. doi:10.1016/j.surg.2014.01.015
13. Salles A, Lin D, Liebert C, et al. Grit as a predictor of risk of attrition in surgical residency. *Am J Surg*. 2017;213:288-291. doi:10.1016/j.amjsurg.2016.10.012
14. Olson AS, Williamson K, Hartman N, Cheema N, Olson N. The Correlation Between Emergency Medicine Residents' Grit and Achievement. Published online 2019. doi:10.1002/aet2.10399
15. Salles A, Cohen GL, Mueller CM. Association for Surgical Education The relationship

between grit and resident well-being. Published online 2014.

doi:10.1016/j.amjsurg.2013.09.006

16. Blackstock F, Judd B, Calo M, Peiris C, Chipchase L. Grit, resilience and mindset in health students Students with low levels of grit and resilience, and with a fixed mindset, may be less able to cope optimally with ... stressors Grit, resilience and mindset in health students. Published online 2019. doi:10.1111/tct.13056
17. Terry D, Peck B. Academic and clinical performance among nursing students: What's grit go to do with it? *Nurse Educ Today*. 2020;88:104371. doi:10.1016/j.nedt.2020.104371
18. Babenko O, Mosewich A, Sloychuk J, Babenko O, Sloychuk J, Mosewich A. Students' perceptions of learning environment and their leisure-time exercise in medical school: Does sport background matter? doi:10.1007/s40037-020-00560-w
19. Tempski P, Santos IS, Mayer FB, et al. Relationship among medical student resilience, educational environment and quality of life. *PLoS One*. 2015;10(6). doi:10.1371/journal.pone.0131535
20. Renee Miller-Matero L, Martinez S, Maclean L, Yaremchuk K, Ko AB. Grit: A Predictor of Medical Student Performance. Published online 2018. doi:10.4103/efh.EfH_152_16
21. Boden AL, Staley CA, Boissonneault AR, Bradbury TL, Boden SD, Schenker ML. Emotional Intelligence in Medical Students is Inversely Correlated with USMLE Step 1 Score: Is there a Better Way to Screen Applicants? *J Med Educ*. 2018;16(4). doi:10.22037/jme.v16i4.19528
22. Olson N, Segura Olson A, Williamson K, Hartman N, Branzetti J, Lank P. Faculty

Assessment of Emergency Medicine Resident Grit: A Multicenter Study. Published online 2018. doi:10.1002/aet2.10309

23. *Research to Evaluate the Fairness, Use, and Predictive Validity of the MCAT® Exam Introduced in 2015.*; 2020. Accessed July 7, 2020.
www.aamc.org/91514/reproductions.html.

Tables

Table 1: The Relationship between Demographics and Grit Score				
Variable	Low Grit	Medium Grit	High Grit	P Value
Gender, n (%)				0.798
Female	26 (61.9%)	23 (60.5%)	25 (67.6%)	
Male	16 (38.1%)	15 (39.5%)	12 (32.4%)	
Race, n (%)				0.513
White	19 (48.7%)	20 (54.1%)	15 (45.5%)	
Black	7 (17.9%)	7 (18.9%)	11 (33.3%)	
Asian	11 (28.2%)	6 (16.2%)	6 (18.2%)	
Other	2 (5.1%)	4 (10.8%)	1 (3.0%)	
MCAT Percentile				0.229
Low	9 (21.4%)	12 (31.6%)	15 (40.5%)	
Medium	14 (33.3%)	16 (42.1%)	11 (29.7%)	
High	19 (45.2%)	10 (26.3%)	11 (29.7%)	

Table 2: The Relationship between Demographics and MCAT Percentiles				
Variable	Low MCAT Percentile	Middle MCAT Percentile	High MCAT Percentile	P Value
Gender, n (%)				0.058
Female	30 (76.9%)	21 (51.2%)	26 (63.4%)	
Male	9 (23.1%)	20 (48.8%)	15 (36.6%)	
Race, n (%)				<0.001
White	9 (23.7%)	21 (55.3%)	25 (67.6%)	
Black	22 (57.9%)	5 (13.2%)	1 (2.7%)	
Asian	5 (13.2%)	7 (18.4%)	11 (29.7%)	
Other	2 (5.3%)	5 (13.2%)	0 (0.0%)	

Table 3: Scores (mean [SD], range) on the exams by Grit-S groups (One-way ANOVAs Comparing Exam Scores between Grit-S groups)

Exam	Low Grit Mean (SD) Range	Medium Grit Mean (SD) Range	High Grit Mean (SD) Range	P Value
Origins	83.4 (8.3) 64.0-96.0	82.4 (8.6) 56.0-97.0	82.8 (8.1) 68.0-98.0	0.860
Human Architecture	84.7 (7.1) 66.0-98.0	84.1 (6.7) 67.0-97.0	84.1 (7.2) 68.0-98.0	0.907
Host and Defense	82.9 (11.0) 54.0-100.0	80.6 (10.2) 53.0-98.0	80.2 (10.4) 57.0-97.0	0.475
Staying Alive	81.5 (7.6) 59.0-94.0	82.5 (6.7) 69.0-95.0	82.7 (7.9) 63.0-96.0	0.754

Table 4: Scores (mean [SD], range) on the Exam by MCAT Percentile Groups (One-way ANOVAs Comparing Exam Scores between Grit-S Groups)

Exam	Low MCAT Percentile Mean (SD) Range	Middle MCAT Percentile Mean (SD) Range	High MCAT Percentile Mean (SD) Range	P Value
Origins	77.1 (7.8) 56.0-89.0	83.3 (7.1) ^a 62.0-94.0	87.4 (6.9) ^{a,b} 64.0-97.0	<0.001
Human Architecture	81.0 (8.4) 66.0-97.0	84.3 (5.6) 71.0-98.0	87.4 (5.3) ^a 73.0-98.0	<0.001
Host and Defense	79.5 (10.4) 53.0-96.0	80.1 (9.5) 58.0-98.0	84.1 (11.3) 54.0-100.0	0.119
Staying Alive	78.5 (7.0) 63.0-90.0	81.7 (6.8) 59.0-91.0	85.7 (6.7) ^{a,b} 66.0-96.0	<0.001

^aP<0.05 compared to the Low MCAT Percentile group; ^bP<0.05 compared to the Middle MCAT Percentile group, Bonferroni multiple comparisons tests.

Table 5: Mean (SD) Scores for Exams within MCAT Percentile Groups for the Grit-S Groups				
Exam	Low Grit	Medium Grit	High Grit	P Value
Origins				0.319
Low MCAT percentile	78.3 (8.3)	74.5 (8.6)	78.5 (6.7)	
Middle MCAT percentile	80.9 (6.2)	85.3 (6.2)	83.6 (8.8)	
High MCAT percentile	87.6 (7.9)	87.1 (5.4)	87.4 (6.6)	
Human Architecture				0.998
Low MCAT percentile	80.6 (10.1)	80.9 (9.3)	81.1 (6.7)	
Middle MCAT percentile	83.7 (4.3)	84.6 (4.3)	84.3 (8.4)	
High MCAT percentile	87.3 (7.0)	87.1 (4.7)	87.9 (4.7)	
Host and Defense				0.862
Low MCAT percentile	83.5 (7.0)	79.0 (12.3)	77.5 (10.7)	
Middle MCAT percentile	80.4 (10.7)	80.4 (8.0)	79.1 (10.8)	
High MCAT percentile	84.5 (12.7)	82.5 (12.0)	84.7 (8.9)	
Staying Alive				0.389
Low MCAT percentile	78.4 (3.7)	79.5 (6.9)	78.5 (7.0)	
Middle MCAT percentile	78.4 (7.8)	83.2 (6.2)	84.2 (4.5)	
High MCAT percentile	85.1 (7.4)	84.5 (7.0)	88.0 (5.0)	
P values are the interaction P values from two-way ANOVAs.				

Appendix A

Short Grit Scale

Directions for taking the Grit Scale: Please respond to the following 8 items. Be honest – there are no right or wrong answers!

1. New ideas and projects sometimes distract me from previous ones.*

- Very much like me
- Mostly like me
- Somewhat like me
- Not much like me
- Not like me at all

2. Setbacks don't discourage me.

- Very much like me
- Mostly like me
- Somewhat like me
- Not much like me
- Not like me at all

3. I have been obsessed with a certain idea or project for a short time but later lost interest.*

- Very much like me
- Mostly like me
- Somewhat like me
- Not much like me
- Not like me at all

4. I am a hard worker.

- Very much like me
- Mostly like me
- Somewhat like me

- Not much like me
- Not like me at all

5. I often set a goal but later choose to pursue a different one.*

- Very much like me
- Mostly like me
- Somewhat like me
- Not much like me
- Not like me at all

6. I have difficulty maintaining my focus on projects that take more than a few months to complete.*

- Very much like me
- Mostly like me
- Somewhat like me
- Not much like me
- Not like me at all

7. I finish whatever I begin.

- Very much like me
- Mostly like me
- Somewhat like me
- Not much like me
- Not like me at all

8. I am diligent.

- Very much like me
- Mostly like me
- Somewhat like me

- Not much like me
- Not like me at all

Scoring:

1. For questions 2, 4, 7 and 8 assign the following points:

5 = Very much like me

4 = Mostly like me

3 = Somewhat like me

2 = Not much like me

1 = Not like me at all

2. For questions 1, 3, 5 and 6 assign the following points:

1 = Very much like me

2 = Mostly like me

3 = Somewhat like me

4 = Not much like me

5 = Not like me at all

Add up all the points. The maximum score on this scale is 40 (extremely gritty), and the lowest score on this scale is 8 (not at all gritty). *Revisions for range created for WSUBSOM.

Grit Scale Citation

Duckworth, A.L., & Quinn, P.D. (2009). Development and validation of the Short Grit Scale (Grit-S). *Journal of Personality Assessment, 91*, 166-174.

<http://www.sas.upenn.edu/~duckwort/images/Duckworth%20and%20Quinn.pdf>

Duckworth, A.L., Peterson, C., Matthews, M.D., & Kelly, D.R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology, 9*, 1087-1101.

<http://www.sas.upenn.edu/~duckwort/images/Grit%20JPSP.pdf>