Is Grit the New Fit?—Assessing Non-Cognitive Variables in Orthopedic Surgery Trainees

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OBJECTIVE: The purpose of this study was to determine overall levels of grit, self-control, and conscientiousness among orthopedic surgery residents, to compare levels of grit across orthopedic resident training levels, and to identify common applicant variables which may correlate with these valuable noncognitive attributes.

DESIGN: A cross-sectional study composed of a confidential electronic survey consisting of a 17-item Grit scale, 10-item Self-control scale, and 9-item Conscientiousness scale was completed by Orthopedic residents and fellows.

SETTING: Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN; a tertiary medical center.

PARTICIPANTS: Grit, ambition, consistency of interest, perseverance of effort, self-control, and conscientiousness were assessed in orthopedic surgery residents and fellows. The survey was distributed to program coordinators of ACGME accredited Orthopedic Surgery residency programs and fellowship. 431 (431 out of 621, 69.4%) respondents completed the assessment.

RESULTS: Orthopedic residents demonstrated high baseline levels of grit (4.0 of 5.0), self-control (3.8 of 5.0), and conscientiousness (4.4 of 5.0). The grit score of 4.0 places them in the 65th percentile of the general adult population. There were no significant differences in scores between training levels of orthopedic residents and fellows. Significantly higher self-control scores were seen in female trainees ($p = 0.042$), inductees of Alpha Omega Alpha honor society ($p = 0.008$), and those with higher numbers of publications ($p = 0.037$). Orthopedic trainees with more publications scored higher in the ambition sub-score (0 publications: 4.0 ± 0.7; 1-3 publications: 4.2 ± 0.5, 3 or more publications: 4.3 ± 0.5; $p < 0.001$).

CONCLUSIONS: Orthopedic surgery residents demonstrated high levels of grit compared to the general population. Key objective variables utilized in the residency application process including Alpha Omega Alpha status and volume of research publications were predictive of these qualities. (J Surg Ed 76:924–930. © 2019 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: Orthopedic surgery residency, grit, self-control, conscientiousness, residency applicants

COMPETENCIES: Professionalism, Interpersonal and Communication Skills, Practice-Based Learning and Improvement

INTRODUCTION

Data from the American Board of Surgeons suggests that nearly 20% of residents entering a categorical surgery residency program do not complete the entirety of the training process, the majority of which end up pursuing nonsurgical residencies instead.[1,2] An issue at the forefront of postgraduate medical training has been the discussion surrounding the rates of attrition among surgical residents. This problem may be‘‘ attributed to a variety of challenging factors such as resident workload, level of satisfaction, burnout, and overall work-life balance. Residency training programs have a decisive role in the selection, fostering, and maintenance of future surgeons.

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Additionally, resident burnout plays a role in individual performance, mental health, and ultimately patient outcomes. Specifically, in a study by Shanfelt et al., 700 of 7905 participating surgeons indicated committing a major medical error with nearly 70% of those respondents associating the error on an individual basis rather than one that was systemic. These reported medical errors were strongly associated with a surgeon's degree of burnout and their mental health quality of life.[3] Such findings represent an area of concern that ties together the interests of surgical residency training programs, the financiers of resident education, and most importantly the interests of patients.

The burden of these issues is not a novel concept to the field of orthopedic surgery. With increased focus on resident wellness, both the selection and training process have become increasingly important in finding the right applicants and in maintaining their well-being throughout the rigorous process. An earlier study on orthopedic residency applicants found increased levels of grit with increasing age, female sex, and a history of collegiate athletic participation.[4] Traditionally, orthopedic resident applicants are chosen based on a variety of objective variables such as their United States Medical Licensing Examination (USMLE) Step 1 score, grades, Alpha Omega Alpha (AOA) honor society status, etc. which can be consistent predictors of testing and educational performance in the future.[5] However, it has been noted that less objective variables such as self-control, moral reasoning, conscientiousness, and interpersonal skills are not correlated well with those traditional measures of an orthopedic resident applicant.[6,7] Therefore, it is necessary to consider additional variables that complement the standard objective measures typically used in order to optimize candidate selection. The concept of "grit" has sparked interest as an atypical metric which has the potential to better define the aforementioned noncognitive qualities. Duckworth et al. defines grit as "steadfast passion and perseverance for long-term goals, especially in the setting of hardship and setbacks."[8] In relation to the medical field, there have been positive correlations of high grit scores with lower attrition rates[9] and increased well-being for surgical residents.[10] Additionally, increased future academic performance and personal success have been correlated with both self-control[11] and conscientiousness[12] in residents.

Recent work has investigated associations between these variables in both attending orthopedic surgeons and orthopedic residency applicants. It was reported that both of these populations showed increased levels of grit compared to the general public[13] and factors such as military experience, AOA status, and number of publications were correlated with higher levels of grit.[14] All of these characteristics are highly valued in orthopedic surgery but there has been little establishment of baseline levels across learners (residents and fellows)
in the field of orthopedic surgery. Accordingly, the objectives of this study were to (1) measure overall levels of grit, conscientiousness, and self-control in orthopedic surgery residents and fellows, (2) compare respondent scores between training years, and (3) find correlations between these scores and personal and career demographic factors. We hypothesized that orthopedic learners (residents and fellows) would demonstrate higher levels of grit, self-control, and conscientiousness than the general population, and that these characteristics would vary based on postgraduate year.

METHODS

Study Design

Previously validated questionnaires assessing respondent's grit[8], self-control[11], and conscientiousness[12] were distributed to Orthopedic surgery residency coordinators via email with the request to disseminate them as surveys to trainees (both residents and fellows within their programs). Program coordinator contact information was collected via FREIDA Online and the AMA Residency and Fellowship Database as well as by manually parsing institutional websites. Coordinators were asked to provide the number of trainees in their program (to whom the survey was sent) and answer data and response rates were collected via Survey Monkey (San Mateo, California). All respondents were informed that the data would be collected in a completely anonymous and deidentified fashion and their responses would in no way affect their current standing within their residency program. With this information, they were encouraged to answer truthfully. Completion of every component of the survey was required in order for the responses to be included in the analysis. Due to the anonymity and deidentification process, the present work was deemed exempt by the institutional review board of the primary institution.

Survey Design

The questionnaire collected respondent demographic information as well as information for criteria used in the residency selection process including level of training, age, sex, desired sub-specialty, number of hours worked per week, USMLE Step 1 score, completion of other graduate degrees, desired practice setting, perception of the 80 hour work, participation in varsity collegiate athletics (and duration), membership in AOA honor society, military affiliation, and number of research publications. A 17-item Grit[8] scale was used to

calculate overall grit scores as well as the following subscores: consistency of interest, perseverance of effort, brief grit score, and ambition. A 10-item Conscientiousness scale[12] and 9-item Self-Control scale[11] were used to generate conscientiousness and self-control scores, respectively. All 3 questionnaires are scored on a 5-point scale with a score of "5" representing the "most grit", "most self-control", or "most conscientiousness". The collected data were within the group of respondents as well across the levels of postgraduate training. Demographic sub-analyses were performed to investigate correlating factors.

Statistical Analysis

Descriptive statistics, including measures of central tendency, standard deviation, and range were performed on all sampled variables. Trainees were further categorized into their corresponding postgraduate year. Appropriate statistical hypothesis testing was performed to compare respondent scores for grit, grit sub-scores, self-control, and conscientiousness across participant demographics including year of training, sex, age, participation in collegiate athletics, AOA status, military affiliations, and number of research publications. All comparisons were reported using 95% confidence intervals and p values of <0.05 representing statistical significance. All analyses were performed using JMP software (version 12.0.1, SAS Institute Inc, Cary, North Carolina).

RESULTS

The survey was completed by a total of 431 (431 of 621, 69.4%) orthopedic surgery residents ($N = 408$) and fellows ($n = 23$). Respondent demographics are shown below in Table 1.

Baseline levels of grit (and sub scores), self-control, and conscientiousness scores of the respondents are in Table 2.

TABLE 1. Respondent Demographics

Training Level	
PGY-1	19.5%
PGY-2	15.1%
PGY-3	23.2%
PGY-4	18.8%
PGY-5	18.1%
Fellow	5.3%
Sex	79.4% male
Mean age	30.1 (2.7)
Collegiate athlete	37.8%
Military	4.6%
AOA	36.0%
Mean # of publications	6.7 (12.1)

TABLE 2. Mean Respondent Scores

Grit score	4.0 (SD: 0.5)
Consistency of effort	3.6 (0.7)
Perseverance of effort	4.4 (0.4)
Brief grit score	4.0 (0.5)
Ambition	4.2 (0.5)
Self-control score	3.8 (0.6)
Conscientiousness score	4.4 (0.5)

Respondent scores did not significantly differ across training years (Figure 1). A total of 408 residents and 23 fellows completed the survey and when compared head-to-head, scores did not significantly differ between these 2 groups with the exception of "Perseverance of Effort," where residents scored higher than fellows (4.4 vs 4.2, $p = 0.044$).

Female respondents, those who were inducted into AOA during medical school, and those with more publications scored significantly higher in self-control scores. There was no significant difference in grit scores or conscientiousness scores based on trainee demographics (Table 3-5).

Trainee variables were investigated to assess significant differences in grit sub-scores. The only statistically significant finding showed that respondents with more publications scored higher in the ambition sub-score (0 publications: 4.0 (0.7); 1-3 publications: 4.2 (0.5) 3 or more publications: 4.3 (0.5); $p < 0.001$).

DISCUSSION

Historically, more objective variables such as USLME Step 1 score, grades, AOA status, etc. have correlated well with orthopedic resident academic performance and test-taking.[15] However, there exists a gap in applicable variables which measure atypical resident characteristics such as interpersonal skills, resiliency, self-control, etc.[7] Grit has been proposed as a new statistic in measuring those desirable qualities of an orthopedic resident. The results of this study illustrated that, on average, orthopedic residents had higher baseline levels of grit, self-control, and conscientiousness than most American adults. Specifically, trainees had grit scores which placed them at the 65th percentile of the general America population.[6,13] Grit, self-control, and conscientiousness scores were sustained throughout the years of orthopedic training as well as into fellowship. Finally, female sex, AOA status, and a higher number of publications correlated with higher self-control scores and those with more publications also scored higher in "ambition."

As illustrated by Salles et al., there is a significant correlation found between high levels of grit and psychological well-being in residents. Additionally, it was reported that

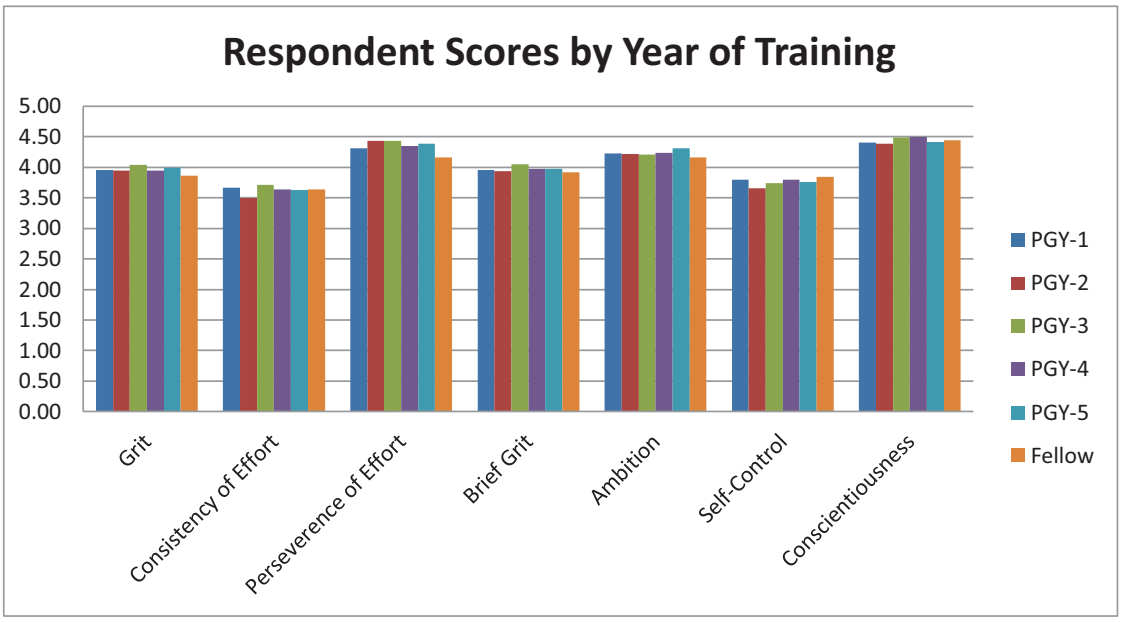

FIGURE 1. Respondent scores remained consistent in all assessed variables when compared across year of training.

grit had a positive correlation with frequency of resident thoughts on completing their residencies and a negative correlation with frequency of thoughts on leaving their residencies.[9] Overall, in terms of orthopedic trainees, the current study's findings of high levels of grit being maintained throughout training levels is potentially suggestive of low levels of attrition in orthopedic surgery residencies and positive psychological well-being. These findings bode well for both the introduction of grit as an assessor of orthopedic residency applicants and maintenance of current resident well-being; specifically, to identify at-risk residents and offer supporting services.

A possible explanation of the consistently high scores of grit, self-control, and conscientiousness (4.0, 3.8, and 4.4, respectively) is that orthopedic residency training programs involve commitment to a path entrenched with various challenges and delayed gratification. As defined by Duckworth et.al.,[8] grit serves as an overriding factor which maintains the stamina necessary to "stay the course" amid setbacks. Those medical students who

TABLE 3. Comparison of **Grit** Scores Based on Different Trainee Attributes

Variable	N	(%)	Mean	(SD)	Range	Median	MD	95% CI	p value
Overall	431	100%	4.0	0.7	2-5	4	-	-	-
Sex									
Female	89	20.6%	4.0	0.4	2.9-4.8	3.9	0.07	−0.18 to 0.03	0.281
Male	342	79.4%	4.0	0.5	2-5	3.8			
Varsity College Sports									
Yes	163	37.8%	4.0	0.5	2.5-4.8	4.1	0.01	−0.07 to 0.10	0.305
No	268	62.2%	4.0	0.4	2-5	4			
AOA status									
Yes	155	36.0%	4.0	0.5	2-5	4.1	0.03	−0.06 to 0.11	0.262
No	276	64.0%	4.0	0.4	2.5-4.8	4			
Military experience									
Yes	20	4.6%	4.1	0.4	3.3-4.6	4	0.08	−0.12 to 0.28	0.596
No	411	95.4%	4.0	0.5	2-5	4			
N. of publications									
0	54	12.5%	3.9	0.5	2-4.7	4	-	-	0.243
1 to 3	138	32.0%	4.0	0.5	2.5-5	4			
3 or more	239	55.5%	4.0	0.4	2.7-4.8	4.1			

Abbreviations: N, number; SD, standard deviation; MD, mean difference; CI, confidence interval; AOA, Alpha Omega Alpha.
MD reported as absolute value.

TABLE 4. Comparison of **Self Control** Scores Based on Different Trainee Attributes

Variable	N	(%)	Mean	(SD)	Range	Median	MD	95% CI	p value
Overall	431	100%	3.8	0.6	1-5	3.8	-	-	-
Sex									
Female	89	20.6%	3.9	0.5	2-4.8	3.9	0.12	−0.25 to 0.02	**0.042**
Male	342	79.4%	3.7	0.6	1-5	3.8			
Varsity College Sports									
Yes	163	37.8%	3.8	0.04	2-4.9	3.8	0.02	−0.09 to 0.13	0.650
No	268	62.2%	3.8	0.03	1-5	3.8			
AOA status									
Yes	155	36.0%	3.84	0.6	1-4.9	3.9	0.12	0.01 to 0.24	**0.008**
No	276	64.0%	3.72	0.6	2-5	3.8			
Military Experience									
Yes	20	4.6%	3.8	0.4	3-4.5	3.9	0.04	−0.21 to 0.30	0.931
No	411	95.4%	3.8	0.6	1-5	3.8			
N. of publications									
0	54	12.5%	3.6	0.7	1-5	3.6	-	-	**0.037**
1-3	138	32.0%	3.8	0.5	2.3-5	3.8			
3 or more	239	55.5%	3.8	0.6	2-4.9	3.9			

Abbreviations: N, number; SD, standard deviation; MD, mean difference; CI, confidence interval; AOA, Alpha Omega Alpha.
Bold p values indicate statistical significance ($p < 0.05$). MD reported as absolute value.

decide to enter orthopedic residency programs may have been self-selected as being "gritty" individuals who are ready to persevere amid potential difficulty and failure. Orthopedic residency applicants and current orthopedic residents have displayed similar levels of conscientiousness and self-control in prior work.[16] Additionally, self-selection of accomplished and competitive applicants who enter orthopedic residency programs is evidenced by the increasing average USMLE Step 1 score, publication numbers, and other objective statistics.[5] This may also be evidenced by the number of medical students who decide to take research years prior to residency. A recent study concluded that the most likely reason for a medical student to take years off for research is "to increase competitiveness for residency applications".[17] It is evident that at the level of medical school, students are expressing high baseline levels of conscientiousness by delaying gratification and prioritizing long term goals. These noncognitive variables are highly sought after in orthopedic training programs. This lends credence to the notion that a feedback loop

TABLE 5. Comparison of **Conscientiousness** Scores Based on Different Trainee Attributes

Variable	N	(%)	Mean	(SD)	Range	Median	MD	95% CI	p-value
Overall	431	100%	4.4	0.5	1-5	4.6			
Sex									
Female	89	20.6%	4.48	0.4	3.1-5	4.6	0.04	−0.15 to 0.07	*0.571*
Male	342	79.4%	4.43	0.5	1-5	4.6			
Varsity College Sports									
Yes	163	37.8%	4.4	0.5	2.6-5	4.6	0.06	−0.16 to 0.03	0.104
No	268	62.2%	4.5	0.5	1-5	4.4			
AOA status									
Yes	155	36.0%	4.5	0.5	1-5	4.6	0.05	−0.04 to 0.14	0.138
No	276	64.0%	4.4	0.5	2.8-5	4.4			
Military experience									
Yes	20	4.6%	4.5	0.4	3.6-5	4.6	0.05	−0.16 to 0.27	0.623
No	411	95.4%	4.4	0.5	1-5	4.6			
N. of publications									
0	54	12.5%	4.3	0.7	1-5	4.4	-	-	0.086
1-3	138	32.0%	4.4	0.4	3.1-5	4.4			
3 or more	239	55.5%	4.5	0.4	2.6-5	4.6			

Abbreviations: N, number; SD, standard deviation; MD, mean difference; CI, confidence interval; AOA, Alpha Omega Alpha.
MD reported as absolute value.

has been created where increasing competitiveness of orthopedic residency positions has led to increasingly gritty residency applicants. Moving forward, it may be beneficial to screen applicants for these qualities; however, this may prove problematic due to desirability bias on the part of the applicant if they know that the assessment will impact their likelihood of matching into a particular program. To overcome this, a number of more "objective" variables from the standard application have been correlated with increased levels of grit, self-control, and/or conscientiousness in orthopedic applicants. These include increased age, decreasing USMLE Step 1 scores, female sex, collegiate athletic experience, and military experience.[4]

There were no significant changes in grit as orthopedic residents advanced through years of training. It could have been expected that as residents advance through more experiences and meaningful activities their grit levels would further strengthen and create a more persistent motivation. Conversely, a decrease in grit scores as level of training increased could have been anticipated due to potential complacency as the training process continues. As residents advance through their training, which is filled with unique and challenging environments, maintaining high levels of grit may reflect a high degree of motivation to stay focused on a goal throughout years of residency.

Increased self-control scores have been correlated with better interpersonal skills and optimal medical professionalism.[18] These are all qualities looked upon with high esteem within the field of orthopedic surgery. However, many typical objective measures of a residency applicant have not been able to effectively measure these noncognitive traits. Female orthopedic residents may express higher levels of self-control due to the persistent gender bias encountered in the surgical environment.[19] The field of orthopedics is typically known for having one of the largest ratios of males to females at a nearly 90% male demographic.[20] This factor in combination with perpetuated stereotypes about the nature of orthopedic work being a "boy's club" could potentially repel many female applicants from entering the field. A major influencer of those women who do enter the field may be that they already exhibit high self-control scores which are crucial for successfully navigating the training process and practicing as a future orthopedist. Orthopedic residents having AOA status also scored significantly higher in self-control. This is most likely evidenced by the fact that those with a higher self-control have greater efficacy in accomplishing tasks and preventing distractive activities from derailing their progress.[11] Resultantly, those residents with AOA status have earned this distinction from high levels of self-control during medical school. Finally, residents with a higher number of publications scored significantly higher in both self-control and the ambition sub-score of grit. These correlations can be multi-faceted in origin. In particular, those residents who have higher self-control unsurprisingly tend to have a better focus and efficacy towards finishing the tasks at hand. Additionally, it takes an intrinsic drive or ambition in order to create publications consistently while also going through the medical education and training process. These correlations between higher respondent scores and career demographic factors may serve to help validate the continued use of AOA status and research publication volume as metrics in selection of orthopedic residency trainees.

The findings of this study are not without limitations. A specific limitation, attrition bias, is inherent to the design of this study. The only responses recorded and analyzed were those from fully completed surveys. This limitation creates the possibility of artificially overinflating the noncognitive variable scores. Additionally, not all eligible respondents may have received the survey. Although it was disclosed that responses had no effect on standing at their institutions and that confidentiality would be guaranteed, some respondents may have answered survey questions in a manner that viewed them positively, the so called desirability bias. Moreover, the nonlongitudinal nature of this study limits its ability to observe which residents fully complete their training. Finally, responses to the survey were subjective in that one's own perception of the scale of grit may differ from a colleague's. This may have underestimated or overestimated the impact of grit scores in this survey.

CONCLUSION

This work may have an impact on the selection, training, and future practice of orthopedic surgeons. Insight on baseline levels of grit, self-control, and conscientiousness provide a necessary tool for identification of residents who are at a greater potential for attrition and poor psychological well-being in the future. Accordingly, it may be in the best interest of individual resident health, residency programs, and patient outcomes to consider the implementation of the noncognitive variables assessed in this investigation for assessment in their residents. Ultimately, orthopedic surgery residents demonstrated high levels of grit compared to the general population. Key objective qualities including AOA status, female sex, and volume of research publications were predictive of these attributes. We believe it is important to the future of orthopedic training programs to not only recruit residency applicants who have high objective scores, but additionally those who have the grit, self-control, and conscientiousness needed to carry

out the critical tasks required of learning this surgical discipline.

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