

# CHIROPRACTIC EDUCATION READINESS ASSESSMENT (CERA): ADVANCING ACADEMIC AND PROFESSIONAL READINESS

## Introduction

In 2023, the National Board of Chiropractic Examiners (NBCE) introduced a novel approach to evaluate prospective chiropractic students with the Chiropractic Education Readiness Assessment (CERA). This diagnostic tool aims to assess the likelihood of a student's success in chiropractic school and their potential for both academic and clinical excellence. *The instrument was not designed to be a barrier for admissions but to diagnose potential educational deficits in core subjects such as mathematics and sciences.*

CERA is divided into two main components: *cognitive* and *non-cognitive* assessments. The cognitive portion evaluates traditional academic skills and knowledge, while the non-cognitive portion focuses on personal attributes such as self-efficacy, grit, and emotional intelligence. This initiative marks a significant shift in the chiropractic profession's approach to student assessment, emphasizing the importance of personal factors in predicting a student's ability to thrive in the rigorous environment of chiropractic education.

## Predictors of Successful Completion of Doctor of Chiropractic Programs (DCPs)

The predictors of success in chiropractic doctoral programs combine a range of academic and non-academic factors, which collectively shape the likelihood of a student thriving in academic and clinical settings. Among the academic predictors, undergraduate GPA emerges as a significant indicator of performance in chiropractic programs (Himelfarb, Shotts, & Gow, 2022). Additionally, Zwick and Himelfarb (2011) showed that high school GPA is the strongest predictor of first-year college GPA. Research by Long and Chen (2020) highlights that a higher undergraduate GPA correlates with a better end-of-trimester-1 GPA. The study also reveals that while there are no significant GPA differences based on race, ethnicity, or sex, age and prerequisite GPAs remain pivotal, suggesting that older students may require additional support to achieve comparable success to their younger counterparts.

Performance in specific undergraduate courses, particularly chemistry, anatomy, and physiology, further influences academic success in chiropractic school (Green, Johnson, & McCarthy, 2003; McRae, 2010; Cunningham, DesJardins, & Christensen, 2005). Long and Chen (2020) found that grades in organic chemistry significantly predict performance in chiropractic biochemistry, indicating the necessity of a solid foundation in these subjects. Similarly, proficiency in anatomy and physiology is crucial, as these courses form the backbone of chiropractic education and are essential for understanding more advanced topics.

Beyond academic criteria, demographic factors may be related to students' success (Abubakar et al., 2011; Sheard, 2009). Age was determined to predict academic outcomes in chiropractic programs, with younger students often outperforming their older peers, as highlighted by Long and Chen (2020). Additionally, attributes such as hard work, commitment, and grit are critical for academic achievement. Pulkkinen and de la Ossa (2021) explored the concept of grit, defined as perseverance and passion for long-term goals, and found a moderate correlation between grit

scores and GPA. Their research suggests that students who demonstrate higher levels of grit tend to perform better academically, stressing the value of assessing non-cognitive traits during admissions.

Effective communication and empathy were identified as significant predictors of success in chiropractic education and practice (Marchiori, Henkin, & Hawk, 2008). These skills can be evaluated through personal interviews and situational judgment tests, ensuring that students are well-prepared for patient interactions and teamwork. Furthermore, stress management is crucial for chiropractic students, who often face high academic expectations and heavy workloads (Innes, 2017; Zhang & Henderson, 2022).

## **Psychological Predictors of Academic Success**

Self-efficacy. Self-efficacy, defined as an individual's belief in their ability to succeed in specific situations or accomplish a task (Bandura, 1982; 1983), plays a pivotal role in educational settings. High self-efficacy influences the effort students put into their studies, their resilience in the face of challenges, and their overall academic performance (Lai Mooi, 2006; Andres, 2020). Research has consistently demonstrated that students with higher self-efficacy are more likely to set challenging goals and persist through difficulties (Zimmerman, 2000). For example, a study by Chemers, Hu, and Garcia (2001) found that college students with high self-efficacy were more likely to report higher levels of academic performance and greater satisfaction with their academic experience.

Grit. Grit, defined by Duckworth et al. (2007) as "perseverance and passion for long-term goals," is another crucial non-cognitive trait linked to educational success. Gritty individuals are characterized by their sustained effort and interest over long periods, despite setbacks and challenges. Duckworth and colleagues (2007) demonstrated that grit predicts success in various domains, including education. Their research showed that grittier students were more likely to graduate from high school and perform well in competitive environments.

Several studies have further explored the relationship between grit and academic performance. Duckworth and Quinn (2009) developed the Grit-S scale, a concise measure of grit, and validated its effectiveness in predicting academic achievement. Their findings indicated that students with higher grit scores tend to achieve better grades and have higher retention rates.

A study by Bowman et al. (2015) investigated the role of grit in undergraduate students and found that grit predicted college GPA and retention beyond traditional academic factors like high school GPA and standardized test scores. Similarly, Strayhorn (2014) examined grit among Black male college students and discovered that grittier students were more likely to persist in their studies and achieve higher academic outcomes.

Grit's influence on academic performance extends across various educational settings and populations. For example, research by Wolters and Hussain (2015) demonstrated that grit positively correlated with self-regulated learning behaviors, which are crucial for academic success. These behaviors include goal setting, time management, and persistence in studying challenging materials.

Additionally, grit has been studied in relation to STEM (science, technology, engineering, and mathematics) education. Research by Lee and Sohn (2017) found that grit predicted persistence and performance in STEM courses, where students often encounter complex and demanding content.

*Emotional Intelligence.* Emotional intelligence (EI), the ability to recognize, understand, and manage one's own emotions and the emotions of others (Salovey & Mayer, 1990), has been increasingly recognized as a significant predictor of educational success. Goleman (1995) popularized the concept, suggesting that EI is as important as IQ in achieving success in life and academics. Research by Brackett, Rivers, and Salovey (2011) found that students with higher emotional intelligence tend to have better social relationships, which in turn supports a positive learning environment and enhances academic performance. Moreover, students with high EI are better equipped to handle stress, leading to improved mental health and academic resilience (Schutte et al., 1998).

In a study conducted by Parker et al. (2004), emotional intelligence was found to be a strong predictor of first-year college students' success. The researchers discovered that students with higher EI scores were more likely to perform well academically, as EI contributed to better adjustment to university life and academic demands.

Furthermore, EI is also closely linked to resilience and the ability to cope with stress and adversity. Students with high EI are better equipped to manage negative emotions, remain calm under pressure, and maintain a positive outlook in the face of challenges. This resilience contributes to improved academic performance and overall well-being (Martins, Ramalho, & Morin, 2010).

Research by Schutte et al. (2007) demonstrated that EI is associated with lower levels of stress and anxiety, which in turn leads to better academic performance. Students with high EI are more likely to use adaptive coping strategies, such as problem-solving and seeking social support, which help them navigate the demands of academic life effectively.

### **Test Plan and Scoring**

The CERA is designed as a comprehensive evaluation tool that measures both cognitive and non-cognitive readiness for chiropractic education. The cognitive section includes 50 multiple-choice questions, each worth two points, resulting in a total possible score of 100. These questions are distributed across five subject domains with the following weightings: Mathematics (22%), Physics (10%), Biology (36%), Chemistry (20%), and Scientific Principles (12%). Based on their total score, students are categorized into one of three performance levels: *Below Proficiency*, *Proficient*, or *Advanced*. These levels provide a clear indicator of how well students meet the expectations for knowledge in these critical areas.

In addition to an overall score, students and chiropractic programs will receive detailed feedback on their performance in each subject domain, expressed as a proficiency level, helping them identify strengths and areas for improvement.

The non-cognitive section consists of 60 items. Responses are rated on a 5-point Likert scale, and scores for each attribute are averaged to provide an overall measure in that area. Eventually, factor analysis (Gorsuch, 1997; Comrey & Lee, 1991) will be conducted and factor score will be used to construct the profiles of students. Students receive personalized feedback on their scores, offering valuable insights into their strengths and potential areas for growth.

The scoring methodology for CERA is designed to adapt as the test evolves. Initially, CERA will be scored using Classical Test Theory (CTT, Allen & Yen, 2001; Crocker & Algina, 1986), which focuses on total scores and provides a straightforward measure of overall performance. CTT is particularly useful in the early stages of test implementation, as it allows for the evaluation of test reliability and validity. As the assessment progresses over time, scoring will transition to Item Response Theory (IRT, Lord & Novick, 1968; Hambleton & Swaminathan, 2013), a more advanced approach that considers item difficulty, discrimination, and individual ability. IRT's adaptive features will enable a more precise evaluation of candidate performance, particularly at the boundaries of proficiency levels, ensuring the assessment remains a robust diagnostic tool.

To establish performance standards for the cognitive part, CERA underwent a standard-setting process on September 28, 2024, using the Bookmark method. The process resulted in the definition of three performance levels: *Below Proficiency*, *Proficient*, and *Advanced*. These categories provide clear and actionable indicators of a candidate's readiness for chiropractic education.

## References

- Abubakar, A., Van de Vijver, F. J., Alonso-Arbiol, I., Suryani, A. O., Pandia, W. S., Handani, P., ... & Murugumi, M. (2016). Assessing sense of school belonging across cultural contexts using the PSSM: Measurement and functional invariance. *Journal of Psychoeducational Assessment, 34*(4), 380-388.
- Allen, M. J., & Yen, W. M. (2001). *Introduction to measurement theory*. Waveland Press.
- Andres, H. (2020). The role of active teaching, academic self-efficacy, and learning behaviors in student performance. *Journal of International Education in Business, 13*(2), 221-238.
- Atkinson, R. C., & Geiser, S. (2009). Reflections on a century of college admissions tests. *Educational Researcher, 38*(9), 665-676.
- Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122.
- Bandura, A. (1983). Self-efficacy determinants of anticipated fears and calamities. *Journal of Personality and Social Psychology, 45*(2), 464.
- Bowman, N. A., Hill, P. L., Denson, N., & Bronkema, R. (2015). Keep on truckin' or stay the course? Exploring grit dimensions as differential predictors of educational achievement, satisfaction, and intentions. *Social Psychological and Personality Science, 6*(6), 639-645.
- Brackett, M. A., Rivers, S. E., & Salovey, P. (2011). Emotional intelligence: Implications for personal, social, academic, and workplace success. *Social and Personality Psychology Compass, 5*(1), 88-103.
- Chemers, M. M., Hu, L. T., & Garcia, B. F. (2001). Academic self-efficacy and first year college student performance and adjustment. *Journal of Educational Psychology, 93*(1), 55.
- Comrey, A. L., & Lee, H. B. (1991). *A first course in factor analysis*. Psychology press.
- Crocker, L., & Algina, J. (1986). *Introduction to classical and modern test theory*. Holt, Rinehart and Winston, 6277 Sea Harbor Drive, Orlando, FL 32887.

- Cunningham, K. A., DesJardins, S. L., & Christensen, M. G. (2005). Predictive efficacy of chiropractic college assessment test scores in basic science chiropractic education. *Journal of Manipulative and Physiological Therapeutics*, 28(3), 175-178.
- 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*, 92(6), 1087.
- Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the Short Grit Scale (GRIT-S). *Journal of Personality Assessment*, 91(2), 166-174.
- Green, B., Johnson, C., & McCarthy, R. (2003). Predictors of performance on the Chiropractic College Aptitude Test (CCAT). *Journal of Manipulative and Physiological Therapeutics*, 26(6), 383-389.
- Goleman, D. (1995). Emotional intelligence. Why it can matter more than IQ. *Learning*, 24(6), 49-50.
- Gorsuch, R. L. (1997). Exploratory factor analysis: Its role in item analysis. *Journal of Personality Assessment*, 68(3), 532-560.
- Hambleton, R. K., & Swaminathan, H. (2013). *Item response theory: Principles and applications*. Springer Science & Business Media.
- Himelfarb, I., Shotts, S., & Gow, D. (2022). Predictors of academic success in chiropractic education. *Journal of Chiropractic Education*, 36(2), 231-240.
- Innes, S. I., & Simpson, J. K. (2022). Empathy levels in Australian chiropractic students. *Journal of Chiropractic Education*, 36(2), 110-116.
- Lai Mooi, T. (2006). Self-efficacy and student performance in an accounting course. *Journal of Financial Reporting and Accounting*, 4(1), 129-146.
- Lee, S., & Sohn, Y. W. (2017). Effects of grit on academic achievement and career-related attitudes of college students in Korea. *Social Behavior and Personality: An International Journal*, 45(10), 1629-1642.
- Long, A. N., & Chen, P. D. (2020). Admissions criteria as predictors of first-term success at a chiropractic institution. *Journal of Chiropractic Education*, 34(2), 132-139.
- Lord, F.M., & Novick, M.R. (1968). *Statistical theories of mental test scores*. Reading, MA: Addison-Wesley.
- Marchiori, D. M., Henkin, A. B., & Hawk, C. (2008). Social communication skills of chiropractors: implications for professional practice. *Journal of Manipulative and Physiological Therapeutics*, 31(9), 682-689.
- Martins, A., Ramalho, N., & Morin, E. (2010). A comprehensive meta-analysis of the relationship between emotional intelligence and health. *Personality and Individual Differences*, 49(6), 554-564.
- McRae, M. P. (2010). Correlation of preadmission organic chemistry courses and academic performance in biochemistry at a Midwest chiropractic doctoral program. *Journal of Chiropractic Education*, 24(1), 30-34.
- Parker, J. D., Summerfeldt, L. J., Hogan, M. J., & Majeski, S. A. (2004). Emotional intelligence and academic success: Examining the transition from high school to university. *Personality and Individual Differences*, 36(1), 163-172.
- Pulkkinen, E. A., & de la Ossa, P. P. (2021). Grit and academic performance in chiropractic students. *Journal of Chiropractic Education*, 35(1), 41-50.
- Salovey, P., & Mayer, J. D. (1990). Emotional intelligence. *Imagination, Cognition and Personality*, 9(3), 185-211.
- Schutte, N. S., Malouff, J. M., Hall, L. E., Haggerty, D. J., Cooper, J. T., Golden, C. J., & Dornheim, L. (1998). Development and validation of a measure of emotional intelligence. *Personality and Individual Differences*, 25(2), 167-177.
- Sheard, M. (2009). Hardiness commitment, gender, and age differentiate university academic performance. *British Journal of Educational Psychology*, 79(1), 189-204.
- Strayhorn, T. L. (2014). What role does grit play in the academic success of black male collegians at predominantly white institutions? *Journal of African American Studies*, 18, 1-10.
- Wolters, C. A., & Hussain, M. (2015). Investigating grit and its relations with college students' self-regulated learning and academic achievement. *Metacognition and Learning*, 10, 293-311.
- Zhang, N., & Henderson, C. N. (2019). Predicting stress and test anxiety among 1st-year chiropractic students. *Journal of Chiropractic Education*, 33(2), 133-139.

- Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology, 25*(1), 82-91.
- Zwick, R., & Himelfarb, I. (2011). The effect of high school socioeconomic status on the predictive validity of SAT scores and high school grade-point average. *Journal of Educational Measurement, 48*(2), 101-121.