The Impact of Mindset on Learning Behaviors and Learning Outcomes Among Health Professions Students

Jennifer Elinich, PT, DPT[1], Krista Rompolski, PhD[1] and Travis Pollen, PhD[2]

[1]School of Rehabilitation Sciences, Moravian University, Bethlehem, PA, USA

[2]Department of Exercise Science, Jefferson College of Rehabilitation Science, Thomas Jefferson University, Philadelphia, PA, USA

Corresponding author: elinichj@moravian.edu

Abstract

Mindset is defined as an individual's beliefs about their inherent characteristics and whether or not those characteristics can be developed. Growth mindsets have been associated with improved academic performance and resilience and may benefit students transitioning to graduate health professions education. This study examined the relationships between mindset, learning behaviors, and learning outcomes of first-semester graduate health professions students enrolled in a neuroanatomy course and examined other factors that may impact academic performance. Forty-one participants completed an electronic survey that included demographics and a mindset questionnaire. Learning outcomes, or grades, and learning behaviors, including office hour and tutoring session attendance, participation in bonus activities, and email correspondence with the course instructor, were collected. Based upon the mindset questionnaire, 10 participants were categorized as "strong growth", 28 participants as "growth with some fixed", and 3 participants as "fixed with some growth". There were no significant differences in mindset score based upon demographic characteristics. No significant correlations were found between mindset score, learning behaviors, or learning outcomes. Using a multivariable model, the factors that best predicted overall course grade were undergraduate grade point average (GPA) and number of prerequisite courses taken. While the lack of heterogeneity in mindset impacts the ability to determine potential relationships between studied variables, this study demonstrates that graduate health professions students largely have growth mindsets, perform well on academic assessments, including undergraduate coursework, and demonstrate frequent positive learning behaviors. Developing and reinforcing these behaviors as undergraduates may positively impact future success at the graduate level.
https://doi.org/10.21692/haps.2023.003

Key words: mindset, neuroanatomy, learning outcomes, health professions, GPA

Introduction

As educators, understanding and facilitating learning is the core of our mission. Considerable effort has been dedicated toward understanding the implicit theories of the nature of intelligence, or the mindset theory. These theories state that intelligence is related to an individual's implicit belief of their ability. An incremental theory of intelligence is one in which an individual believes that their intelligence can be molded or increased whereas an entity theory of intelligence is one in which an individual believes that their intelligence is not controllable (Dweck and Leggett 1988).

Accordingly, mindset is the belief about one's innate characteristics and the ability of those characteristics to either be developed (a growth mindset) or remain fixed (a fixed mindset; Dweck 2006). Individuals with a growth mindset tend to seek challenges that promote learning, have high levels of persistence, and recognize that setbacks are part of the path to mastery. Individuals with a fixed mindset may

avoid challenge or risk, have low levels of persistence, and avoid activities that would provoke negative judgment of their ability (Dweck and Leggett 1988).

Previous studies on the mindset theory have investigated the relationships between and overlapping nature among mindset and several variables associated with learning and performance, including grit and resilience. Grit can be defined as persistence for long-term goals despite the potential presence of challenges (Duckworth and Quinn 2009). Similarly, resilience can be defined as the ability to overcome adversity to achieve personal growth (Sanderson and Brewer 2017). Interrelationships between mindset and grit and resilience have been demonstrated in several studies (Barbouta et al. 2020; Bazelais et al. 2018; Calo et al. 2022; Hochanadel and Finamore 2015; Klein et al. 2017; Mosanya 2021; Wang et al. 2017) suggesting that in a learning environment, individuals with a growth mindset, greater

grit or more resilience will have increased persistence even in the presence of challenges. In addition, a growth mindset has been associated with improved psychological well-being (Whittington 2017; Wolcott 2021). This further supports the notion that individuals with a growth mindset will be better prepared to handle adversity and the challenges associated with learning.

Further, several studies have investigated the relationship between mindset and learning strategies with results demonstrating that those with a growth mindset were more likely to utilize feedback, efficiently monitor errors, and generally use more effective learning strategies such as quizzing and teaching (Ng 2018; Williams 2020). Finally, a large majority of the studies investigating mindset have explored its relationship with academic achievement or performance. However, the findings related to this relationship are mixed. Several studies demonstrated that there was little to no evidence that a growth mindset positively affected academic achievement (Bahnik and Vranka 2017; Bazelais et al. 2018; Kustritz 2017; Sisk et al. 2018) with one study demonstrating a negative, though insignificant, association between mindset and academic achievement (Li and Bates 2020). Conversely, there are several studies that supported the positive relationship between mindset and academic achievement (Blackwell et al. 2007; Destin et al. 2019; Liu et al. 2018; Romero et al. 2014; Yeager and Dweck 2020; Yeager et al. 2019). Finally, academic achievement may also influence mindset in a reciprocal manner by which academic outcomes may create shifts towards a greater growth or fixed mindset and be particularly relevant and greater for students starting out with a tendency towards fixed attitudes (Limeri et al. 2020).

The impact of mindset on academic achievement has been investigated in many populations. However, its impact on academic achievement has not been widely studied within the graduate health professions, including within doctor of physical therapy students, master of occupational therapy students, and master of speech language pathology students (Williams and Lewis 2021). Of the studies that have specifically measured mindset in health professions' students, mindsets have largely skewed toward strong growth or growth with some fixed ideas (Calo et al. 2022; Kustritz 2021; Stuart and Wolcott 2021; Williams 2020; Wolcott et al. 2021).

Numerous studies have examined factors that predict graduate grade point average (GPA), clinical performance, and pass rates on board examinations within these professions. Consistently, undergraduate GPA, prerequisite coursework, graduate record examination (GRE) scores, and behavioral interview scores were found to be positively correlated with outcomes (Baus et al. 2021; Coleman-Salgado 2019; Gleeson et al. 2020; Kjelgaard and Guarino 2012; Lysaght et al. 2009; Pucillo et al. 2022; Roman and Buman 2019). Behavioral

interviews evaluate a candidate's ability to utilize specific skills through their past experiences and are commonly assessed using a predetermined rubric of the demonstration of the skill through the candidate's response. However, these variables cannot necessarily predict how a student will respond to academic challenges in traditionally challenging science, technology, engineering and math (STEM) graduate coursework such as neuroanatomy (Javaid et al. 2019; Jozefowicz 1994). If mindset is associated with response to challenges, interventions to shift mindset towards growth may be worthwhile pedagogical strategies to implement as early as possible before or within matriculation into a graduate health professions program.

The purpose of this study was to examine the relationships between mindset, learning behaviors, and learning outcomes during an interprofessional neuroanatomy course taken in the first semester of a graduate health professions program. A secondary objective was to investigate the factors frequently examined in previous literature that predicted students' overall grade. The authors hypothesized that a greater growth mindset would be associated with increased occurrence of learning behaviors such as attendance at unstructured, professor-led office hours and higher achievement of learning outcomes as measured by examination and overall course grades.

Methods

This project was approved by the Moravian University Institutional Review board, protocol #22-0017, and informed consent was obtained from all participants.

Participants were recruited using convenience sampling. All first year doctor of physical therapy (DPT), master of occupational therapy (MSOT), and master of speech-language pathology (MSSLP) students were invited to participate. All students were enrolled in an interprofessional neuroanatomy and neurophysiology course. This course occurred during the first semester of their programs and was delivered and designed by the second author to provide a core syllabus of outcomes for the three health professions students. Each profession had a separate laboratory component that was discipline-specific. Potential participants were informed of the study by an outside party during their graduate program's orientation. They were provided with a short description of the study and a copy of the informed consent form. All students in the course were provided with the link to complete the survey and were told to only complete the survey if they completed the informed consent. The survey was open for three weeks, and reminders were sent on a weekly basis.

Survey Instrument

The instrument used in this survey consisted of a demographic questionnaire and a mindset survey adapted from the work of Dweck (Dweck 2006). The survey instrument used was Qualtrics (version June 2022, Qualtrics, Provo, UT). The demographic questionnaire asked participants to provide information about their gender, ethnicity, race, size of undergraduate institution, type of undergraduate institution (private or public) and first-generation student status. Finally, the survey asked students to report which relevant prerequisite courses they completed prior to entrance into their respective graduate programs. Undergraduate GPA for each participant was obtained from the university.

The mindset survey consisted of twenty questions scored on a four-point scale which included the descriptors "strongly agree," "agree," "disagree," and "strongly disagree." The survey included items that address an "ability mindset" and a "personality/character mindset" and was constructed as either a "fixed" or "growth" mindset statement. Each question was scored based upon its construction as either a "fixed" or "growth" statement and the participants' response. Scores ranged from 0 to 60 points and were divided into four categories: strong growth mindset (45-60), growth mindset with some fixed ideas (34-44), fixed mindset with some growth ideas (21-33), and strong fixed mindset (0-20). Despite its frequent use, there is no consensus on the reliability and validity of this instrument.

Outcome Variables

Learning behaviors of participants throughout the first semester of their graduate program, through their participation in the neuroanatomy and neurophysiology course, were collected by the course instructor. These behaviors included office hour attendance with the instructor, attendance during course-sponsored tutoring sessions, participation in bonus activities, and student correspondence about course material with the course instructor via email, exclusive of logistical questions. All of these learning behaviors were optional for students to attend. Educational outcomes, including examination grades and final course grades, were also collected by the course instructor. These data were provided to the primary investigator following the conclusion of the course. During the semester, all investigators were blinded to student participation in the research study.

Statistical Analysis

Learning behaviors were calculated as the sum of office hours and tutoring sessions attended, bonus activity participation, and email correspondences. Change scores between examinations were also calculated (e.g., $\Delta Grade_{12}$ = examination 2 grade – examination 1 grade). Normality of the data was assessed with the Shapiro-Wilk test and visual inspection of histograms. Frequencies were calculated for demographics variables, learning behaviors, and learning outcomes (examination grades, change scores between examinations, and overall grades).

Means and standard deviations (SDs) described normally distributed data; medians and interquartile ranges described non-normally distributed data. Differences between mindset scores and demographic variables were assessed with one-way analyses of variance (ANOVAs) and independent samples t-tests. Correlations between mindset scores and learning interactions and outcomes were assessed with Pearson's r (normally distributed data) and Spearman's ρ (non-normally distributed data). For the secondary objective of the study, correlations were used to assess the univariate relationships between predictor variables and overall neuroanatomy grades. Univariate correlations with p < 0.20 were retained for further analysis using multiple linear regression. Statistical significance was set to α = 0.05. All analyses were conducted in SPSS (version 27.0, IBM Corp, Armonk, NY).

Results

Forty-one of 89 enrolled first-year graduate students participated in the study (Table 1). The participants had a mean ± SD undergraduate GPA of 3.4 ± 0.3 and had taken a mean ± SD of 5.4 ± 2.2 prerequisite courses. The mean ± SD mindset score was 41.8 ± 4.8 (range: 28-54). Based on these scores, 10 students were categorized as "strong growth," 28 students as "growth with some fixed," and 3 students as "fixed with some growth." There were no significant differences in mindset scores based on demographics variables (Table 1).

Variable	Descriptive Statistics	P-Value
Program	20 Doctor of Physical Therapy 13 Master of Speech-Language Pathology 8 Master of Occupational Therapy	0.868†
Gender	35 Females 6 Males	0.784‡
Race/Ethnicity	30 White 11 Non-white*	0.159‡
Undergraduate Institution Type	25 Four-year public 11 Four-year private (non-profit) 5 Four-year private (for profit)	0.292†
Size of Undergraduate Institution	7 <2,000 students 16 2,000-5000 students 6 5,000-10,000 students 10 >10,000 students	0.675†
First-Generation College Student	7 Yes 34 No	0.460‡

*3 Asian, 2 Hispanic/Latino, 1 Other, 5 Mixed
†One-way analysis of variance
‡Independent samples t-test

Table 1. *Participant demographics and differences in mindset scores.*

There were no significant correlations (Table 2) between mindset scores and learning behaviors or any learning outcomes (examination grades, change scores between exam grades, or overall course grade).

Variable	Central Tendency and Dispersion	Correlation with Mindset
Learning Interactions*	4 ± 3†	$\rho = 0.18$, $p = 0.257$
Examination 1 Grade	84.0 ± 21.8†	$\rho = -0.03$, $p = 0.840$
Examination 2 Grade	92.0 ± 14.0†	$\rho = 0.11$, $p = 0.480$
Examination 3 Grade	81.6 ± 11.4‡	$r = 0.12$, $p = 0.472$
$\Delta Grade_{12}$ (Exam 2–Exam 1)	3.0 ± 12.0‡	$r = 0.17$, $p = 0.279$
$\Delta Grade_{13}$ (Exam 3–Exam 1)	-1.8 ± 11.9‡	$r = 0.11$, $p = 0.479$
$\Delta Grade_{23}$ (Exam 3–Exam 2)	-4.8 ± 8.3‡	$r = -0.09$, $p = 0.593$
Overall Grade	89.8 ± 7.0‡	$r = 0.09$, $p = 0.558$

*Learning interactions are the sum of office hours attended, tutoring sessions attended, bonus activities participated in, and email correspondences
†Median ± interquartile range
‡Mean ± standard deviation

Table 2. *Learning interactions, learning outcomes, and correlations with mindset scores.*

For the secondary objective of the study and based on univariate analyses, three variables were retained for multiple regression (p < .20): race/ethnicity, undergraduate GPA, and number of prerequisite courses (Table 3). In those univariate analyses, higher overall grades were associated with Caucasian participants, higher undergraduate GPAs, and more prerequisite courses taken. The multivariable model that best predicted overall neuroanatomy grade included undergraduate GPA and number of prerequisite courses (R^2 = 0.234, F(2,37) = 5.652, p = 0.007). The regression equation for this model was Overall Grade = 43.86 + undergrad GPA*11.43 + prerequisites*1.25. This model explained 23.4% of the variance in overall neuroanatomy grades.

Variable	Correlation with Overall Neuroanatomy Grade
Gender	r_{pb} = 0.13, p = 0.412
Race/ethnicity	r_{pb} = 0.30, p = 0.055*
Size of Undergraduate Institution	ρ = -0.05, p = 0.784
First-Generation College Student	r_{pb} = 0.01, p = 0.962
Mindset Score	r = 0.09, p = 0.558
Undergraduate Grade Point Average	r = 0.33, p = 0.037*
Number of Prerequisite Courses	r = 0.25, p = 0.126*
Learning Interactions	ρ = -0.18, p = 0.274

Abbreviations: r_{pb}, point-biserial correlation coefficient
*p < 0.20

Table 3. *Univariate correlations with overall neuroanatomy grade.*

Discussion

Many factors impact a student's success in a graduate health professions program. All programs create admissions standards with the attempt to enroll students most likely to complete the program and continuously review those standards when students do not achieve learning outcomes or degree completion. However, the admissions process cannot effectively capture how a student will respond to challenges or how well they believe they can improve when they face academic challenges or setbacks. A student with a growth mindset has been suggested to be more likely to respond to academic challenges by taking the steps necessary to improve their performance, such as attending office hours or review sessions (Dweck and Leggett 1988; Ng 2018; Williams 2020).

The results of this study did not reveal any statistically significant relationships between mindset and learning outcomes, nor any demographic factors related to mindset in a first semester neuroanatomy course of a graduate health professions program. The findings are consistent with previous studies that have also found no relationship between mindset and learning outcomes (Bahnik and Vranka 2017; Bazelais et al. 2018; Calo et al. 2022; Kustritz 2017; Sisk et al. 2018). All but three participants had a growth mindset (strong growth or growth with some fixed ideas), and none were classified as strong fixed, which may have limited the ability to capture the impact of a fixed mindset on learning outcomes and behaviors.

The mindset of students in this study, all healthcare trainees, is also consistent with previous studies (Calo

et al. 2022; Stuart and Wolcott 2021). It is possible that students who are attracted to the health professions, specifically physical therapy, occupational therapy, and speech language pathology, either have or develop growth mindsets. A significant amount of the work of and training to become a healthcare provider is dedicated to motivating behavior change and facilitating a positive outlook toward rehabilitation. Even if they began their undergraduate careers with more fixed ideas, the students may have developed growth mindsets throughout their undergraduate careers as they experienced success in their prerequisite course work or overcame challenges in these courses, demonstrating the reciprocal relationship proposed in previous studies (Limeri et al. 2020).

Additionally, the exam grades among the participants were all above a mean of 80%, and the average overall course grade, which included quizzes and group assignments based on completion, was 89%, with all students passing the course. As previously mentioned, the literature examining the relationships between mindset and academic outcomes is mixed, with some studies finding strong relationships between growth mindset and positive academic outcomes and others finding no evidence. Any investigation into factors that influence learning outcomes must account for the vast differences in how those learning outcomes are measured, the level of transparency from the instructor on how to achieve these outcomes, the availability of support, and opportunities for feedback prior to higher stakes assessments. Student outcomes have also been shown to be related to the mindset of the instructor. A fixed mindset in an instructor was shown to have a disproportionately detrimental effect on underrepresented minority students in STEM education (Canning et al. 2019). More heterogeneity in both mindset and exam score than is present in this study may be needed to capture the relationships between mindset and academic achievement found in previous studies.

Mindset was also not correlated with learning behaviors such as emailing the instructor with questions, attending office hours, and attending tutoring sessions. A pilot study conducted in the summer of 2021 among only the DPT students (n=17) taking the same course found that mindset was also heavily skewed toward growth in this sample (88% strong growth or growth with some fixed, no strong fixed). This investigation found significant correlations between mindset and office hours attendance, attendance at exam reviews and the final examination, but not with overall course grade or the first 2 exams, suggesting that mindset may be related to learning behaviors that "pay off" at the end of the course (Elinich et al. 2021). By expanding the investigation to capture more types of learning behaviors and increasing the study population, the authors hoped to increase heterogeneity in mindset scores and reveal any significant relationships between mindset, learning outcomes and learning behaviors, and did not anticipate the same trend in mindset scores.

It is worth noting that all the participants participated in at least two, and up to 13 unique learning behaviors, with an average of 4 ± 3 interactions across the participants over a 10-week course, or close to an average of once every 2.5 weeks. Given the long-standing debate about the usefulness of office hours and the reasons students tend not to participate in them, this was an encouraging result. Previous studies examining why students do not ask for help, usually in the form of office hour attendance, have cited a lack of usefulness and not knowing what questions to ask as common reasons for not seeking assistance (Griffin et al. 2014). In the interprofessional neuroanatomy course, students were provided with weekly formative quizzes as well as study guides and were strongly encouraged to break down each quiz question until they could justify their answers and explain them to an instructor or peer. Thus, most of the email correspondence, tutoring and office hour attendance was spent directly working through difficult problems that students were aware they needed to overcome. This help-seeking behavior is consistent with previous students that have shown that growth mindset is related to feedback-seeking and improved performance on formative assessments (Ng 2018; Stuart and Wolcott 2021; Williams 2020; Yan et al. 2014).

The authors also sought to determine what factors predict a student's overall neuroanatomy grade. Consistent with the literature that examines graduate anatomy and neuroanatomy courses, undergraduate GPA is a consistent predictor of performance (Coleman-Salgado 2019; Gleeson et al. 2020; Kjelgaard and Guarino 2012; Lysaght et al. 2009; Pucillo et al. 2022; Roman and Buman 2019). The number of prerequisite courses was also a significant predictor in the model of performance. Among the three groups of health professions students in this study, prerequisite requirements varied greatly. The DPT students are required to take over twice the STEM courses for admission compared to MSOT and MSSLP students with the result that the DPT students averaged significantly more of these courses taken than the MSOT and MSSLP students (6.8 ± 1.4 versus 4.5 ± 2.4 and 3.8 ± 1.6, respectively). Previous studies have shown that prerequisite coursework performance predicts graduate coursework performance, but the results are mixed in terms of the number of courses, specific content of courses, or overall science GPA (Baus et al. 2021; Halberstam and Redstone 2005; Pucillo et al. 2022, Roman and Burman 2019; Sylvan et al. 2020). Prerequisite coursework may provide students with a foundational knowledge base upon which to build their graduate coursework, or simply to help develop the skills to be successful in a science course at the graduate level. However, the benefits of this prerequisite coursework may be limited to those initial basic science courses in a curriculum (Coleman-Salgado 2019). Furthermore, success within these courses may encourage a growth mindset, as models of a feedback loop between mindset and academic achievement have been proposed (Limeri et al. 2020).

Limitations

This study helps to address a gap in the literature on mindset and its impact on learning outcomes among graduate healthcare professions students. It incorporated learning behaviors such as completion of bonus activities, attendance at tutoring sessions, emails, and office hours in addition to grades, as well as examination of the change scores between exams. The study was limited by the lack of variety in mindset scores as well as a tendency for all participants to achieve high scores on the exams and high overall course grades. There are inherent limitations to survey-based research including measuring variables of interest at only one point in time, the potential for self-report bias, and the potential for variable interpretation of survey questions. Recruitment for the study occurred during what could be a potentially overwhelming time for the incoming graduate student, and this may have contributed to the 47% participation rate. The participants were predominantly white, female, and at least second-generation college students, which limits the generalizability to larger, more diverse populations of students. The authors were also unable to capture any other learning behaviors such as watching videos, meeting with peers, or the myriad other factors such as time available to study, social support, and health challenges that may have contributed to their grades.

Conclusion

This study found that graduate healthcare trainees overwhelmingly possess a growth mindset, but the results of this investigation are unable to associate that mindset with their learning behaviors or learning outcomes. Learning outcomes in graduate education continue to be predicted by undergraduate GPA and prerequisite coursework. Therefore, the results of this investigation suggest that interventions to shift mindset would not have a beneficial effect on learning outcomes or behaviors in this population. However, as there are interrelationships with mindset and other variables such as grit and resilience, it may be worth investigating the impact of these variables on learning outcomes and learning behaviors in future studies to learn how instructors can facilitate optimal learning strategies and outcomes in health professions students to maximize both their academic and professional success. Future studies should consider re-administering the mindset instrument at the end of a course to see if learning outcomes cause shifts in mindset, and which students are more vulnerable to shifts towards a fixed mindset when they encounter challenges. Finally, it may be worthwhile to examine the relationship between mindset and learning outcomes for students further into their graduate programs, rather than at the onset of their graduate studies, after they have potentially had more academic challenges to overcome.

About the Authors

Jennifer Elinich, PT, DPT, is an Assistant Professor in the Doctor of Physical Therapy Program at Moravian University in Bethlehem, Pennsylvania. She teaches courses in neurologic physical therapy examination and intervention. Krista Rompolski, Ph.D., is an Associate Professor in the Doctor of Physical Therapy Program at Moravian University in Bethlehem, Pennsylvania. She teaches courses in gross anatomy, neuroanatomy, pathophysiology, and exercise physiology. Travis Pollen, Ph.D., is an Assistant Professor at Thomas Jefferson University in Philadelphia, Pennsylvania. He teaches courses in exercise science.

Literature Cited

Bahnik S, Vranka MA. 2017. Growth mindset is not associated with scholastic aptitude in a large sample of university applicants. *Pers Indiv Differ* 117(1):139-143. https://doi.org/10.1016/j.paid.2017.05.046

Barbouta A, Barbouta C, Kotrotsiou S. 2020. Growth mindset and grit: How do university students' mindsets and grit affect their academic achievement? *Int J Car Sci* 13(1):654-664.

Baus CA, Lunsford D, Valdes KA. 2021. Factors impacting student success in a graduate neuroscience course. *J Occup Ther Educ* 5(3). https://doi.org/10.26681/jote.2021.050303

Bazelais P, Lemay DJ, Doleck T, Hu XS, Vu A, Yao J. 2018. Grit, mindset, and academic performance: A study of pre-university science students. *Eurasia J Math Sci Tech Educ* 14(12):em1615. https://doi.org/10.29333/ejmste/94570

Blackwell LS, Trzesniewski KH, Dweck CS. 2007. Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Dev* 78(1):246-263. https://doi.org/10.1111/j.1467-8624.2007.00995.x

Calo M, Judd B, Chipchase L, Blackstock F, Peiris CL. 2022. Grit, resilience, mindset, and academic success in physical therapist students: A cross-sectional, multicenter study. *Phys Ther* 102(6):1-10. https://doi.org/10.1093/ptj/pzac038

Canning EA, Muenks K, Green DJ, Murphy MC. 2019. STEM faculty who believe ability is fixed have larger racial achievement gaps and inspire less student motivation in their classes. *Sci Adv* 5(2):eaau4734. https://doi.org/10.1126/sciadv.aau4734

Coleman-Salgado B. 2019. The relationship of preadmission academic variables to academic performance in a Doctor of Physical Therapy program. *J Allied Health* 48(1):e9-e14.

Destin M, Hanselman P, Buontempo J, Tipton E, Yeager DS. 2019. Do student mindsets differ by socioeconomic status and explain disparities in academic achievement in the United States? *AERA Open* 5(3). https://doi.org/10.1177/2332858419857706

Duckworth AL, Quinn PD. 2009. Development and validation of the Short Grit Scale (Grit-S). *J Pers Assess* 91(2):166-174. https://doi.org/10.1080/00223890802634290

Dweck CS, Leggett EL. 1988. A social-cognitive approach to motivation and personality. *Psychol Rev* 95(2):256-273. https://psycnet.apa.org/doi/10.1037/0033-295X.95.2.256

Dweck CS. 2006. Mindset: the new psychology of success. New York (NY): Random House Publishing Group.

Elinich J, Rompolski K, Pollen T. 2021. Impact of mindset on learning outcomes in physical therapy students. *20th Ann Fac Conf Teach Excellence*, Temple University, Philadelphia, PA.

Griffin W, Cohen SD, Berndtson R, Burson KM, Camper KM, Chen Y, Smith MA. 2014. Starting the conversation: An exploratory study of factors that influence student office hour use. *Coll Teach* 62(3):94-99. https://doi.org/10.1080/87567555.2014.896777

Gleeson PB, Mitchell KE, Ellison J, Schaumberg EC, Travis SA, Naiki A, et al. 2020. Demographic and preadmission factors predictive of first year DPT program success. *CSM APTA Comb Sec Meet*, Denver, CO.

Halberstam B, Redstone F. 2005. The predictive value of admissions materials on objective and subjective measures of graduate school performance in speech-language pathology. *J High Educ Policy Manag* 27(2): 261-272. https://doi.org/10.1080/13600800500120183

Hochanadel A, Finamore D. 2015. Fixed and growth mindset in education and how grit helps students persist in the face of adversity. *Int J Educ Res* 11(1):47-50. https://doi.org/10.19030/jier.v11i1.9099

Jozefowicz RF. 1994. Neurophobia: the fear of neurology among medical students. *Arch Neurol* 51(4):328–329. https://doi.org/10.1001/archneur.1994.00540160018003

Javaid MA, Chakraborty S, Cryan JF, Schellekens H, Toulouse A. 2018. Understanding neurophobia: Reasons behind impaired understanding and learning of neuroanatomy in cross-disciplinary healthcare students. *Anat Sci Educ* 11(1):81-93. https://doi.org/10.1002/ase.1711

Kjelgaard MM, Guarino AJ. 2012. Assessing the predictive validity of the admission process in a master's level speech language pathology program. *Psychol Rep* 111(2):613-617. https://doi.org/10.2466/03.15.28.PR0.111.5.613-617

Klein J, Delany C, Fischer MD, Smallwood D, Trumble S. 2017. A growth mindset approach to preparing trainees for medical error. *BMJ Qual Safe* 26(9):771-774. http://dx.doi.org/10.1136/bmjqs-2016-006416

Kustritz MVR. 2017. Pilot study of veterinary student mindset and association with academic performance and perceived stress. *J Vet Med Educ* 44(1):141-146. https://doi.org/10.3138/jvme.1115-181R1

Li Y, Bates TC. 2020. Testing the association of growth mindset and grades across a challenging transition: Is growth mindset associated with grades? *Intelligence* 81:101471. https://doi.org/10.1016/j.intell.2020.101471

Limeri LB, Carter NT, Choe J, Harper HG, Martin HR, Benton A, Dolan EL. 2020. Growing a growth mindset: Characterizing how and why undergraduate students' mindsets change. *Int J STEM Educ* 7(1):35. https://doi.org/10.1186/s40594-020-00227-2

Liu Y, Robinson MN, Xu, H. 2018. The effect of mindset on students' desire to work for big four accounting firms and on academic performance. *e-J Bus Educ Schol Teach*12(2):92-106.

Lysaght R, Donnelly C, Villeneuve M. 2009. Factors predicting applicant outcomes in occupational therapy education. *Can J Occup Ther* 76(1):38-47. https://doi.org/10.1177/000841740907600110

Mosanya M. 2021. Buffering academic stress during the COVID-19 pandemic related social isolation: Grit and growth mindset as protective factors against the impact of loneliness. *Int J Appl Posit Psychol* 6(2):159–174. https://doi.org/10.1007/s41042-020-00043-7

Ng B. 2018. The neuroscience of growth mindset and intrinsic motivation. *Brain Sci* 8(2):20. https://doi.org/10.3390/brainsci8020020

Pucillo EM, Marinas R, Salmon C, Agrawal V. 2022. Admission variables predict success in a hybrid-online physical therapist education program. *Int J Allied Health Sci Prac* 20(1):Article 18. https://doi.org/10.46743/1540-580X/2022.2122

Roman G, Buman MP. 2019. Preadmission predictors of graduation success from a physical therapy education program in the United States. *J Educ Eval Health Prof* 16:5. https://doi.org/10.3352%2Fjeehp.2019.16.5

Romero C, Master A, Paunesku D, Dweck CS, Gross JJ. 2014. Academic and emotional functioning in middle school: The role of implicit theories. *Emotion* 14(2):227-234. https://doi.org/10.1037/a0035490

Sanderson B, Brewer M. 2017. What do we know about student resilience in health professional education? A scoping review of the literature. *Nurse Educ Today* 58:65–71. https://doi.org/10.1016/j.nedt.2017.07.018

Sisk VF, Burgoyne AP, Sun J, Butler JL, Macnamara BN. 2018. To what extent and under which circumstances are growth mind-sets important to academic achievement? Two meta-analyses. *Psychol Sci* 29(4):549-571. https://doi.org/10.1177/0956797617739704

Stuart PE, Wolcott DM. 2021. Investigating the impacts of a semester long growth mindset intervention on students' academic success in a human anatomy course. *HAPS Educator* 25(3):45-54. https://doi.org/10.21692/haps.2021.032

Sylvan L, Brock KL, Perkins A, Garrett J. 2020. Building blocks of knowledge: A close look at prerequisite coursework for graduate programs in speech-language pathology. *Perspectives* 5(5):1262-1271. https://doi.org/10.1044/2020_PERSP-20-00042

Wang S, Dai J, Li J, Wang X, Chen T, Yang X, et al. 2018. Neuroanatomical correlates of grit: Growth mindset mediates the association between gray matter structure and trait grit in late adolescence. *Hum Brain Mapp* 39(4):1688-1699. https://doi.org/10.1002/hbm.23944

Whittington RE, Rhind S, Loads D, Handel I. 2017. Exploring the link between mindset and psychological well-being among veterinary students. *J Vet Med Educ* 44(1):134-140. https://doi.org/10.3138/jvme.1215-192R

Williams C. 2020. Nursing students' mindsets and choice of learning strategies. *Nurs Educ* 46(2):92-95. doi: http://doi.org/10.1097/NNE.0000000000000870

Williams CA, Lewis L. 2021. Mindsets in health professions education: A scoping review. *Nurs Educ Today* 100:104863. https://doi.org/10.1016/j.nedt.2021.104863

Wolcott MD, McLaughlin JE, Hann A, Miklavec A, Beck Dallaghan GL, Rhoney DH, Zomorodi M. 2021. A review to characterize and map the growth mindset theory in health professions education. *Med Educ* 55(4):430-440. https://doi.org/10.1111/medu.14381

Yeager DS, Hanselman P, Walton GM, Murray JS, Crosnoe R, Muller C et al. 2019. A national experiment reveals where a growth mindset improves achievement. *Nature* 573:364-369. https://doi.org/10.1038/s41586-019-1466-y

Yeager DS, Dweck CS. 2020. What can be learned from growth mindset controversies? *Am Psychol* 75(9):1269-1284. https://psycnet.apa.org/doi/10.1037/amp0000794

Yan VX, Thai K-P, Bjork RA. 2014. Habits and beliefs that guide self-regulated learning: Do they vary with mindset? *J Appl Res Mem Cogn* 3(3):140–52. http://dx.doi.org/10.1016/j.jarmac.2014.04.003

Appendix 1: Mindset Quiz

To what extent do you agree or disagree with these statements?
(Strongly Agree   Agree   Disagree   Strongly Disagree)

1. Your intelligence is something very basic about you that you can't change very much. _____

2. No matter how much intelligence you have, you can always change it quite a bit. _____

3. You can always substantially change how intelligent you are. _____

4. You are a certain kind of person, and there is not much that can be done to really change that. _____

5. You can always change basic things about the kind of person you are. _____

6. Music talent can be learned by anyone. _____

7. Only a few people will be truly good at sports – you have to be "born with it." _____

8. Math is much easier to learn if you are male or maybe come from a culture who values math. _____

9. The harder you work at something, the better you will be at it. _____

10. No matter what kind of person you are, you can always change substantially. _____

11. Trying new things is stressful for me and I avoid it. _____

12. Some people are good and kind, and some are not – it's not often that people change. _____

13. I appreciate when people, parents, coaches, teachers give me feedback about my performance. _____

14. I often get angry when I get feedback about my performance. _____

15. All human beings without a brain injury or birth defect are capable of the same amount of learning. _____

16. You can learn new things, but you can't really change how intelligent you are. _____

17. You can do things differently, but the important parts of who you are can't really be changed. _____

18. Human beings are basically good, but sometimes make terrible decisions. _____

19. An important reason why I do my school work is that I like to learn new things. _____

20. Truly smart people do not need to try hard. _____

Key

1. ability mindset – fixed
2. ability mindset –growth
3. ability mindset – growth
4. *personality/character mindset - fixed*
5. *personality/character mindset – growth*
6. ability mindset – growth
7. ability mindset – fixed
8. ability mindset – fixed
9. ability mindset – growth
10. *personality/character mindset - growth*
11. ability mindset – fixed

12. *personality/character mindset – fixed*
13. ability mindset –growth
14. ability mindset – fixed
15. ability mindset – growth
16. ability mindset – fixed
17. *personality/character mindset – fixed*
18. *personality/character mindset –growth*
19. ability mindset – growth
20. ability mindset - fixed

Scoring
Growth Questions
1. Strongly agree – 3 points
2. Agree – 2 points
3. Disagree – 1 points
4. Strongly disagree – 0 point

Fixed Questions
1. Strongly agree – 0 point
2. Agree – 1 points
3. Disagree – 2 points
4. Strongly disagree – 3 points

Strong Growth Mindset = 60-45 points
Growth Mindset with some Fixed ideas = 44-34 points
Fixed Mindset with some Growth ideas= 33-21 points
Strong Fixed Mindset= 20-0 points

Adapted from: Dweck, C. S. (2006). Mindset: The new psychology of success. New York: Random House Inc.