Winter 12-2021

Executive Functions and Student Success During Physical Therapist Education: An Exploratory Study

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BACKGROUND: Clinical reasoning relies on executive functions (EFs) that manage attention, inhibition, organization, and decision-making. Assessment of EFs may help identify students who excel at clinical reasoning, yet data showing this relationship in physical therapy (PT) education programs are lacking. The primary purpose of this exploratory study was to examine EFs in relationship to success in PT educational programs. **METHODS:** Thirteen third-year PT graduate students completed two EF tests which were compared to culminating scores in the program and admissions scores. **RESULTS:** A relationship existed between National Physical Therapy Examination (NPTE) and comprehensive exam results and one EF test score; comprehensive exams and NPTE scores related to the other EF test. **CONCLUSIONS:** EF measures may provide insights into student successes, especially as they pertain to outcomes requiring clinical reasoning. *J Allied Health* 2021; 50(4):e107–e114.

CLINICAL REASONING skills are essential to the practice of physical therapy (PT) and are therefore a topic of interest to educators and clinical instructors looking to maximize student learning in clinical reasoning, decision-making and critical thinking (1–3). Executive functions (EFs) include initiation, planning, volition, monitoring, self-regulation, inhibition, flexibility, decision-making, verbal reasoning, and judgment (4–6). Despite the use of selection metrics such as overall grade point average (GPA), science GPA and GRE scores, a portion of PT graduate students fail to complete their programs or have challenges passing the national examination (7). Because assessment of EFs can take place prior to attaining any clinical knowledge, faculty may be able to identify students who are weaker in these general skills and begin interventions early in a curriculum to strengthen these critical skills and improve the chances for student success academically and clinically. In this exploratory study, we aimed to examine whether EFs scores correlate with measures of success in a PT education program. These exploratory findings, while preliminary, may have implications for metrics used in physical therapy admissions procedures.

A considerable number of studies have examined factors related to successful performance in PT students. Most of these studies focus on success in academic and national test performance. When academic performance is evaluated, studies have reported that verbal GRE scores, quantitative GRE scores and grade point averages for coursework taken prior to admission to the PT education program (what we will term UGPA) are most predictive of high achievement (8–10). Likewise, studies that have examined factors most predictive of passing performance on the National Physical Therapy Examination (NPTE) also have reported that standardized pre-admission assessments such as quantitative Graduate Record Examination (GRE) and Scholastic Aptitude Test (SAT) scores along with UGPA and program GPA have greatest predictive value (7,11–13). In the largest studies examining a national data set from more than 3,000 PT graduate students, about 10% of students had difficulties academically or on the NPTE (14,15). Regression analyses showed that UGPA, verbal GRE, and quantitative GRE predicted poor performance for both of those outcome measures (14,15). Notably, older students and students from ethnically diverse backgrounds were more at risk for failing in academic measures, a finding also reported in other studies (7,9).

Test scores and grades can thus *help* predict academic performance in a professional health program, but they do not appear to measure the ability to apply reasoning skills. Hughes described a "mis-match" between critical thinking skills identified by an expert consensus and abilities measured on the GRE (16). More importantly, these tests do not provide useful information for crafting educational experiences that will help students

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The authors report no funding or conflicts of interest related to this study.

RN2435—Received July 12, 2021; accepted Oct 4, 2021.

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develop their critical thinking abilities. Jones et al. summarized the extant literature and noted: "The PT literature suggests the variables that predict a student's success in the classroom may not be the same ones that predict success in the clinical setting" (17p3). The authors proposed that emotional intelligence, personality traits, and critical thinking may be influential in clinical performance for PT students (17). Yet, few studies in the PT literature have carefully examined such factors as they influence clinical success. Vendrely reported that the California Critical Thinking Skills Test (CCTST) results correlated with NPTE scores, but not with clinical performance scores during the program in their sample of 42 students (18). Similarly, Kosmahl found that clinical performance instrument results did not correlate with NPTE scores (19). Huhn and Parrot reported that physical therapists' Health Science Reasoning Test scores (a version of the CCTST for health professions) when combined with UGPA, first year GPA, and GRE scores improved their regression model's ability to predict NPTE results in 178 students (20). Thus, while GPA, GRE, and clinical reasoning tests may tap into some elements essential in academic outcomes, additional factors may be at play in successful clinical performance.

Clinical performance differs from academic achievement because it encompasses a multi-faceted process of clinical reasoning and critical thinking that leads to clinical judgement. The Commission on Accreditation in Physical Therapy Education (CAPTE) accreditation standards acknowledge the importance of clinical reasoning skills (1). Brudvig et al. defined clinical reasoning for PT students as "the thinking and decision-making processes associated with clinical practice" (21p3). Using knowledge and skills, the clinician must activate and deliberate among potential alternatives, consider the evidence, and choose the best solution (22). Clinical reasoning encompasses critical thinking where analysis, interpretation, and inferences take place in making diagnostic and treatment decisions (23). Clinical judgement refers to a conclusion that is drawn about the patient problem, while clinical decision-making refers to the actions to be taken to address a patient's issues (24). Huhn et al. emphasized that, for PT students, each patient poses a unique scenario which places great demands on critical thinking skills during the process of clinical reasoning and judgments (23). It is known that the more complex or novel the task, the more EFs are engaged. Thus, the processes of clinical reasoning and clinical judgment draw considerably upon EFs.

A number of standardized neuropsychological tests have been developed to assess EFs (5). Among the most extensively studied and used is the Wisconsin Card Sorting Test (WCST) (25). Designed initially as a test of cognitive reasoning, this test assesses an individual's ability to strategize, organize, shift cognition based on environmental cues, manage behaviors to achieve goals, and control impulses (26). To complete the test, participants select one of four stimulus cards and match it to another card based on color, number, or shape. After several consecutive correct responses, the sorting rule is unexpectedly changed. For example, if previously the initial rule was to sort based on shape, the rule changes to sort by number or sort by color and the test-taker must adapt to respond correctly. There are 11 raw scores on the WCST that include trials administered, total correct, total errors, perseverative responses, perseverative errors, concept level responses, categories completed, trials completed, failure to maintain set, and learning to learn. Our reasons for selecting the WCST for this study were threefold. The WCST is a) a well-known, standardized EF assessment, that b) investigates the aforementioned EFs that are employed by healthcare professionals (e.g., cognitive flexibility, problem-solving, reasoning and working memory), and c) is available in a computerized research format.

While most objective standardized EF tests must be administered and scored by a trained, credentialed clinician, more recent rating scales also have been developed to allow for observation of behaviors and characteristics representative of EFs in daily life activities (27). One such tool is the Comprehensive Executive Function Inventory-Adult (CEFI), which, like the WCST, was developed to describe behaviors reflecting inhibitory control, flexibility, and working memory (28). Originally developed as a 100-item rating scale for use in children, it was recently adapted and standardized for use in an adult population (29). Using a six-point Likert-like rating scale, the participant rates their abilities on 80 items across nine different EF areas (i.e., attention, emotion regulation, flexibility, inhibitory control, initiation, organization, planning, self-monitoring, and working memory). Full-scale score and subscale scores are calculated.

EFs may play an influential role during clinical reasoning and clinical judgments, however causality has not yet fully been determined. Therefore, the question arises about the relationship between EFs and academic and clinical outcomes for PT graduate students. In our review of the literature, we identified no studies that directly evaluated such relationships beyond tests of critical thinking and clinical reasoning, as mentioned earlier (23,18).

We previously asked a similar question with respect to a cohort of students in a speech-language pathology (SLP) master's program (29). Results indicated significant relationships between EF measures and SLP student outcomes. The WCST subtest Failure to Maintain Set, where lower scores indicate better performance or less failure, was significantly negatively correlated with student performance in the overall program GPA (i.e., the higher program GPA, meant lower failure score).

Similarly, WCST Learning to Learn subtest score positively correlated with clinical grades in the second semester of training (i.e., those who had higher grades in their second semester of clinical training demonstrated a greater change in learning efficiency over the test administration). In sum, the poorer the student's performance was in clinic, the higher the number of perseverative responses, and lower learning to learn score. Perseverative responses represent the persistence to make a wrong decision using the previous decision rule, while learning to learn indicates the test-taker's average change in efficiency regarding concepts over the course of the test. In the Roitsch et al. study, CEFI-A emotional regulation metric was significantly negatively correlated with third semester clinic grades (29). That is, SLP students who self-reported feeling less control over their emotions scored higher third semester clinic grades. CEFI-A organization and initiation subscales were positively correlated with program GPA and scores on the national examination in speech language pathology, respectively. Thus EF measures correlated with several clinical measures in the SLP student group.

As the areas of cognitive flexibility, problem-solving, reasoning and working memory are all demands of healthcare professionals making clinical judgments, including PTs, examining EFs of students working toward advanced degrees in these areas may be a fruitful enterprise. For this reason, we investigated the relationships between EF measures and student outcomes in Doctor of Physical Therapy (DPT) students to determine what areas they identified as their strengths and weaknesses and then compare these results to their DPT program performance.

Methods

Study Participants

The participants in this study were 13 students (7 female) in a DPT program at a southeastern U.S. university between 2019–2020. All participants were enrolled in the DPT education program, were completing their last year of the program, and were working toward completing their final clinical externship. Ages ranged from 25 to 30 yrs (mean 26, SD 1.6). All students had completed bachelor's degrees, and one completed a master's degree. See Table 1 for descriptive characteristics. Among the 43 students in the DPT program invited to enroll in this project, 13 of the students consented to participate. This study was approved by the Old Dominion University's Institutional Review Board (#1071045).

Technical Information: Materials

Student academic records were collected directly from the graduate program director following the PT students' written consent. At the end of the academic year, program GPA, performance on a written comprehensive exam, and performance on the NPTE were collected. Additional data retrieved from student records included admissions metrics of UGPA and Verbal, Quantitative and Analytic GRE scores.

The written comprehensive exam for this program involves 200 multiple choice questions designed to mimic the PT licensing exam. It is a timed test with a limit of 4 hours. The questions are written to require clinical reasoning skills rather than memorization or basic sciences. The examination is scheduled in computer labs so that all students take the test simultaneously in a proctored environment. A passing score is 70% and greater.

Additionally, PT students in this study completed two EF tests at the end of their academic programs as a preliminary examination of relationships between EFs and performance in PT programs. Two EF tests were administered in alternating order to each participant: the Wisconsin Card Sorting Test-Computer Version research edition (WCST-CV4) and the Comprehensive Executive Function Inventory–Adult (CEFI-Adult) (24,29). The WCST-CV4 was administered individually and in-person by the first author (24). Upon test completion, the computerized research edition of the WCST automatically provides several scoring outcomes, such as measures of perseveration (i.e., continuing to make the same sorting selection regardless of stimulus card change), categories correctly sorted, and number of errors. These outcomes include raw scores, age- and education-corrected standardized scores, *T* scores, percentile scores as well as normative and age-matched scores. The participants' total raw scores and 10 raw scores (i.e., trials administered, total errors, perseverative responses, perseverative errors, non-perseverative errors, conceptual level responses, categories completed, trials to complete first category, failure to maintain set, and learning to learn) were entered into a data collection sheet by the first author and downloaded for statistical analysis.

The CEFI-Adult was sent via email link to the PT students who consented to participate in the study. Using a 6-point rating scale, the PT participants rated their abilities on 80 items across nine different EF areas (i.e., attention, emotion regulation, flexibility, inhibitory control, initiation, organization, planning, self-monitoring, and working memory). The overall score and subscale scores for the CEFI are scored online automatically. Results for each of the nine EF areas on the CEFI were entered into a data collection sheet by the first author and downloaded for statistical analysis.

Statistical Analysis

Following coding to protect personal information of participants, data were imported into SAS version 9.4

TABLE 1. Descriptive Statistics for Study Participants

	No.	Mean	Min	Max	SD
UGPA	13	3.63	3.14	4.00	0.24
PGPA	13	3.88	3.60	4.00	0.15
GREQ	13	154.92	151.00	163.00	3.62
GREV	13	154.85	149.00	163.00	3.91
GREA	13	3.96	3.00	5.50	0.59
NPTE	12	692.92	636.00	740.00	36.87
Comps	13	79.12	73.00	86.50	3.46
WCST Trials administered	13	83.69	70.00	128.00	15.42
WCST Total correct	13	69.15	62.00	77.00	4.67
WCST Total errors	13	14.54	6.00	55.00	12.78
WCST Perseverative responses	13	6.77	4.00	23.00	5.21
WCST Perseverative errors	13	6.62	4.00	22.00	4.98
WCST Nonperseverative errors	13	7.92	2.00	33.00	8.03
WCST Concept level responses	13	65.31	49.00	71.00	5.86
WCST Categories completed	13	5.85	4.00	6.00	0.55
WCST Trials completed	13	13.00	11.00	20.00	3.32
WCST Failure to maintain set	13	0.31	0.00	1.00	0.48
WCST Learning to learn	13	0.68	–2.47	4.18	2.00
CEFI Full scale	11	106.18	84.00	120.00	11.12
CEFI Attention	11	99.91	73.00	120.00	13.90
CEFI Emotion regulation	11	101.27	66.00	124.00	16.54
CEFI Flexibility	11	97.64	80.00	106.00	9.52
CEFI Inhibition control	11	104.09	90.00	131.00	11.58
CEFI Initiation	11	111.09	89.00	125.00	13.26
CEFI Organization	11	108.82	83.00	125.00	14.13
CEFI Planning	11	107.18	78.00	121.00	12.96
CEFI Self-monitoring	11	108.09	92.00	121.00	10.01
CEFI Working memory	11	108.64	78.00	124.00	14.58

Abbr: UGPA, undergraduate grade point average; PGPA, program grade pointaverage; GREA, Graduate Record Examination-Analytic; GREQ, Graduate Record Examination, Quantitative; GREV-Graduate Record Examination Verbal; NPTE, National Physical Therapy Exam; Comps, comprehensive examinations.

for analysis (30). Pearson correlation coefficients were used to determine the association between two EF measures (WCST-CV4 scores and CEFI scores), and program completion metrics (program GPA and comprehensive exam scores). We also examined relationships of EF measures to preliminary admissions metrics (UGPA and GRE scores). A p-value < 0.05 was used to determine statistical significance.

Results

Table 1 displays the descriptive statistics for all study variables. NPTE scores were available from 12/13 participants and CEFI scores were available from 11/13 participants. All other metrics were retrieved from all 13 participants. Missing data were recoded to provide an account of missing information. The standard deviation and minimum and maximum scores indicate that a range of scores were observed in this group, allowing for correlation analyses to take place.

WCST-CV4 results. For program outcomes measures, the WCST-CV4 Learning to Learn raw score showed a significant positive correlation with both the comprehensive exam and the NPTE scores (comps: $r = 0.62$, $p = 0.02$; NPTE: $r = 0.60$, $p = 0.04$). None of the other subscales of the WCST-CV4 was significantly correlated with either of these exams. In examining relationships of the WCST-CV4 to admissions metrics, the WCST-CV4 Total Correct scores showed a positive correlation with UGPA ($r = 0.77$, $p = 0.002$). Negative correlations were identified between WCST-CV4 Total Correct with GREV ($r = –0.62$, $p = 0.02$), and between WCST-CV4 Trials Completed and GREV ($r = –0.60$, $p = 0.03$).

CEFI results. Table 2 presents the correlations between CEFI scores and program outcomes measures and admissions metrics. There was no significant correlation between the CEFI Full Scale or any of the component scores and PGPA. However, CEFI scores in the areas of Attention and Initiation were positively correlated with NPTE scores (both $r = 0.69$, $p = 0.03$). Further, CEFI scores were positively correlated with comprehensive examination scores in the CEFI Full Scale ($r = 0.82$, $p = 0.002$), and with component CEFI scores in the areas of Attention ($r = 0.64$, $p = 0.03$), Inhibition Control ($r = 0.74$, $p = 0.01$), Initiation ($r = 0.81$, $p = 0.003$), Organization ($r = 0.66$, $p = 0.03$), Self-Monitoring ($r = 0.64$, $p = 0.03$), and Working Memory ($r = 0.63$, $p = 0.04$). Relationships between EF scores and admission criteria indicated some positive correlated metrics as CEFI Emotion Regulation positively correlated with UGPA ($r = 0.61$, $p = 0.05$). Further, CEFI was positively correlated with GRE-Quantitative (CEFI Organization: $r = 0.65$, $p = 0.03$; and Planning $r = 0.64$, $p = 0.04$).

TABLE 2. Pearson Correlations Between Comprehensive Executive Function Inventory-Adults (CEFI) Scores and PT Student Scores for UGPA, PGPA, GRE, NPTE, and Comps

CEFI scores	UGPA	PGPA	GREQ	GREV	GREA	NPTE	Comps
Full scale	0.204	0.396	0.515	–0.082	0.192	0.449	0.816**
Attention	–0.002	0.276	0.380	0.175	0.233	0.692*	0.641*
Emotion regulation	0.611*	0.041	–0.073	–0.346	0.086	0.243	0.415
Flexibility	0.334	–0.049	0.053	–0.361	0.216	0.197	0.392
Inhibition control	0.388	0.435	0.205	–0.199	0.123	0.576	0.736**
Initiation	–0.032	0.576	0.574	–0.139	0.334	0.692*	0.808**
Organization	0.116	0.498	0.645*	0.133	0.146	0.233	0.662*
Planning	–0.022	0.256	0.635*	0.094	0.104	0.150	0.597
Self-monitoring	-0.152	0.299	0.562	0.113	0.229	0.357	0.638*
Working memory	0.095	0.280	0.418	–0.068	–0.141	0.185	0.634*

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Outcomes and admissions results. To finalize our analyses, Table 3 presents the correlations between program outcomes measures (PGPA, comprehensive exam and NPTE scores) and admissions metrics (UGPA, GRE-A, GRE-Q and GRE-V). Between admissions and outcomes measures, only GRE-A scores were significantly correlated with PGPA ($r = 0.75$, $p \leq 0.00$). Among outcomes measures, NPTE scores were significantly correlated with comprehensive exam scores ($r = 0.71$, $p = 0.01$) and PGPA scores ($r = 0.83$, $p \leq 0.00$). PGPA and Comps scores were significantly correlated ($r = 0.56$, $p = 0.04$).

Discussion

Clinical reasoning relies on a variety of executive functions. Yet the relationship between clinical outcomes in PT programs and EFs had not been explored previously. In our exploratory study, we endeavored to investigate the relationships between EF measures, academic performance and tests requiring clinical reasoning in a small group of DPT students to determine whether their EF strengths and weaknesses correlated to their program outcomes scores and, further, if the EFs at the end of their third year in the program demonstrated any relationship to their performance on admissions measures. It was hypothesized that a relationship would exist between EFs and program outcomes measures as each of these areas require clinical reasoning. It was further hypothesized that an inverse relationship may exist between admissions criteria and EF scores. Results support these hypotheses to some extent. Although this exploratory study is limited in statistical power and magnitude of relationships due to the limited number of study participants, we feel that our findings discussed further below suggest a deeper dive into EFs and success in DPT programs is warranted.

WCST-CV4 Results

The WCST-CV4 is an objective measure of EFs used very commonly in neuropsychology practice. The test taps into a number of skills that are related to the demands of critical thinking in clinical practice. In this sample, however, the WCST results were only somewhat related to PT student outcomes. Only one WCST component, the Learning to Learn score, was significantly correlated with both the comprehensive exam and NPTE results. The Learning to Learn score is indicative of the test taker's average change in efficiently understanding concepts across the categories of the WCST. Students who were efficient in Learning to Learn in the WCST also had higher scores in outcomes that tapped into clinical knowledge and skills on the comprehensive exam and the NPTE. These findings are similar to those reported in Roitsch et al. where they examined academic and clinical outcomes of a

TABLE 3. Pearson Correlations Between PT Student Scores for UGPA, PGPA, GRE, Comps, and NPTE

	UGPA	PGPA	GREA	GREQ	GREV	NPTE	Comps
UGPA	–						
PGPA	0.219	–					
GREA	–0.081	0.745**	–				
GREQ	–0.373	0.304	0.671*	–			
GREV	0.002	0.468	0.619*	0.446	–		
NPTE	0.126	0.829**	0.562	0.123	0.477	–	
Comps	0.349	0.565*	0.460	–0.171	0.236	0.709*	–

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

speech-language pathology graduate program (28). WCST Total Correct also correlated significantly with clinical case studies papers in the SLP cohort and Learning to Learn score had a relationship to clinic grades. Interpretation of this result is complicated because overall score may reflect several EF components (e.g., working memory, perseveration, inhibition). However, the Learning to Learn score was significantly related to outcomes measures in SLP and DPT students and may be indicative of a growth mindset that is linked to a student's ability to use new information to guide decision-making and make online adjustments in a clinical environment.

The positive correlation of WCST Total Correct with UGPA indicates that those who did better in undergraduate coursework tended to do better overall on this test of EF. On the other hand, those who scored higher on the verbal section of the GRE did worse on the test overall (total correct), although they were able to complete the first trial with fewer attempts (trials completed). We do not have a definitive explanation for these conflicting results. Additional research with a larger sample size and a broader range of student abilities may help to clarify these relationships.

CEFI Results

The CEFI-Adult is a newer measure developed to gain subjective self-perspectives of executive functions in adults. Scores on the CEFI-A are normalized around 100, like IQ scores. Scores of 90 to 120 are considered low to high average. Individual students in this study exhibited CEFI-A scores ranging from below low average to above high average, although all mean scores were in the average range.

The CEFI-A Full Score and six of the nine subscales (attention, inhibition, initiation, organization, self-monitoring and working memory) showed a positive relationship with the PT program comprehensive exam. Further, two of the CEFI-A components, attention and initiation, were positively correlated with NPTE scores. These associations suggest that students who perceive their own EFs to be stronger ultimately perform better on the PT comprehensive examinations and NPTE. As these examinations require critical thinking and synthesis of information to make clinical judgments, students with greater confidence in their own abilities may indeed demonstrate higher scores. The Roitsch et al. results in SLP students also showed relationships between CEFI-A Emotional Regulation and Initiation subscale scores and student clinical performance measures (28). In contrast, no CEFI-A score was significantly associated with program GPA. This suggests that CEFI-A measures something other than academic ability. These findings suggest that the CEFI-A might be a tool to provide insights into clinical reasoning skills.

Program GPA, NPTE, and Comps Performance

Our two outcome measures requiring clinical reasoning and decision-making (i.e., the comprehensive exam results and the NPTE) were significantly correlated with each other. This is expected because the comprehensive exam was designed to mimic the NPTE and is used as a benchmark for completion of the didactic portion of the DPT curriculum. NPTE scores were also significantly correlated with PGPA.

Only one of the admission metrics showed a significant relationship to any of the three outcomes measures. GRE-Analytic correlated with program GPA. This is similar to earlier studies which reported that PT students' GRE-Analytic scores may provide insight into academic success in graduate coursework (8,13). None of the admission metrics showed a relationship with comprehensive exam or NPTE scores. This implies that other measures may be needed to help predict which students are likely to be successful in clinical reasoning tasks.

Limitations

Much more goes into clinical reasoning and decision-making in clinical practice than can be represented on a card sorting test or a self-survey. Huhn et al. determined that clinical reasoning in physical therapy involves integrating cognitive, psychomotor and affective skills (23). In addition to demonstrating logical thinking, students must be able to communicate well and be intentional and professional in their interactions. However, as this study suggests, healthcare professional preparation programs may be able to use tests of executive function as an additional tool to identify students' strengths and weaknesses regarding clinical reasoning skills and the underlying bases for employing those skills.

As noted throughout this work, the small sample size of this study is a decided limitation, however. All participants were admitted to and successfully completed a DPT program, so their scores are not reflective of those from a typical pool of applicants, and they do not reflect scores from students who failed to complete the educational program for academic or other reasons. The uniformity of success in academic and outcomes measures limits broad interpretation and generalization of results. Likewise, the presentation of the EF tests in the third year of the participants' graduate school careers does not allow for predictive or longitudinal assessment of EFs, but rather a "point-in-time" snapshot of ability and self-assessment.

These students' EFs and self-reported EFs may have differed if the EF assessments were provided at the start of their graduate school careers. The use of the EF tests for this study, although chosen based on historical use and presumed applicability and appropriateness for participants, may not be the optimal choices to provide information about cognitive processes and their associ-

ation to academic and clinical outcomes for PT graduate students. Yet we argue that our investigation (i.e., looking at reasoning vs clinical reasoning) is a strength of this study as the outcomes of this work present EF results prior to clinical training. As this exploratory study was undertaken at one public university, the generalization of the outcomes to the general population of graduate PT students is guarded at best.

Implications

While this preliminary investigation of EFs and PT program outcomes reports a small sample size, the findings may have implications for current clinical training practices and future research investigations. As students proceed through clinical training, some are faced with challenges when clinical reasoning demands increase. Those with lower EFs may benefit from remediation practices to address broader EFs as well as EFs as directly applied to PT clinical practice. While this is an exploratory study, another implication of these findings is the applicability of EF testing in the graduate admission process. While EFs are likely to change over the course of training, those students with lower EFs may be identified earlier as students who need specific attention and guidance to maximize their clinical learning and success. In our future research we will examine these possibilities prospectively rather than at the end of the training period.

Conclusions

In this preliminary analysis of a small group of PT students, we documented relationships between an EF self-report measure, the CEFI-Adult, and outcomes on the NPTE and the PT comprehensive exam, the latter two of which are geared to assess clinical decision-making and judgments. To a lesser extent, WCST-CV4 results were also correlated with comprehensive exam results in the PT program. These findings are consistent with findings in an earlier study by Roitsch et al. in SLP graduate students (28). While we proceed with caution, the results of this exploratory study are suggestive of a new direction to consider in assessing readiness for clinical reasoning and critical thinking within a health professional education program. The CEFI-Adult is a measure that would be feasible to administer to students in clinical programs to enact interventions for students lower on the EF spectrum who may be at risk for weaknesses in clinical endeavors and may be a consideration for admissions committees making decisions about students who will be most likely to succeed in clinical training.

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Published online 1 Dec 2021
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