The LASSI as a Measure of Doctoral of Physical Therapy Students Study Skills and Its Relationship to PEAT and NPTE

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by

KELLY STEPHENS

Dr. David Bergin, Dissertation Advisor

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The undersigned, appointed by the Associate Vice Chancellor of the Office of Research and Graduate Studies, have examined this dissertation entitled:

HOW IMPORTANT ARE

STUDY SKILLS, HABITS, AND BEHAVIORS FOR

DOCTORATE OF PHYSICAL THERAPY STUDENTS' SUCCESS?

Presented by Kelly Stephens,

A candidate for the degree of Doctorate of Philosophy in Educational Psychology, and hereby certify that, in their opinion, it is worthy of acceptance.

Dr. David Bergin

Dr. Matthew Easter

Dr. Steven Sayers

Dr. Steven Whitney

DEDICATION

This dedication is first of all to my husband, Aaron. He has been a constant support of my education and encouraged me every step of the way. Without him many things would not be possible. He finds a way to drive me when I need it and provide a space to vent when I am frustrated. He never wavers his love and support and gives our family the strong foundation that allows all of us to be successful. Thank you for being an amazing husband, father, and friend for so many years and truly pushing me to get through this.

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ABSTRACT

Physical therapy students, like most students frequently use poor study strategies that do little to promote long term retention. This undermines the ability to pass a comprehensive entry level licensure exam. This research correlated the Learning and Study Skills inventory (LASSI) with retrospective GRE scores and prospective performance on the National Physical Therapy Examination. The sample was physical therapy students from the University of Missouri including five cohorts of students (N= 456). Measures included the LASSI, GRE, Practice Exam and Assessment Tool (PEAT), and National Physical Therapy Examination (NPTE). The PEAT and NPTE represent the board exam performance. A factor analysis was performed to determine the most appropriate factor structure for this sample. A six-factor structure was the most appropriate but complicated by numerous cross loadings of items. Analyses used the 3rd addition of the LASSI and the total score. Students did not significantly increase in LASSI scores as they progressed through the program, suggesting that they did not improve their use of study strategies. The GRE did not predict LASSI scores for this sample. The LASSI predicted student performance on the PEAT and for the NPTE, but prediction was not statistically significant for the NPTE.

CHAPTER ONE

Introduction

Student study skills, habits, and behaviors that improve learning retention are topics that have interested me for many years. Students are frequently taught some strategies and often find some on their own. Many times, the most straightforward strategies (reading, highlighting, cramming) which are successful in the short term are not the most beneficial for long-term retention of knowledge (Dunlosky, 2013; Karpicke et al., 2009; Kuhbandner & Emmerdinger, 2019). Without feedback about which strategies are beneficial, many students will continue with the easiest, limit their study options, and miss out on considerable success and retention. Students need to find ways to hone their "skill" of studying to ensure they have diverse, efficient, and effective strategies and they know when to use them (Gettinger & Schurr, 2002). The ability to assess a student's current strategy use and promote their ability to find strategies, habits, and tactics to study more effectively and efficiently would be highly valuable to students at all levels.

Statement of the Problem

Elite students who are admitted to highly competitive programs, such as physical therapy, often incorrectly believe they have effective study strategies because they have gained admission. However, often they do not. In addition, there is evidence that these students experience high levels of stress and anxiety. Research suggests that if more effective study strategies were used, students would be more successful and experience less anxiety. This study examined students use of study strategies and their relation with important outcome variables.

My Personal Experience

I developed interest in study skills after six of my students graduated but did not pass their National Physical Therapy Exam (NPTE). These students passed their didactic coursework and completed four full-time clinicals while maintaining a 3.0 cumulative GPA. Despite these achievements, the members of Department of Physical Therapy faculty were not really shocked by their subpar performance. It appeared faculty had known these students struggled, but no one felt they could intervene in a meaningful way. I had not fully understood each student's areas of deficits until I started helping them study. During study sessions, I found they needed to relearn topics from earlier courses in the curriculum. They could remember the course and broad concepts but not enough details to functionally use this knowledge or pass the test. When they started to review and study, they used re-reading and highlighting as their most common study strategies. Research suggests these are not effective (Dunlosky et al., 2013; Putnam, Sungkhasettee, & Roediger, 2016) I learned through conversation that my students primarily used the most inadequate study strategies throughout college (undergrad and graduate) and were continuing to use those strategies to prepare for a comprehensive licensure exam.

As I continued to help these students, I discovered that they tended to have lower achievement in the program. During clinical internships, they demonstrated adequate critical thinking and clinical reasoning. However, when asked to use this same knowledge in an exam these students were challenged. So how can we help these students accomplish this last hurdle before beginning their career?

In the case of the six students who failed the exam, they appeared to need some scaffolded instruction to help them get started. I taught them techniques such as self-testing and finding ways to link information together or make connections among different content areas. Next, students began taking practice exams. Afterwards, they reviewed each of the questions

reflecting on why they got it correct, or if they guessed, why they chose that answer, and if they got it wrong, why. Reflection was powerful. After each practice exam students reflected individually. Then the students would review questions as a group and determine why each answer choice was right or wrong and what they needed to change to make each answer correct. During this time, each student took the lead and taught the others. Finally, students created new questions and provided the rationale for correct answers during their group sessions. After three months of attempting new study habits, five of the six passed their exam, and the remaining student passed after another attempt. Each student stated that changing their study habits was the true reason for their success. This was powerful and made evident the need for further assessment and intervention, possibly for all students in the program.

This experience and anecdotal evidence supported by research led the way to altering a final semester course into a board preparation course. In this course, I taught evidence-supported study strategies to my students. The students utilized self-testing, distributed practice, writing board exam questions, and taking practice board exam questions. With each intervention strategy students performed self-reflection and developed a study plan. They had the motivation to try new strategies, and the course provided the structure and the scaffolding to practice new skills.

As I reflected on the success of this course, I also realized it felt too late. Why should students change their habits at the end of the program? They should learn habits earlier and use them throughout the program. When preparing for the board exam, the students were highly motivated to change their habits or try new ones because they wanted to pass their board exam (and they had heard horror stories of not passing). Students entering the physical therapy program were high achievers and felt successful even if they used inadequate study habits. They

lacked motivation to try new strategies because they felt many of the strategies required more time and effort. They did not see how they strategies would pay off (Dunlosky, 2013; Kuhbandner & Emmerdinger, 2019; Schutz et al., 2011). What evidence could I provide to motivate students to put forth the effort to try something new? I searched for study strategy inventories to show students their strengths and weaknesses and found numerous publications (Entwistle & McCune, 2004; Schmeck & Cercy, 1991; Weinstein et al., 1987). Most publications focused on at-risk college freshman; would these studies be relevant for high achieving graduate students? Would these inventories show a difference between high and lower achievers or students at risk of not passing the board exam? As my search continued, I needed to find an inventory that would be easy to administer, be easy for students to understand, and have a score or report to show their areas of strength and weakness.

Research Purpose and Research Questions

This research aims to ascertain if scores on a study skills inventory (Learning and Study Strategy Inventory) are predicted by GRE scores and if the inventory (LASSI) predicts performance on the NPTE. In addition, the research examined whether students report better strategies in years two and three of the physical therapy doctoral program compared to year one.

The following are four specific research questions:

1. What is the factor analytic structure of the LASSI?
2. Do third-year students use better study strategies as measured by the LASSI compared to second- and first-year students?

3. Do GRE scores correlate with LASSI scores? That is, do students who have high GRE scores when they apply then report better study skills in the program as measured with the LASSI?
4. Do LASSI scores predict standardized exam scores on the physical therapy licensure exam (retired/practice NPTE National Physical Therapy Examination and NPTE)?

Definition of terms

The following definition of terms and abbreviations are included to ensure understanding throughout the document. The researcher developed some of the definitions, and others are included with the citations.

APTA: American Physical Therapy Association (www.APTA.org), a US organization of individual members that are physical therapists, physical therapy assistants, and student physical therapists.

Clinicals: Full-time internships with a student that is supervised by a licensed physical therapist that has been practicing for over one year. Required for all students before graduation and needed to prove entry-level performance.

FSBPT: Federations of State Boards of Physical Therapy (https://www.fsbpt.org), this is the regulation board for the licensure of Physical Therapists and Physical Therapy Assistants.

LASSI: Learning and Study Strategies Inventory (C. E. Weinstein et al., 2016)

NPTE: National Physical Therapy Examination (https://www.fsbpt.org), national licensure examination for physical therapists and physical therapy assistants in the United States. Timed, computer-based, multiple-choice examination given four times a year proctored at an independent testing site.

PEAT: Practice Exam and Assessment Tool (https://www.fsbpt.org), timed, computer-based, multiple-choice examination that can be purchased by students to prepare for the NPTE.

PT: physical therapist, movement expert that requires a doctoral degree and a license to practice.

SPT: student physical therapist

First cohort: students that have just started in the program after interview and acceptance

Second cohort: students that have completed one year of the doctorate of physical therapy program and one clinical

Third cohort: at the beginning of the third year, students have completed two years in the program and two clinicals. By the final assessment, they have completed three years and four clinicals for a total of 32 clinical hours.

Conclusion

High achieving students set goals and use resources to achieve those goals. For doctorate of physical therapy students, the ultimate goal is obtaining their license to practice. Prior to entering their professional graduate program measuring success was based on grades. Each student found ways to be successful to meet all the criteria to gain admittance into the highly competitive program. Research has shown that most students in high school and undergraduate education depend on the most rudimentary study skills such as re-reading and highlighting along with rote memorization (Dunlosky, 2013; Gettinger & Schurr, 2002; Karpicke et al., 2009; Kuhbandner & Emmerdinger, 2019). If students receive no formal training in better options that build on principles of information processing, students will continue with the same weak strategies. The transition from undergraduate work, which is largely noncumulative, to graduate

school courses that are cumulative is challenging. In these courses, all information learned is needed to improve clinical reasoning. Effective learning helps the student to see the "whole picture." Continuing with weak study strategies can be very problematic because the use of memorization or re-reading makes it very difficult to retain knowledge for future functional use in courses and clinicals. This is when students start to realize they need to do more and begin to seek out better options from peers, mentors, or faculty. The transition to PT graduate school comes with greater stress. Are the stressors due to inadequate study strategies or are they created due to the amount of coursework and the density of the content? If the research shows that healthcare students have more anxiety than peers, it is imperative to find ways to help with reduction of anxiety. High quality study skills can help with retention and greater academic success (Udeani, 2012).

A literature review will be provided in Chapter 2 to discuss the significance of study skills for high achieving students. The literature review also discusses the LASSI inventory and its reliability and validity as compared to other inventories. Chapter 3 will provide a description of the methods and procedures used to address the four research questions. The results will be revealed in Chapter 4. Finally, Chapter 5 will discuss the findings and implications for both the current sample of students and for the greater population of physical therapy students.

CHAPTER 2

Review of Literature

Introduction

I began to search for study strategy inventories to show students their strengths and weaknesses and found numerous publications. Additionally, I needed to find an inventory that had been used within graduate and elite students. Would these inventories be able to differentiate between high and low achievers or students at risk to not pass the board exam? I will discuss and focus on three of these inventories, including their strengths/weaknesses, reliability, validity, and other aspects of importance. These inventories are the Inventory of Learning Processes (ILP), Approaches and Study Skills Inventory for Students (ASSIST), and Learning and Study Skills Inventory (LASSI).

Inventory of Learning Processes ILP

Inventory of Learning processes was originally a 62 item, 4-scale (deep processing, elaborative processing, fact retention, methodical study) inventory that focuses on learning styles. First published in 1977 with true/false responses, the ILP was developed using information processing theory (Schmeck & Geisler-Bernstein, 1992). The revision used a 6-point Likert scale (strongly disagree to strongly agree) and increased to 160 items and 4 scales (academic self-concept, reflective processing, agentic processing, methodical study) (Schmeck & Cercy, 1991). Academic self-concept has four subscales: intrinsic motivation, self-efficacy, non-iterative processing, and self-esteem. Reflective processing has three subscales: deep processing, elaborative processing, and self-expression. Agentic processing has three subscales: conventional, serial processing, and fact retention. The methodical study factor does not have reported subscales. Initial reliability and validity data for the revised scale reported Cronbach

alpha coefficients ranging from .65 to .93; the lowest alpha were for methodical study (.65) and serial processing (.69). To test construct validity, the authors performed intercorrelations for scales and subscales and then the intercorrelations between these and three personality measures. The subscales within each scale are more highly correlated to each other than to the other scales or subscales. For further examination of construct validity, the authors formed two groups using median splits (group 1: low anxiety and high locus of control and high self-esteem, group 2: high anxiety and low locus of control and low self-esteem). This was intended to support the theoretical framework and the results were consistent with expectations for each group. Group one had higher achievement scores than Group 2, which supported validity.

Gadzella (2003) chose to revisit the inventory after 25 years to see if it was still relevant to students. She chose to use the original 62 item true-false, four scale version. Pearson correlations were .77 to .88 for all 4 scales. The test-retest reliability was significant and found to be very similar to the original data from 1977. The overall impression was that it was simple to administer and straightforward for students to understand and respond quickly. Interestingly, Gadzella (1987) had studied validity and reliability of the revised version earlier in 1987 and put out a report, but no formal publication. In this report test-retest reliability was significant except for self-efficacy in men. She then correlated the results of the ILP with course grades and GPA's and found deep and shallow processing correlated significantly and inversely, and deep and elaborative processing correlated significantly and positively. Significant correlations were found between deep processing, elaborative processing, and self-efficacy (conceptualization) and course grades and GPA. Shallow processing, memorization, and methodical study did not correlate significantly with course grades and GPA. In a separate study, Gadzella and Baloglu (2003) used the original version to determine if the ILP could detect differences between low and

high achieving students (as determined by grades in an educational psychology course). It was shown that high achievers scored significantly higher on deep processing and fact retention ($t= 2.23$, $p <.03$ and $t = 3.19$, $p<.01$). An interesting thought presented by the author was if the low achievers pursued degrees to become teacher, how would they teach students effective learning strategies and study habits when they had scored low in these areas?

Clump (2005), a few years later, investigated internal consistency and intercorrelations of the original 62 item inventory and found similar results for three scales (deep processing, elaborative processing, and methodical study) but found significantly better results for the fourth scale (fact retention $t= 2.28$, $p< 0.05$). Clump found the inventory demonstrated strong psychometric properties. Clump went on to compare the ILP (original version) with class assessments in a cognitive psychology course (Clump & Sandoval, 2010). The findings included the following: Deep Processing subscale significantly correlated with discussion points with in the course ($r= .39$), test ($r=.42$), and total points ($r= .44$). Significant correlations were found between Elaborative Processing subscale and discussion points ($r= .44$), tests ($r=.53$), journaling scores ($r=.43$), and total points($r=.58$). There were no significant correlations between fact retention and methodical study subscales and any of the course assignments. This was the first study providing evidence to use ILP functionally. The course materials could be evaluated based on what scales or subscales they correlated with to show what level of the skill or depth of learning was needed for each assignment. This was very interesting to not only use the ILP as an assessment of students but to find what depth of knowledge was needed for an assignment.

It appears the original version of 62 true/false items is frequently preferred for research. This could be due to the length of the revised test, which has a greater number of scales and subscales and no concise information for interpretation or how to use this information for

intervention for students, or guidance for practitioners. I found no user's manual for the revised version. The ILP literature does provide support for its use based on the ability to predict academic performance and also as an assessment tool for the depth of learning needed for coursework. It does not provide any further information to assist in interventions corresponding to the students' deficits or weaknesses. Limited research on the factor structure was reported. All of these factors make it unsuitable for physical therapy graduate students.

Approaches to Study Skills Inventory for Students ASSIST

Approaches to Study Skills Inventory for Students (ASSIST) consists of three sections (six statements, Approaches to Studying Inventory [ASI], and preference for teaching style), first of which has six statements regarding conceptions of learning rated on an agreement scale of 1-5. The second section contains the Approaches to Studying Inventory, and the third section contains items that allow students to indicate preferences for teaching styles (Entwistle, McCune, & Tait, 2013). The Approaches to Studying Inventory (ASI) contains 52 items, and there is an alternative revised Approaches to Studying Inventory (RASI) composed of only 18 items. The inventory uses a 5-point Likert scale. The foundation of this inventory is three factors: Deep, surface, and strategic approaches. Three main factors were divided into subscales (seeking meaning, relating ideas, use of evidence, interest in ideas, monitoring effectiveness, organized studying, time management, achieving, alertness to assessment demands, lack of purpose, unrelated memorizing, fear of failure, and syllabus-boundness). The authors reported Cronbach alpha coefficients for each factor and subscales that are listed below in Table 1. The original authors provide little discussion on how to use this inventory other than for assessment. It is difficult to determine if a student has strengths in all three factors or how to promote more deep and strategic learning.

Table 1

Cronbach Alpha Coefficients for factors and subscales of the ASSIST

Deep	0.82	subscales: seeking meaning, relating ideas, use of evidence, interest in ideas, monitoring effectiveness (0.76-0.81)
Strategic	0.83	subscales: organized studying, time management, achieving, alertness to assessment demands (0.76-0.85)
Surface	0.65	subscales: lack of purpose, unrelated memorizing, fear of failure, syllabus-boundness (0.46-0.62)

Byrne (2004) found similar internal reliability measured with Cronbach's alpha using two samples of US and Irish accounting students. Byrne also found the greatest percent (61%) of variance explained for both samples was with a three-factor model (Deep, Strategic, and Surface Apathetic; chi-squared 1.98 and 3.68). Results showed high levels of internal consistency, and low correlations between the factors. A cross-loading was noted in the subscale monitoring effectiveness, which loaded on both Deep and Strategic factors. The subscale of alertness to assessment loaded more heavily on the Deep factor instead of Strategic (where is it is a subscale) for the US sample and had low loading across all three factors in the Irish sample. This study was interesting because of the nature of the sample with a very specific degree program. This can provide some support for using this inventory for other majors that are similar in course work.

Brown (2015) investigated approaches to learning and studying in students in an undergraduate science course. The students in the sample were all enrolled for a bachelor's of science pursuing a variety of different majors from biomedicine, geology, and general science. Students were taking an introduction to chemistry course. Each student took the ASSIST, and

the dominant learning style found across all majors was the surface approach. Since there were no true chemistry majors, it is possible that students did not use their best study strategies for the course or that they were early in their undergraduate course work and were still using more memorizing or surface learning as their dominant strategy.

Occupational therapy is a major similar to physical therapy. Bonsaksen (2018) completed a cross-sectional investigation of occupational therapy students to see if they used deep, superficial, or both styles of learning for three cohorts (1st, 2nd, and 3rd years) while in an undergraduate program in Norway. The authors collected demographic details, the Norwegian Rosenburg Self-Esteem Scale, the General Self-Efficacy Scale, and education learning concepts using the ASSIST. The sample as a whole had identical average scores on deep learning concept (M = 12.8, SD 1.5) and surface learning concept (M = 12.8, SD = 1.5). Maybe surface learning can't be abandoned, even during higher level learning. Surface strategies, such as memorization, could be essential to part of difficult concepts or new information as it is introduced. After the initial surface learning, students may be able to progress to deeper strategies such as making associations and relationships to other knowledge.

The ASSIST inventory has evidence to support its use in a variety of student majors to assess learning strategies and depth of learning. Further research should also evaluate the ability of this inventory to help with interventions and assessment of those interventions for the promotion of student success. However, there was limited literature confirming or supporting its structure with factors and subscales, and it is unclear how to use the inventory to promote academic performance in students.

Learning and Study Skills Inventory

The Learning and Study Skills Inventory was created in 1982 after two years of development. The initial version was tested at the University of Texas, Austin. The second edition in 2002 was constructed in the same fashion with 12 universities for normative data analysis. The current third version from 2016 is a 60 item self-report 7-point scale (from "Not at all typical of me" to "Very much typical of me") inventory with three main components of learning (skill, will, and self-regulation) each having 10 subscales (information processing, selecting main ideas, test strategies, anxiety, attitude, motivation, concentration, self-testing, study aids/academic resources, and time management). The authors (Weinstein et al., 1987) described it as diagnostic and prescriptive, allowing colleges to identify students at risk and help students find areas in need of improvement. In the development, the authors had a three-credit-hour freshman course centered around taking the inventory and then interventions individualized to each student. Not much information was provided about the three factors of skill, will, and self-regulation. Most data presented by the original authors is regarding the ten subscales.

The LASSI was developed for use with undergraduate college students. There is also a high school version that has been widely used. While there are various articles investigating the high school, my study is of graduate students, and there are relatively few studies of the LASSI with graduate students. Therefore, I have limited my literature review to studies of college and graduate students.

LASSI for Physical Therapy Student Population

The LASSI has been shown to be a predictor of performance on the board examination for chiropractors (Schutz et al., 2013). Specific LASSI subscales (anxiety, concentration, and goal orientation) have also been shown to be positively correlated with GPA for chiropractor students and with their exam performance (Schutz et al., 2011). This is useful to know because

determining PT students' study skills upon admittance and predicting their performance on the physical therapy board examination are two of the major questions for this dissertation research.

The study aides subscale was shown to be higher in lower achievers, but it is not clear if these students used them more because they were struggling or because using study aides is a poor strategy (Sleight & Mavis, 2006). In a different study with anesthesiology residents (de Oliveira Filho & Vieira, 2007), LASSI subtests of anxiety, motivation, and selection of main ideas were the best predictors for poor academic performance. Additionally, anxiety was negatively correlated with motivation and selection of main ideas.

A meta-analysis was performed of 158 studies, including over 70,000 students, using the LASSI and comparing to academic outcomes (grades/GPA, test scores, and persistence) (Fong et al., 2020). This analysis was 86.2% postsecondary students, 63.5% in the U.S., and 40% of the studies were from 2010 to present. The authors also had 15 samples that used LASSI total score and all three academic outcomes. The average correlation of the total score and the academic outcomes was $r = 0.25$. When Fong and colleagues evaluated each of the subscales, motivation was the strongest correlate with academic outcomes, and study aides/academic resources was the weakest. This meta-analysis also found gender, race, and culture were not associated significantly with outcomes, thus supporting the use of the LASSI with varied populations. Use with varied populations can also be supported because it was developed to be independent of any domain, and that was supported in this analysis.

LASSI factor analysis, reliability, and validity

Psychometric evaluations created by the original authors will be compared to additional literature to evaluate the validity and reliability of the LASSI and its application. The authors of

the three versions of the LASSI have performed research with multiple sample groups from single universities and multiple universities. Table 2 presents scale statistics for the 3rd version.

Table 2

LASSI subscales (Weinstein et al., 2016)

Subscale name	Scale Mean	Standard Deviation	Coefficient Alpha
Anxiety	17.753	6.048	0.866
Attitude	23.701	4.223	0.762
Concentration	19.207	4.905	0.849
Information Processing	21.576	4.323	0.811
Motivation	23.636	3.994	0.774
Selecting Main Ideas	20.673	4.997	0.863
Self-Testing	18.027	4.980	0.804
Test Strategies	20.761	4.276	0.765
Time Management	18.011	4.939	0.802
Using Academic Resources	20.175	4.907	0.764

In early research, the correlations among the LASSI's ten subscales, four correlations were found to be greater than 0.60. These included test strategies and anxiety (0.624), motivation and concentration (0.612), motivation and time management (0.691), and selecting main ideas and test strategies (0.743) (Weinstein & Palmer, 2002). These correlations suggest that the three main factors are not independent. Further evaluation of the number of LASSI factors is needed. Presented below are two other authors' theories on possible structures for the latent variables. See Table 3 for a summary of each of the three versions.

Cano (2006) explored the latent structures of scores on the LASSI and used two independent groups of students consisting of college freshman and seniors (from various majors: sciences, social sciences, and arts). He performed confirmatory factor analysis for three factors; they accounted for 66.24% of the variance. The factors loaded similarly when comparing the

groups based on major of study. Instead of using the original skill, will, and self-regulation as the three factors, Cano used Affective strategies, Goal Strategies, and Comprehensive Monitoring Strategies. The CFA for the proposed factors showed reasonable goodness of fit, chi^2= 96.67; p<.01, GFI=.96, AGFI=.91, RMR=.04, CFI= .95.

Table 3

Comparison of the original author's (Weinstein et al., 2016) *factors and subscales and two proposed set of factors and subscales.*

Weinstein	Cano	Prevatt
Skill • Information processing, selecting main ideas, test-strategies	Affective Strategies • Time management, Motivation, Concentration, Attitude	Effort-related activities • Motivation, time management, concentration, attitude
Will • Anxiety, attitude, motivation	Goal Strategies • Test strategies, anxiety, attitude	Goal orientation • Concentration, anxiety, test strategies, selecting main ideas, attitude
Self-regulation • Concentration, self-testing, study aids/academic resources, time management	Comprehensive Monitoring Strategies • Information processing, study aids, self-testing	Cognitive activities • Selecting main ideas, information processing, study aids, self-testing

Within Cano's proposed factor structure, three of the latent structures/subscales were found to be interrelated (affective strategies, goal strategies, and comprehension monitoring strategies), and affective strategies and goal strategies were positively correlated to academic performance. Cano stated the original skill, will, and self-regulation factors did not appear as independent constructs but as factors that merge. The CFA confirmed the proposed factor structure. Cano (2006) stated that, this could be due to a higher diversity in his sample versus previous samples or due to the complexity of the latent structures and the ten subscales. The question of how many factors continues to be investigated.

Comparisons of the original factor structure with another proposed structure were performed by Prevatt (2006). Her sample consisted of undergraduate students, 47% from general education classes, and the remainder referred for academic difficulties. A confirmatory factor analysis was performed for both the original three factors (skill, will, and self-regulation) and a new three-factor model (effort-related activities, goal orientation, and cognitive activities). Table 4 provides statistics showing the original model had poorer goodness of fit when compared to the new model. The evidence also found lower reliability (alpha = .66) with study aides (academic resources) as a subfactor. Although multicollinearity was low to moderate for the ten subscales in the intercorrelation matrix, the strongest relationship was found between selecting main ideas and test strategies (r= .83) and anxiety and test strategies (r= .70). The proposed new model had improved chi^2 and goodness of fit compared to the original model (shown in Table 4), although some high intercorrelations were found between the three main factors of the proposed model (Effort-Related Activities and Cognitive Activities r= .79, $p<.01$). The factor loading for the original model was published to show the subscales loading on each of the three factors listed in Table 3 in the proposed model; some subscales loaded on multiple factors. This included attitude, concentration, and test-taking strategies. The subscales did load more heavily on the factor that was in the model. Again, the question arises of how many scales or factors should be included for evaluation. Another question is what factor structure would be the most beneficial to provide assessment and intervention for the students and faculty using this inventory. These unanswered questions make it difficult to determine which of these three-factor structures is superior.

Table 4

Comparison of original LASSI and Prevatts (2006) *proposed model*

	Original model	**Proposed model**
chi^2	(32, N=300) = 678.59, *p*< .001	(27, N=300) =118.16, *p*< .001
RMSEA	.26 (.24, .28, 90% CI)	.11 (.08, .13, 90% CI)- high
NFI	.78	.93-good
CFI	.79	.95- good
AGFI	.46	.85- not as good

Another researcher, Melancon (2002) wanted to determine the reliability coefficients for the 10 scales, if the LASSI can support a 10-scale structure, and if the LASSI has criterion validity when correlated with the Personal Preference Self-Description Questionnaire (PPSDQ). Data were gathered from 502 university students. Cronbach alpha was high for both the LASSI and the PPSDQ. Eigenvalues found that 18 factors were >1.0. All alpha coefficients were +/- .03 of the ones listed in the manual for the LASSI (Weinstein et al., 2016), and all were greater than .7 except study aids (.667) with a range for the LASSI of .667-.859, PPSDQ .868-.916. This shows that all of the scores are reliable with criterion-related validity comparison between the two, but the PPSDQ does have more reliable scores (Melancon, 2002). The authors found that the criterion-related validity coefficients for correlations of PPSDQ and LASSI are all near zero except PPSDQ judging/perceiving with LASSI time management (-.440) and PPSDQ judging/perceiving and LASSI motivation (-.410). According to the author, "the results indicate that persons who prefer to be more judgmental tend to be more oriented toward time management and are more likely to accept responsibility for academic success or failure. Both results would be expected" (p. 1026). Based on correlations among LASSI subscales rather than on eigenvalues. Melancon concluded that there may be fewer than 10 legitimate subscales.

As many universities are currently using the LASSI to help target at-risk students for support, it is beneficial to find if the LASSI can differentiate between groups of students based on achievement standards. Albaili (1997) did just that, trying to determine if the LASSI could discriminate between low, average, and high achieving college students using GPA as the indicator of achievement. There was a significant difference between low-achieving students and both average and high-achieving students, but no significant difference between average and high achieving students. The low-achieving students scored lower on all 10 scales, but the results indicate only three contribute significantly for the discriminant analysis function: motivation ($F [1,165] = 19.32$, $p<0.00$), information processing ($F [2,165] =13.11$, $p<0.00$), and selecting main ideas ($F [3,165] =10.77$, $p<0.00$). Motivation was the most powerful factor to discriminate low and high achieving students. This evidence supports the use of LASSI for determining at-risk individuals, but with students with GPAs above 3.0, research is limited.

There have been several revisions that have improved the LASSI's ability to meet the needs of the universities using it by having a paper and online version to help determine at-risk students. The LASSI also provides feedback for each student regarding their weak areas to promote improvement, which can help in programs such as mine where the faculty are unsure how to assist students improve their study habits. The company will also provide a statistical analysis of a cohort of students taking the test to the university for no additional cost. Due to previously mentioned strengths, ease of use for both the administrator and student, the information provided after administration, and relative weakness of the competitors I used the LASSI for my research. See Table 5 for comparison of scales and subscales of the ILP, ASSIST, and LASSI.

Table 5

Comparison of scales and subscales of ILP, ASSIST, and LASSI

ILP Scales	ILP Subscales	ASSIST Scales	ASI/RASI Subscales	LASSI scales	LASSI subscales
		Concepts of Learning (part 1)	*Six statements for agreement on concepts of learning*		
Academic Self-Concept	*Intrinsic motivation* *Self-efficacy* *Non-iterative processing* *Self-esteem*	**Deep Approach (part 2)**	*Seeking meaning* *Relating ideas* *Use of evidence* *Interest in ideas* *Monitoring effectiveness*	**Skill**	*Information processing* *Selecting main ideas* *Test Strategies*
Reflective Processing	*Deep processing* *Elaborative processing* *Self-expression*	**Surface Approach**	*Organized studying* *Time management* *Achieving* *Alertness to assessment demands*	**Will**	*Anxiety* *Attitude* *Motivation*
Agentic Processing	*Conventional processing* *Serial processing* *Fact retention*	**Strategic Approach**	*Lack of purpose* *Unrelated memorizing* *Fear of failure* *Syllabus-boundness*	**Self-Regulation**	*Concentration* *Self-testing* *Time management*
Methodical Study	***No subscales***	**Preference for Teaching Styles (part 3)**	*Student responses*		

Relevant Research in Health Fields with Similar Educational Demands

Examining comparative fields of study such as occupational therapy and medicine can be beneficial to our understanding as similar demands for performance and retention of information are required. For example, occupational therapy students were found to use deeper and more strategic approaches with increased years in the program, as measured by the Approaches and Study Skills Inventory for Students (ASSIST) (Bonsaksen, 2018). Bonsaksen also found that students used a combination of deep and superficial learning strategies throughout the program. Similar results were found in another study with undergraduate occupational therapy students, but this study also found a significant difference in deep learning approaches based on the year in

the program (Brown & Murdolo, 2016). This points to all learning as a continuous process. A student is continuously making deeper connections to content or applying foundational content to new area. Therefore, there will always be new content acquisition and new encoding. An example is examination across different patient populations. Evaluation skills have similarities for all patient populations, but depending on the diagnosis, the evaluation takes on a different approach or slight alterations as their function allows.

Many fields in medicine and health professions use different approaches for instruction, such as problem-based learning. Our physical therapy department uses problem-based learning for a large portion of content. This attempts to take upper-level content and keep it relevant to patient care, as well as, push students to think of all aspects of care and knowledge needed for quality patient care. This type of instruction can promote a more significant amount of deep learning and is based on patient cases to simulate more real-world critical thinking. Students find they have a purpose to learn, not just memorizing for a test (Castro-Sánchez et al., 2012). Evaluating students' study skills in the light of different methods of instruction can facilitate techniques to improve students' long-term retention and ability to apply knowledge to the level needed for a comprehensive exam.

Cross-sectional comparisons in a single graduate program showed a difference in surface and deep learning approaches based on the demands placed on the student and level of experience (Brown & Murdolo, 2016). Because physical therapy programs are three years, determining if students developed improved strategies across the three years would be valuable. However, no differences in this study of first-, second-, and third-year occupational therapy students, who took the ASSIST, were found in a student's level of surface processing and study strategies (Bonsaksen, 2018; Brown & Murdolo, 2016). These results show that on average,

students are relying on their previously honed study strategies and may not make any changes without intervention.

Many physical therapy programs start early to build on information and apply it to patient cases. Does this style of instruction foster differences in learning approaches? A deeper learning approach was found in physical therapy students when compared to their conventionally taught, graduate school peers through problem-based learning using the ASSIST to analyze study skills (Castro-Sánchez et al., 2012).

Another study of medical students (May et al., 2012) found a significant relationship between first-year medical students' depth of learning (using the ASSIST inventory) and performance on a high-stakes test at the end of their first year. Students who reported deep approaches had higher test scores, and students who reported surface approaches tended to have lower exam scores. Are the environment and instruction encouraging deeper learning and improved study strategies, or is the type of student that seeks out that type of degree program someone that makes connections early? Questions such as these will guide this research study.

Quality of Study Skills, Strategies, and Habits

Why do students continue to use less efficient study strategies even at the graduate school level? Some students may not understand or have any exposure to alternative strategies, or they may believe they are using the most appropriate strategies because they are achieving the grades they desire. This could support their goals at the time for immediate success but not for long term retention. Also, if a student has observed other strategies, perhaps from a peer, but feels they are more complicated, they will have low self-efficacy and low motivation to trial the novel strategy.

Studying is a skill that needs to be learned, practiced, and refined. It is an intentional activity that is different for each person and requires some form of reflection or assessment to make adjustments or improvements for complete success (Gettinger & Schurr, 2002) Students start with the basics, reading and highlighting. If this form of studying is successful, they will be building their self-efficacy and motivation to continue. All strategies need to feel effective as well as efficient. Evaluation of study strategy success could typically be in the form of a grade or evaluation; a student can get positive or negative feedback. If students obtain their desired grade, they will attribute it to the level of study. However, if they are not successful, they may attribute it to inferior strategy use, insufficient study time, or ultimately develop a belief they have a lower ability to be successful in school. Students need to find time to reflect on their success and failure, time to develop an understanding of how they think (metacognition) and progress to some self-regulation of their study skills, habits, and strategies (Boser, 2019; Gettinger & Schurr, 2002).

Identifying when a student has the appropriate study strategies has not been an aspect of most instructors' prerequisites for a course. Many professors may feel that if the student has been able to gain acceptance, they must have the basics for studying needed, but is this true? Do students develop better study strategies as they have increased demands in college? In a recent study with physical therapy and occupational therapy students also using the ASSIST inventory, it was found PT students had higher levels of surface learning as compared to their OT peers, and poorer mental health scores for both groups led to more surface learning (DaLomba et al., 2021). Deeper and strategic learning can be evaluated in the LASSI under the subscales of information processing, using academic resources, self-testing and testing strategies. In a study of first-year law students, assessment of study skills using the Approaches to Learning and Study Inventory

predicted graduation time and completion of degree on time (Haarala-Muhonen et al., 2017). The authors found that students that were organized and applied deeper approaches were more likely to graduate in the expected time of 5 years while the students with a surface approach were more likely to take 7 years or longer.

The use of higher-quality study strategies develops either by observation of peers, instruction from a teacher or parent, or out of trial and error. Retrieval strategies such as self-testing improve long-term retention (Dunlosky, 2013; Dunlosky et al., 2013). Many students do not use self-testing as a primary study strategy as they do not view retrieval practice as a way to improve learning. They obtain an "illusion of competence" because when they use more superficial strategies and continue to keep reviewing in the same way there is an improvement of their ease to process the text/material and they mistakenly perceive it as learning (Karpicke et al., 2009). The LASSI evaluates students' ability to use these higher-level study strategies specifically as subscale of self-testing within the scale of self-regulation. Many students have not had exposure to self-testing as a strategy. There is some evidence that students use self-testing at the end of a study sessions as a way to create a self-assessment just prior to an exam. At this time, it might be too late (Kuhbandner & Emmerdinger, 2019).

Development of more effective and appropriate study skills can be challenging. Initially a student will need to set an achievement goal and attribute the best study skills for that goal attainment. For example, if a student has clear expectations and understanding of an assignment or examination requirement, they set clearer goals. In addition, this improved and contextual goal setting can improve their selection of study strategies. With improved goal setting a student can change from a goal of completing the assignment or exam (process goals), to a more complex goal of completing with the results they desire (outcome goals). The ability to set goals

at a higher level to appropriately select the study strategies that will help obtain that goal requires reflection and self-regulation (Zimmerman & Kitsantas, 1997). The ability to self-regulate (LASSI subscales of concentration, self-testing, time management, and using academic resources) in study sessions leads to improved outcomes.

Programs with experiential learning environments, such as ours, improve students' perception of the information needed to learn. During experiential learning students shift from reliance of rote memorization to being more of an active participant by asking questions and attempting to fully understand the content (Groves et al., 2013). Being an active participant in learning is vital, not just for greater retention but also to improve focus and motivation for learning. The LASSI subscales of attitude, information processing, motivation, and concentration assess these processes.

Anxiety and Performance

Anxiety, stress, and nervousness are inevitable in the academic setting. At the college level, anxiety can be due to a transition. An example would be transitioning to a highly competitive graduate program such as physical therapy. Now the environment, people, places, and expectations are all changing. Each student has to acclimate to the college atmosphere. There is the stress of possible move, the desire to feel included, and worry of adequate performance. Ultimately each student in the physical therapy program has the same goal: obtain the needed knowledge and skills for their career as a physical therapist. Within this situation of overall new stress, another layer of testing or examination anxiety exists. A certain amount of testing anxiety is positive to keep each student alert but can be detrimental if it exceeds a level the student can manage (Motevalli et al., 2013). The LASSI has subscales that measure anxiety

and testing strategies, but also subscales selecting main ideas, attitude, concentration, and motivation can be relevant in the area of testing anxiety.

Finding ways to reduce test anxiety is vital for all students, but especially students that become negatively impacted. Test anxiety can also impact other areas of learning, such as motivation, concentration, retrieval, and efficient studying (Trifoni & Shahini, 2011). This presents a situation that each area of learning can have an influence on the other. If one has increased testing anxiety and then has difficulty studying and concentrating, this could lead to a poor outcome on the exam that would then increase future testing anxiety. Could study skills be an area of intervention that can reduce anxiety and improve test scores?

Literature has shown that study skills can affect anxiety caused by assessments or examinations (Motevalli et al., 2013; Tobias, 1985). However, telling students to improve their study habits and strategies will not have the desired impact. As previously stated, some students have not had exposure to alternative or higher efficiency study strategies (Peverly et al., 2003). Students may require overt and systematic training (Udeani, 2012). The LASSI could be the initial step to allow students to report what they are currently using and open the door to see what other options are available. Study skills intervention is reliable to assist anxious students and help reduce testing anxiety (Motevalli et al., 2013). By explaining both assignments and examinations in advance, instructors could aide in reducing students' fears and allowing time for the setting of appropriate study session goals. This can help students reflect and find more systematic ways to choose the study habits and strategies that are best for each type of examination (Trifoni & Shahini, 2011).

Many programs, including physical therapy, are heavily reliant on testing as assessments to demonstrate a competent grasp of the material. There are various types of assessment, from

standard multiple-choice examinations to practical exams with standardized patients presenting as real patients for students to perform skills. Foundational knowledge, such as fact retrieval for anatomical structure, is not explicitly tested with many of these assessments. Instead, the examinations use all the foundational knowledge in addition to the new content to assess critical thinking as it relates to real patient cases. This can be very different than what students have been exposed to in undergraduate courses. Furthermore, since examinations have been shown to increase anxiety in students, allowing each student to know what is expected can allow them time to find strategies or resources to better study (Gettinger & Schurr, 2002). This early understanding of the expectations can assist in setting better study goals and perhaps finding more appropriate study strategies.

Anxiety is well documented for students of many different majors (de Oliveira Filho & Vieira, 2007; Frank & Cassady, 2005; Macauley & Plummer, 2017; Schwartz et al., 2015; Trifoni & Shahini, 2011; Udeani, 2012). Are there specific degree majors that have more significant general anxiety as compared to their peers? Yes, evidence has been shown that entry-level doctorate of physical therapy students has higher levels of stress and anxiety when compared to their age and gender-matched peers consisting of working adults and students of the same age (Frank & Cassady, 2005).

How can anxiety be reduced? Physical therapy students' performance was improved on exams when they were untimed (Schwartz et al., 2015). Currently, in most physical therapy programs examinations of any type are timed including their high-stakes licensure exam. This makes the ability to intervene even more essential to help mediate the compounding effects of stress and anxiety, improving study strategies could be a sound option. Many physical therapy graduate programs rely heavy on examinations within a population that has high levels of stress

and anxiety. It becomes vitally important to equip students with strategies to help students reduce their experience of debilitating stress and anxiety.

Physical Therapy Students Testing

According to Richardson (1994, 1995), there seems to be a trend of students using increasingly more complex study strategies as they grow older. I expected the same pattern to exist within the three years of PT school. That is, I expected that third year students, who are approaching taking their NPTE exam, would use better study strategies than first- and second-year students. As students progress from undergraduate work to graduate education that is focused on patient cases and obtaining didactic and psychomotor knowledge a progression to deeper learning would make sense.

Entering into a doctorate of physical therapy program, most students have had observation hours to understand at least a basic concept of the knowledge required in day-to-day interactions with patients. What they may not have investigated prior to seeking admittance is the requirements for licensure. The accrediting board mandates that all physical therapy programs report their licensure exam pass rates for the last three years (FSBPT, 2021). This provides vital information about each of the prospective programs but does not lay out what this entails. In addition, it does not describe to future physical therapy students the timed comprehensive examination that will be given over five hours at a testing center at the end of their education. Once they start coursework in the program, they are continually reminded of the impending exam. Initially, it may seem too far away to worry about, especially with imminent exams in their first-year course work. This is a time when it would be important to intervene and promote the introduction or the expectation of need for higher level, more effective study strategies to retain knowledge obtained over the three years of study. The LASSI can do just

that, allowing students at any level to report their current study strategies and receive a report of their skills and alternatives.

The research is lacking in physical therapy for study skills assessment and correlation with National Physical Therapy Examination (NPTE) performance. However, there are limited studies, discussed earlier in chiropractic medicine, that show the positive impact study skills have on licensure exams (Pringle & Lee, 1998; Schutz et al., 2013). There is also evidence of improved academic performance with improved study skills (Schutz et al., 2011; Sleight & Mavis, 2006). GRE and GPA at admittance and GPA during the program have been shown to be positive predictors for NPTE performance (Kume et al., 2019; Luedtke-Hoffmann et al., 2012; Wolden et al., 2020). Examining relationships between the LASSI, academic performance, and NPTE scores will be beneficial for understanding possible areas for intervention.

Conclusion

The LASSI was chosen for this research because of evidence of validity and reliability and because it has been used with populations that are comparable to physical therapy. Despite limited research at the graduate school level and with high achieving students, the LASSI is still the best option. The literature has shown evidence that LASSI subscales can effectively assess study strategies. Because anxiety (one of the subscales of the LASSI) is shown to be greater in health care professions, the LASSI is particularly appropriate for the study. Study skills do appear to be an option for intervention for physical therapy students at risk for national licensure exam failure. Although the number of students that do not pass is very small, the impact for these students is tremendous. If methods are found that contribute to the reduction of stress and greater retention of knowledge, all students could benefit.

CHAPTER 3
Method

Study skills, behaviors, and habits are a unique part of learning. Everyone believes they are vital for success, but very few students have been explicitly taught how to study. Most students develop some study skills but do not know all the options for studying or which are the best for long term knowledge retention. Students also have a priority of effectiveness and efficiency. However, knowing that a study skill might be effective and efficient in the short term but may not be the strongest for long term retention is also beneficial. Initially, students do not focus on the future use of their knowledge. They only focus on the very imminent exam. This creates an urgency to have the best outcome on the current exam, and poor strategies such as cramming do have short-term success (Dunlosky, 2013). However, if that knowledge is needed for a subsequent course, it may require a return to the material to re-learn. Students don't often feel this is a failure. They may be frustrated to not remember, but since most of their peers use the same study skills, they continue with the same poor skills used before.

This research evaluated students' self-reported study skills and tested for differences across years in the program. It also examined whether study skills predicted success on the licensure examination.

The Researcher

I have been a physical therapist for 21 years and have worked with students in the field on clinicals or in the classroom for the last 17 years. Over the past 8 years, I have worked in an academic program at a midwestern university.

Participants

According to the Commission on Accreditation in Physical Therapy Education, there are 261 accredited physical therapy educational programs and many pending accreditations (CAPTE, 2021). Each program has 20-100 students per cohort, and most program lengths are three years. This means at any time there could be between 5,000 to 26,000 students getting ready to graduate and take the licensure exam and a total of 15,000 to 78,000 physical therapy students studying with a variety of strategies across the nation.

Participants in the study were members of a single physical therapy program in the Midwest that has a maximum of 60 students per cohort. The program takes 3 years, so there are three cohorts in the program. The cohorts are identified by the year they are in the program (1st years, 2nd years, and 3rd years) or graduation year as appropriate. These students have been accepted into the University of Missouri Doctorate of Physical Therapy program. The students had to have a minimum of three years of undergraduate coursework and obtain a GPA of 3.0 for cumulative (last 60 hours) and core requirement (physics, biology, chemistry, physiology, anatomy, statistics, and medical terminology) GPAs. Each student applies to the program and has an interview before their acceptance into the program. The reported GPA averages for the three cohorts were averages of undergraduate or pre-physical therapy program of 3.8 and a range of 3.5-4.0. GRE score averages were 310 with a range of 280-320 (the class of 2024 was not required to submit a GRE due to COVID). These scores have been consistent for the last 6 years as reported by the department's website and information given to prospective students.

The data collection occurred for three cohorts of doctorate of physical therapy students in 2019 (included cohorts graduating in 2020, 2021 and 2022) and 2021 (included cohorts graduating in 2022, 2023, and 2024) for a total number of respondents equaling 465 (418 from

these two collections and 47 from a pilot collection). Not all of the participants completed all of the components of the data collection, leaving some of the analysis with smaller sample sizes. First, only the cohorts preparing to graduate will have taken the PEAT or the NPTE. The PEAT is part of a course and the full collection of 220 was available. For the NPTE, the scores are obtained from the FSBPT and students can block access at this level even after they had signed the consent and this limited the sample to 152. Additionally, GRE testing sites had limited access due to COVID restrictions, and the department determined these scores were optional for admission requirements for the graduating cohorts of 2023 and 2024. Refer to table 7 for number of participants for each analysis.

Institutional Review Board

Approval was received from University of Missouri Institutional Review Board (IRB) by the primary investigator. The approval was for the primary investigator and two research staff (one student for data entry and one staff to assist in data collection). As defined by the University of Missouri IRB, this study has minimal risk and is an exempt project. Exempt projects have minimal risk to the participants, and the information collected is anonymous. To formalize the students' low risk of FERPA violations and their privacy, an online version of the test was used.

Procedure

The recruitment process of the three doctorate of physical therapy cohorts started with each student receiving an informational email from the primary investigator. This email included the purpose of the study, the possible risks and benefits, a description of the research, and the consent form. The date and times for the inventory to be completed were included in the

email, along with a request for each student to have a device (laptop or tablet) to log onto and complete the inventory online. Students could email any questions to the primary investigator. The reason for a specific time allotted for students to complete the online inventory was to carve out time in their day to facilitate ease of participation and lessen the burden of finding time outside of their day to complete the inventory. During the time allotted for administration, a research staffer was in the room to give out and collect the consent form. Instructions were given for logging into and completing the survey. The survey took about 15 minutes. The research staff retained the consent forms in a locked file in a locked office. The rationale for having a research staff instead of the primary investigator present for the administering of the inventory was to allow students who did not want to participate to decline participation without fear of repercussions. The primary investigator is also an instructor in the program.

After consent forms were completed, the research staff acquired GRE scores from student files that are kept within the department and were given scores from the PEAT and NPTE. Scores were entered into the data base that included the results from the LASSI. Also, in this data base the students were identified by their graduating class, and a separate file was created for the primary investigator with names of students removed. Students were able to complete the survey and receive information about study skills without being in the study.

Instrumentation/Data Collection

Data were collected initially as a pilot to help students understand their study skills and provide some information to assist in their study habit for future. This was the data collection of 2019 for three cohorts. Second data collection occurred fall 2021 for three cohorts. Students could participate in the survey but opt out of the study, so they would receive the information

about study skills regardless of whether they were in the study or not. See Table 6 for details on data collection based on cohort (described by year of graduation).

Graduate Record Exam (GRE)

The GRE was used as an admissions test for graduate schools across the US. The GRE has three sections: verbal reasoning (scaled 130 to 170), quantitative reasoning (scaled 130 to 170), and analytical writing (scores 0 to 6). In the present research, the verbal and quantitative reasoning scales were summed to provide the GRE scores.

Practice Exam and Assessment Tool (PEAT)

The PEAT is created by the Federations of State Boards of Physical Therapy (FSBPT) consisting of a retired NPTE board exam. The score used for this research is the scaled score, ranging from 200 to 800, with a passing score being above 600. All students in the University of Missouri Doctorate of Physical Therapy program are required to take the PEAT prior to graduation.

National Physical Therapy Examination (NPTE)

The NPTE is created by the FSBPT as one part of the evaluation process for licensure as a physical therapist in the United States. The scores used for this research are scaled scores ranging from 200 to 800, with a passing score being above 600. A student must pass this exam and complete all requirements for the state of licensure to obtain a license to practice as a physical therapist.

Research Questions

The following are four specific research questions:

1. What is the factor analytic structure of the LASSI?
2. Do third-year students use better study strategies as measured by the LASSI compared to second- and first-year students?
3. Do GRE scores correlate with LASSI scores? That is, do students who have high GRE scores when they apply then report better study skills in the program as measured with the LASSI?
4. Do LASSI scores predict standardized exam composite scores on the physical therapy licensure exam (retired/practice NPTE National Physical Therapy Examination and NPTE)?

Statistical Analysis for Research Questions

Descriptive statistics for sample

Descriptive statistics of each cohort were computed. Percentage of male and female students as self-described by students was calculated. The LASSI score for each individual was the total score from the entire questionnaire. See Table 6 for details of the data collections.

Analysis for research question 1: *What is the factor analytic structure for sample?*

To determine the appropriate factor structure for this sample an explanatory factor analysis was performed followed by a confirmatory factor analysis.

A parallel analysis scree plot was used to determine the appropriate number of eigenvalues. Next, the full sample was randomly split in half, and an explanatory factor analysis was performed using the first half. Multiple factor analyses were performed to determine the best factor structure to be used in the CFA. The second half of the sample was then used to perform the confirmatory factor analysis, as guided by the results of the EFA. This determined

items loadings on factors and thresholds between responses of the items within the LASSI. This analysis determined which test items loaded together for this unique sample and was compared to the original author description of LASSI scales and subscales.

Analysis for Research Question 2: Do more experienced students use better study strategies?

Three cohorts of students took the inventory at the beginning of the fall semester in 2019, and in 2021 three cohorts took the inventory (two cohorts took the LASSI twice, class of 2021 and 2022). Since there are three independent groups for each year (independent variable), a one-way ANOVA was used to compare the LASSI scores (dependent variable) across the three cohorts of physical therapy students to determine if any differences exist. Tukey's post hoc test was performed for significant results to determine which groups are significantly different from each other.

Paired t-test were performed to test for change over time by comparing the first LASSI and the second LASSI scores. As shown in Table 6, only cohort 2021 and 2022 had repeated LASSI scores. These cohorts were analyzed. This is important since the first analysis was cross sectional and this analysis was longitudinal.

Analysis for Research Question 3: Do GRE scores correlate with LASSI scores?

Pearson's correlation coefficients were used to determine the strength and direction of the relationship. Additionally, a linear equation model was used to determine if GRE scores predicted LASSI scores for this entire sample while controlling for other variables such as year in the program.

The importance of determining the relationship of the GRE and LASSI is as an early indicator for students that could struggle. The GRE historically is used for admission to graduate

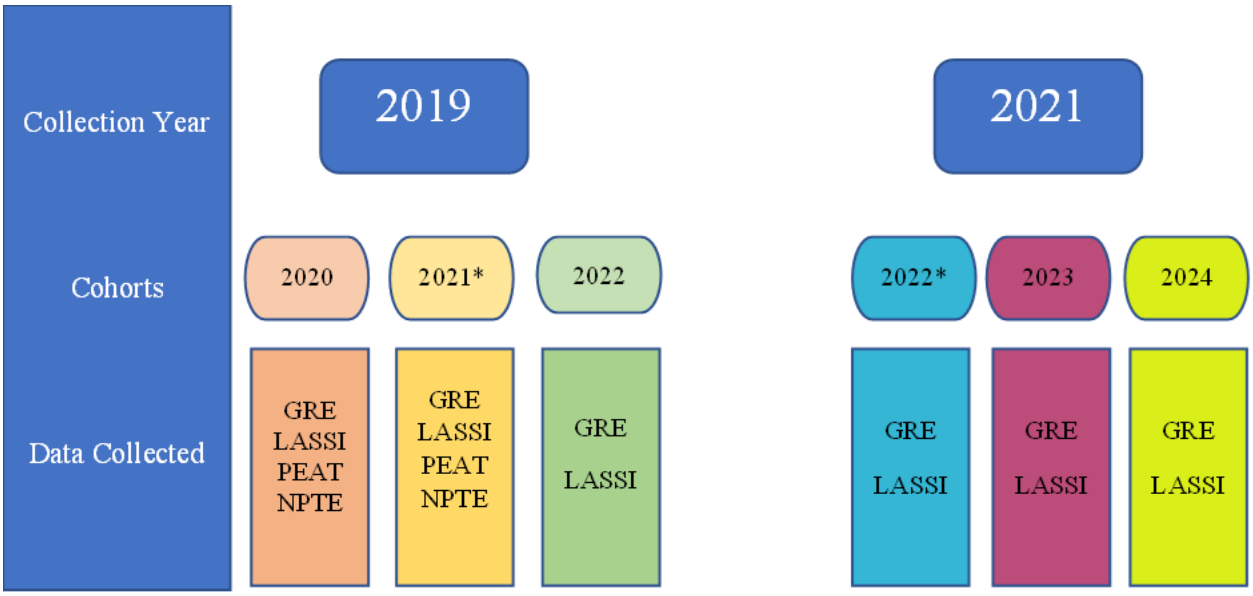
school, and most PT schools use it as one of the academic determinants. It is important to look at GRE and determine if it can predict study strategies since many students take the GRE prior to graduate school, and the program can identify students that are at risk to struggle and provide early support for those students.

Analysis for Research Question 4: Do LASSI scores predict physical therapy licensure exam scores?

Since the PEAT and NPTE are only taken in the last semester of the program, only the third-year cohort (the cohort getting ready to graduate) had LASSI scores and licensure exam scores, so only this cohort is relevant to this research question and analysis. Analysis computed correlations between LASSI scores and practice exams (PEAT) taken spring of 2021, and also correlated LASSI scores with the actual licensure exam (NPTE) taken April or July 2021. Descriptive statistics for means and standard deviations were calculated for the third cohort. Linear regression analysis was used to determine if LASSI scores predicted scores on the PEAT or NPTE.

Table 6

Data collection based on cohort



*Class of 2021 has graduated and has PEAT and NPTE scores and has also taken the LASSI two times.
Class of 2022 has not yet graduated so does not have a PEAT or NPTE but did take the LASSI two times.

Budget

The costs associated with this research were centered around the inventory and data entry. The LASSI 3rd edition cost $3.50/inventory. Total inventories used were 420. After each collection of LASSI scores, H&H Publishing (publishers of LASSI) provided feedback to students.

Conclusion

Through this research, I hoped to determine if the LASSI is a tool that can help students to reflect on their study skills, direct interventions for study skills, and help monitor students who struggle. Being able to determine if students could be at risk for difficulty on the licensure exam will help plan for the future and provide assistance much earlier. Chapter 4 will present the results, and Chapter 5 will discuss results and their relevance.

CHAPTER 4

Results

Descriptive statistics

See Table 7 for descriptive statistics. All data analysis was conducted using r i386 4.1.2.

Table 7

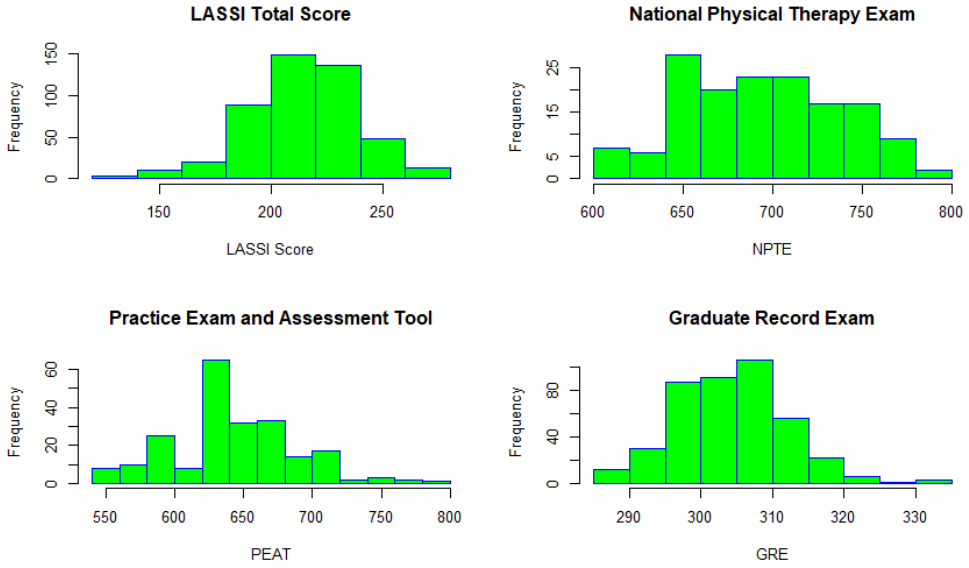
Descriptive Statistics of Data and Correlations

	n	*%*	*Mean*	*SD*	*1*	*2*	*3*
1.GRE	414	89	304.85	7.76			
2.LASSI	465	100	215.10	24.14	-0.05		
3.PEAT	220	91.7	643.32	44.34	0.23	0.15	
4.NPTE	152	84.4	695.01	43.40	0.25	0.09	0.52

Skew and kurtosis were found to be within appropriate boundaries. NPTE (skew =0.05, kurtosis = -0.74), PEAT (skew = 0.33, kurtosis = 0.34), GRE (skew = 0.39, kurtosis = 0.71), and LASSI (skew = -0.41, kurtosis = -0.41). As the histogram shows (see Figure 1) there is greater skew (-0.41) of the total sample's LASSI scores than any of the other variables. See Figure 1 for the histograms of each of these sets for a visual of normality and Table 7 for the correlation matrices of main variables.

Figure 1

Histograms of main data analyzed

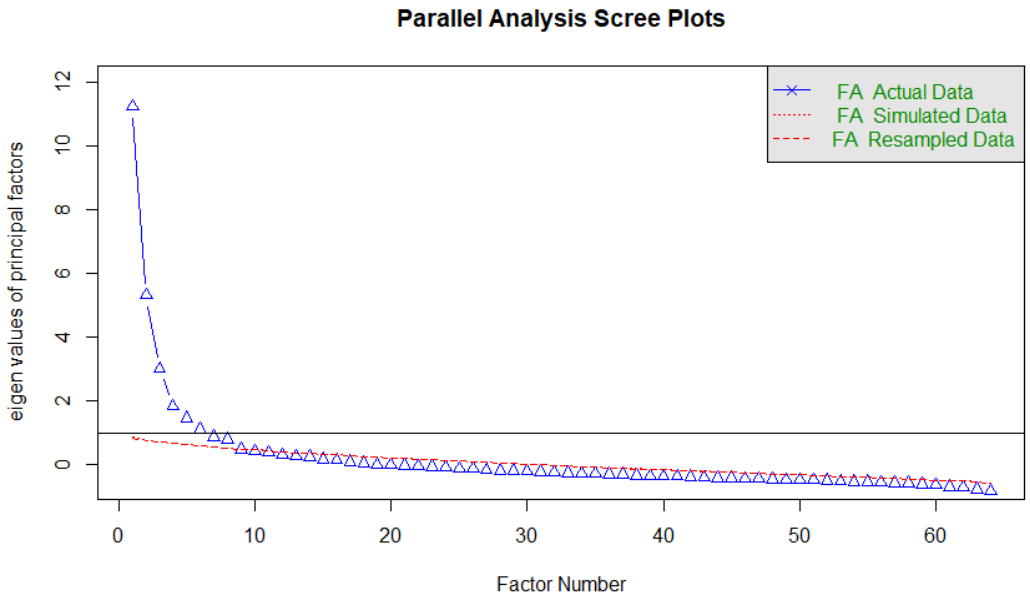


Analysis of research question 1: *What is the factor analytic structure for sample?*

To prepare to complete an exploratory factor analysis, a parallel analysis scree plot was created (see Figure 2). The scree plot showed 6 factors above the eigenvalue cut off of 1.0 (explaining a cumulative variance of 37.4%) and 8 above the simulated data line. Exploratory factor analysis was completed with a randomly selected half of the full sample (n = 232). This analysis was completed for 10, 9, 8, 7, 6, and 3 factor models. The wide range was chosen since the initial LASSI research had 3 scales and 10 subscales and to capture the eigenvalue results of 6-8.

Figure 2

Parallel Analysis Scree Plot to Determine Eigenvalues



After the exploratory factor analysis was performed, it was found that factor models of 10, 9, 8, and 7 had two factors with no items loading. The 6-factor model, which was recommended by the eigenvalues had items loading on all 6 factors and had the lowest BIC of all the models (Klopp, 2019), see Table 10. In all of the models tested, most of the items loaded on the first factor. With further investigation of the 6-factor model, the subscales represented with the first factor are: time management, motivation, concentration, and self-testing. Factor two represents the subscales of anxiety and test strategies, the third factor is information processing, fourth is attitude, fifth is selecting main ideas, and finally the sixth factor is academic resources. In Fong et. al.'s (2022) meta-analysis study to find the factor structure of the LASSI (using four different three factor models), the model with the best fit had similar structure to this research's 6 factor model findings and several cross loadings as well (see Table 8). As noted in Table 9, Fong

et. al.'s model is more complex with cross loading, but does have a similar structure for fitting of the subscales in the three main scales.

Table 8

Proposed factor structure for the LASSI 10 subscales with loadings and cross loadings (Fong et al., 2022) compared to model for this research

Factor	*PT model*	*Fong Comparable Model*
1	Time Management Motivation Concentration Self-Testing	Time management Motivation Concentration *(cross loading with factor 2)*
2	Anxiety Testing Strategy	Attitude *(cross loading with factor 1 and 3)* Anxiety Testing Strategy Selecting Main Ideas *(cross loading with factor 3)*
3	Information processing	Information Processing Self-Testing Academic Resources
4	Attitude	
5	Selecting Main Ideas	
6	Academic Resources	

The final analysis was to perform a confirmatory factor analysis using 6 factors on the randomly selected second half of the sample (n = 233). First, it was determined with omega that this inventory has good reliability (ω= 0.91, CI = 0.89-0.94). Next, the 6 factor CFA was completed and fit indices and loadings were obtained (see Table 11). Chi^2 was significant but higher than the EFA results, and not all of the fit indices met the thresholds to determine this model to be a good fit as shown in Table 9. See table 11 for loadings on 6 factors. Additionally, a one factor CFA was completed to determine the LASSI's possibility of being a single latent trait in this sample and determine its benefit as a single complete assessment to use the LASSI total score, see Table 12 for factor loadings. It was noted only one item (item 50) did not load and was not significant. Furthermore, 11 items loaded under 0.30, many of which were just below this cutoff but all were still shown to be significant. These items represent a variety of subscales.

After completing the single factor CFA, it shows the entire inventory holds together pretty well, with minimal number of items loading slightly below the cutoff of .30 for this sample. This would justify using it as created since this is how it will be used in the field. For my purposes I need to use it as a single factor, as it does not make since to initially pull it apart. With the use of the entire inventory each student get feedback on each of the subscales and this could help inform other investigators for any further research in this or similar samples.

The LASSI developers proposed 3 factors with 10 subscales. Fong et. al. also found 3 factors but a different structure than the original LASSI research. I found 6 factors for my sample and was shown in both split samples for the EFA and the CFA and additionally a single factor CFA held together with all but one item significantly loading. However, for the purposes of this research, I am interested in using the LASSI to give feedback to students. Given the preponderance of the variance is encompassed by a single factor and the desire to use the LASSI as provided by the publishers, I decided to examine LASSI scores using the total score. The total score is the sum of the items. This has also been used by other authors as reported by Fong (2020) in his meta-analysis where he found the total score was had a weighted average correlation with the academic outcomes to be $r = 0.254$, in 15 distinct samples.

Table 9

EFA and CFA Fit Indices

Factor Models *Desired*	Chi^2 *Null=8041.51*	CFI *>0.95*	TLI *>0.90*	RMSEA *<0.06*	BIC *lowest*	RMSR *<0.01*	SRMR *≤0.08*	# of items not loading	# of cross loadings
10	1123.23		0.85	**0.043**	-5707.64	0.03		3	33
9	1284.25		0.831	0.046	-5845.41	0.04		3	24
8	1521.43		0.791	0.051	-5888.5	0.04		2	18
7	1835.37		0.77	0.054	-5987.98	0.04		1	18
6	2236.62		0.723	0.059	**-5996.17**	0.05		**1**	18
3	4621.01		0.59	0.072	-5909.48	0.07		2	16
CFA 6	4773.53	0.52	0.50	0.09			0.11		
CFA 1	5935.15	0.339	0.316	0.103			0.121		

Table 10

CFA 6 Factor and Loadings for Each Item of the LASSI

All items loaded greater than 0.30 except two that are bolded

Factors	*1*	*2*	*3*	*4*	*5*	*6*
Item1	0.529					
Item4	0.685					
Item6	0.517					
Item8	0.404					
Item9	0.389					
Item10	0.395					
Item11	0.624					
Item13	0.688					
Item14	0.345					
Item17	0.515					
Item19	0.448					
Item20	0.468					
Item21	0.467					
Item23	0.649					
Item24	0.467					
Item25	0.628					
Item30	0.492					
Item31	0.38					
Item32	0.474					
Item33	0.353					
Item38	0.459					
Item39	0.321					

Item40	0.555				
Item43	0.324				
Item44	0.485				
Item45	0.331				
Item46	0.34				
Item47	0.737				
Item48	0.423				
Item49	0.369				
Item51	0.534				
Item52	0.433				
Item54	0.467				
Item55	0.328				
Item57	0.376				
Item58	0.442				
Item62	0.335				
Item5		0.312			
Item28		0.821			
Item34		0.794			
Item36		0.433			
Item37		0.639			
Item50		0.802			
Item53		0.59			
Item56		0.798			
Item3			0.693		
Item15			0.38		
Item18			0.735		
Item22			0.533		
Item26			0.367		
Item35			0.681		
Item41			0.796		
Item60			**0.243**		
Item29				0.606	
Item42				0.878	
Item59				0.579	
Item16					1
Item2					0.458
Item7					0.716

Item27	0.542
Item31	**0.251**

Table 11

CFA 1 Factor and Loadings for Each Item of the LASSI

All items loaded greater than 0.30 except bolded, all significant except one

Item	*p value*	*loading*
1	0	0.489
2	0	0.313
3	0	0.352
4	0	0.595
5	0	**0.295**
6	0	0.478
7	0	0.412
8	0	0.369
9	0	0.467
10	0	0.451
11	0	0.525
12	0.001	**0.246**
13	0	0.647
14	0	0.309
15	0	0.388
16	0	0.526
17	0	0.51
18	0.002	**0.228**
19	0	0.519
20	0	0.424
21	0	0.534
22	0	0.337
23	0	0.558
24	0	0.475
25	0	0.566
26	0.002	0.**227**
27	0	0.319
28	0.035	0.**146**
29	0	0.429
30	0	0.547
31	0	0.523
32	0	0.443
33	0	0.341
34	0.004	**0.203**

35	0	**0.266**
36	0.001	**0.246**
37	0	0.349
38	0	0.42
39	0	0.317
40	0	0.52
41	0	0.309
42	0	0.534
43	0	0.34
44	0	0.558
45	0	**0.297**
46	0	0.333
47	0	0.652
48	0	0.502
49	0	0.43
50	**0.569**	**0.039**
51	0	0.515
52	0	0.47
53	0	**0.299**
54	0	0.401
55	0	0.416
56	0	0.366
57	0	0.455
58	0	0.447
59	0	**0.266**
60	0	0.322

Analysis of Research Question 2: *Do more experienced students use better study strategies?*

To analyze whether younger cohorts had lower LASSI scores than the older cohort, a one-way ANOVA was performed. This analysis was completed for the two different collection times (2019 and 2021). For the collection of 2019, a statistically significant relationship between graduation year and scores on the LASSI was found ($p = 0.02$). When Tukey HSD post hoc tests were performed the significant differences occurred between the students getting ready to graduate and both the student in the first and second year of the program ($p < 0.05$ for both) with the third-year cohort being significantly lower than both. This means that the older student self-

reported using worse study strategies as measured by the LASSI. No significant difference was found between the students in the first and second year of the program. Interestingly, when this analysis was repeated for the 2021 collection data, no significant differences were found between any of the years (see Table 12 and 13).

Table 12

Cross Sectional LASSI Scores for 2019 and 2021 Collections

	2019 Collection MEAN (SD)	*2021 Collection MEAN(SD)*
1st Year (2022/2024)	217(28.38)	219(21.16)
2nd Year (2021/2023)	213(24.21)	217(21.26)
3rd Year (2020/2022)	206(26.16)	214(22.53)
F	3.99	0.65
p value	0.02	0.52

Table 13

Differences and Significance of 2019 and 2022 Collections

2019 collection	*Difference*	Lower/upper	p *value*
2021-2020	8.92	4.9/17.36	0.03
2022-2020	11.18	0.94/21.41	0.02
2022-2021	2.26	-6.13/10.64	0.8
2022 collection			
2023-2022	2.85	-7.88/13.59	0.80
2024-2022	5.14	-5.50/15.80	0.48
2024-2023	2.29	-8.16/12.75	0.86

For the analysis of the two cohorts who completed the LASSI twice, each cohort had 60 students. The difference in the means was found to be statistically significant for the class of 2021 but not for the class of 2022. For the 2021 class t (59) = -2.12, p = 0.04, and for the 2022 class t (54) = 1.22, p = 0.23, see Table 14 for means and standard deviations.

Table 14

Longitudinal LASSI Score Means and Standard Deviations for 2021 and 2022 Cohorts

	2021	*2022*
1st LASSI Mean (SD)	231.45(24.21)	217.45(21.36)
2nd LASSI Mean (SD)	219.78(23.15)	213.65(22.47)
F	21.68	15.99
p value	<0.001	<0.001

Analysis for Research Question 3*: Do GRE scores correlate with LASSI scores?*

To determine if there was a relationship between the application GRE and the LASSI scores a regression model was created. A nonsignificant relationship was found, F (3,142) = 0.73, p = 0.53 when also controlling for graduation year, NPTE, and PEAT. For every one unit of change in GRE there was a 0.19 increase in the LASSI scores. In a linear regression model, GRE did not significantly predict LASSI total score, with 1.5% of the variance of the LASSI accounted for by the GRE. Using Pearson's product-moment correlation there was a weak negative (r = -0.047) and non-significant correlation between GRE and LASSI score t = -0.949, p = 0.343. The null hypothesis was supported that there was no relationship between the GRE and LASSI scores. Figure 3 shows the linear relationship of the LASSI and GRE.

Analysis for Research Question 4: *Do LASSI scores predict physical therapy licensure exam scores?*

Using Pearson's product moment correlation, significant positive correlation (r = 0.15) was found between the LASSI total score and PEAT scores t = 2.234, p = 0.026. A positive (r = 0.09) non-significant correlation was found between the LASSI total score and NPTE score t = 1.123, p = 1.263.

Similar results were found using a linear regression model. The LASSI predicted the PEAT, F (3, 216) = 12.01, p <0.05 when controlling for grad year and GRE. 14% of the variance of the PEAT could be accounted for by this model (see Figure 4).

Significant results were found with a regression model in which LASSI predicted NPTE when controlling for grad year, GRE, (F [2, 149] = 5.51, p <0.05). 6.8% of the variance of the NPTE could be explained by this model (see Figure 5). The PEAT was not included as a variable due to its correlation with the NPTE (r = 0.52) and the possible issue of multicollinearity.

PEAT scores significantly predicted NPTE scores, F (1,144) = 52.51 p < 0.05, with 26.7% of the variance of the NPTE accounted for by the PEAT (see Figure 6 and Table 15).

To establish if other covariates could be affecting the relationship further linear models were performed. All the variables (GRE, LASSI, and PEAT) are significantly related to the NPTE except the LASSI score, F (3,142) = 19.67, p <0.05. 29.36% of the outcome variance could be explained by all the predictors in this linear regression model (see Table 16).

Table 15

Linear Regression Model to Predict PEAT

Predictor	*b*	*b_95%_CI*	*beta*	*beta_95%_CI*	*sr2*	*sr2_95%_CI*	*r*	*fit*
Intercept	55159.99**	[29483.42, 80836.57]						R2 = .143** 95% CI[.06,.22]
LASSI	0.33**	[0.10, 0.55]	0.18	[0.06, 0.31]	.03	[-.01, .08]	.15*	
Grad. Yr	-27.21**	[-39.93, -14.50]	-0.27	[-0.40, -0.14]	.07	[.01, .13]	-.23**	
GRE	1.31**	[0.62, 2.00]	0.23	[0.11, 0.36]	.05	[-.00, .11]	.23**	

* indicates p < .05. ** indicates p < .01.

Table 16 (a and b)

Linear Regression Model to Predict NPTE scores with and without PEAT as a covariate

Without PEAT

Predictor	*b*	*b_95%_CI*	*beta*	*beta_95%_CI*	*sr2*	*sr2_95%_CI*	*r*	*fit*
Intercept	270.08*	[16.31, 523.85]						R2 = .069** 95% CI[.01,.15]
LASSI	0.14	[-0.18, 0.46]	0.07	[-0.09, 0.23]	.00	[-.02, .03]	.09	
GRE	1.29*	[0.47, 2.11]	0.25	[0.09, 0.40]	.06	[-.01, .13]	.25**	

*** indicates *p* < .05. ** indicates *p* < .01**

With PEAT

Predictor	*b*	*b_95%_CI*	*beta*	*beta_95%_CI*	*sr2*	*sr2_95%_CI*	*r*	*fit*
Intercept	70.76	[-161.46, 302.97]						R2 = .294** 95% CI[.16,.39]
LASSI	0.14	[-0.15, 0.42]	0.07	[-0.07, 0.21]	.00	[-.01, .02]	.10	
GRE	0.75*	[0.01, 1.50]	0.15	[0.00, 0.29]	.02	[-.02, .06]	.26**	
PEAT	0.57**	[0.40, 0.74]	0.48	[0.34, 0.63]	.22	[.11, .34]	.52**	

Figure 3

Scatter Plot and Regression Line for GRE Predicting LASSI scores

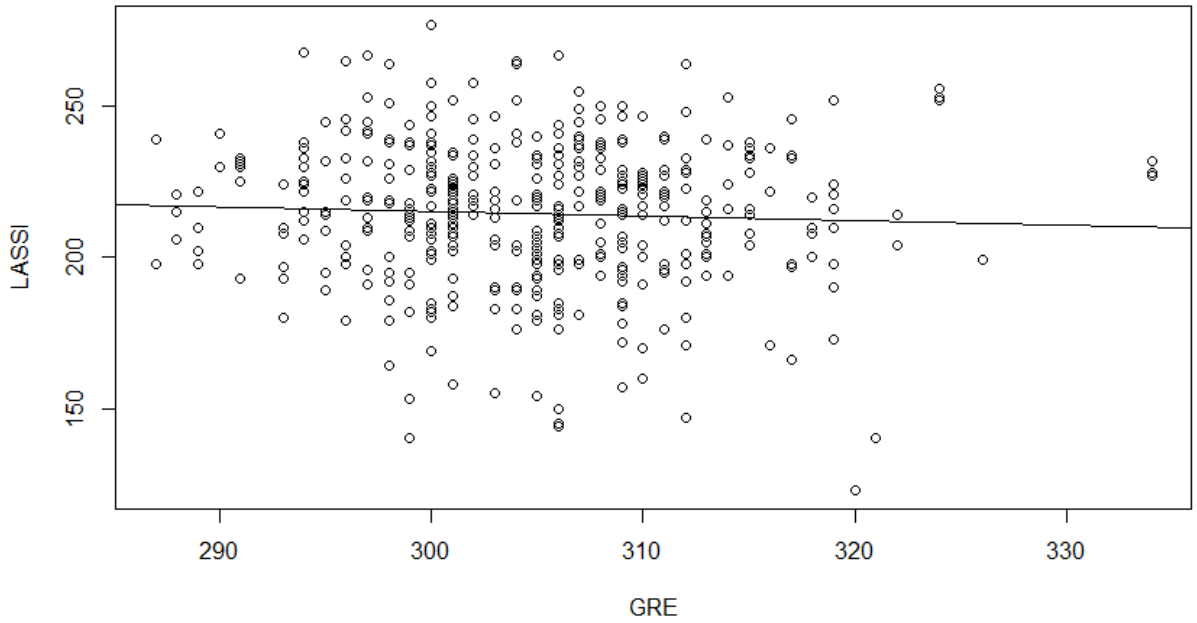


Figure 4

Scatter Plot and Regression Line of LASSI Scores Predicting PEAT

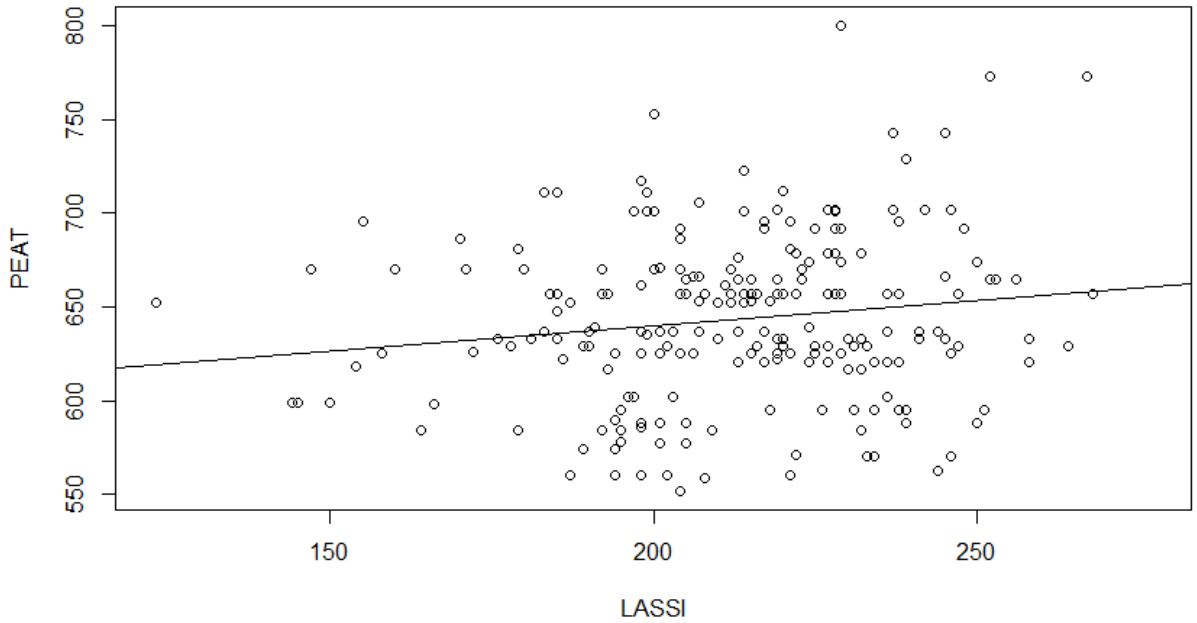


Figure 5

Scatter Plot and Regression Line of LASSI Scores Predicting NPTE

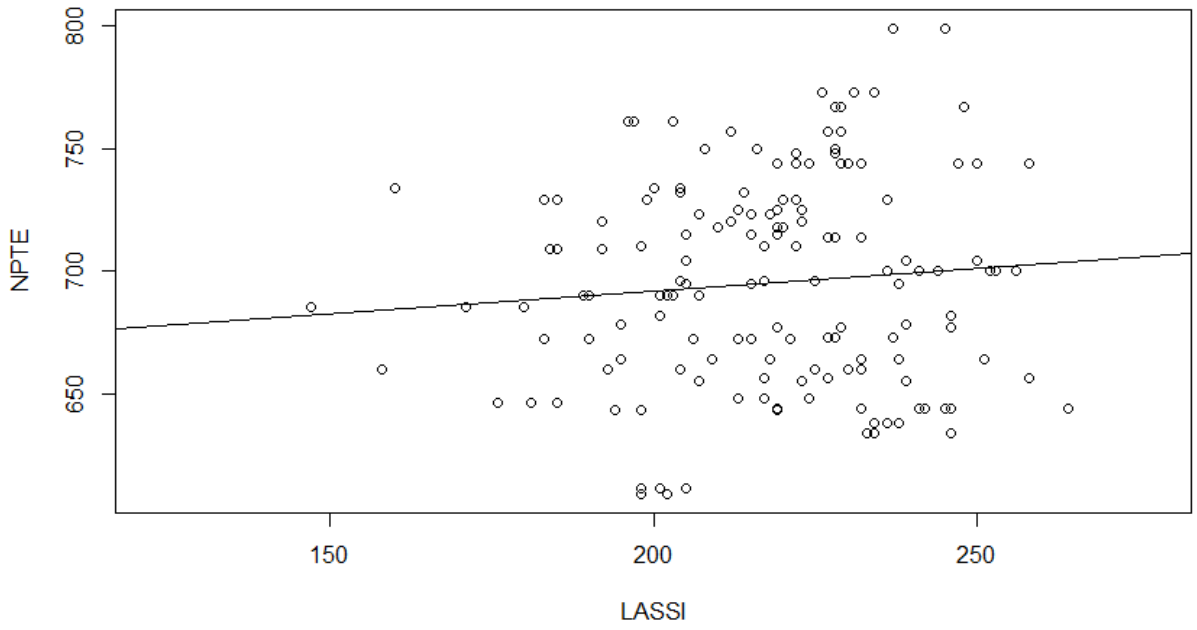
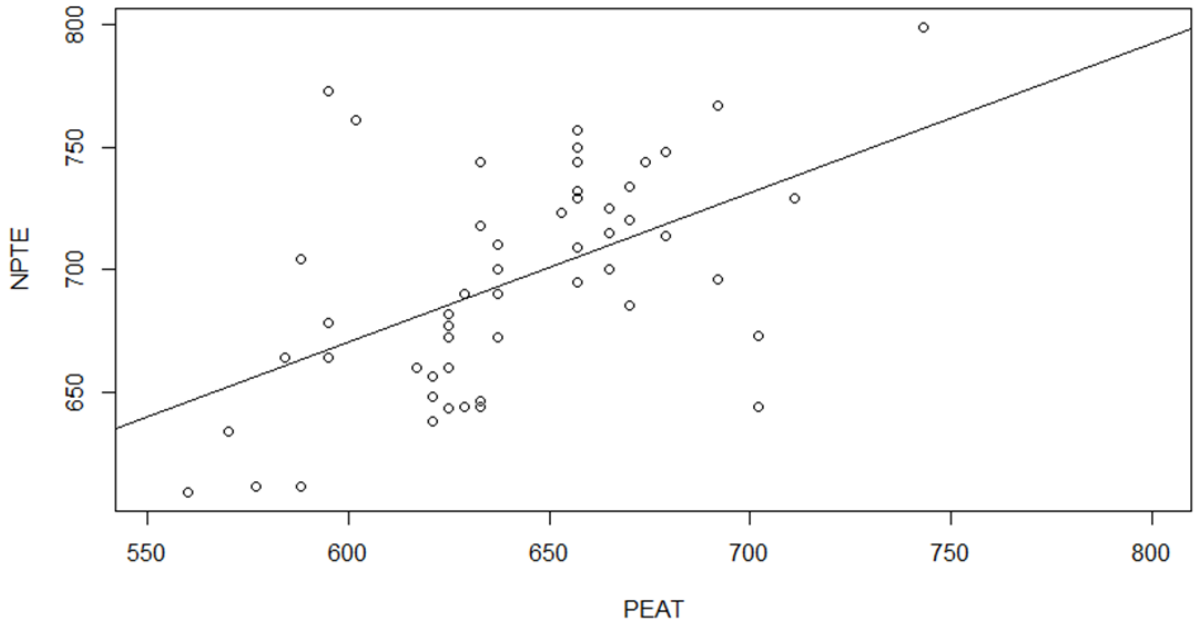


Figure 6

Scatter Plot and Regression Line for PEAT Predicting NPTE



CHAPTER 5

Discussion

This research investigated the use of study strategies inventory to understand the study strategies used by physical therapy doctoral students. Finding a tool to assess these students' baseline study skills was a challenge since this is not a conventional population that perceives a need of intervention. The LASSI was chosen as the inventory after also considering the ASSIST and ILP. The LASSI was more appropriate because of evidence of validity and reliability and because it has been used in populations comparable to physical therapy. Additionally, the LASSI has an easily accessible online version that provides each student with their results. The main guiding force of this research is to help these students experience more learning and less stress while they complete the program and pass the national licensure exam. Determining if there is a connection between study skills and their performance on the board exam can help discover opportunities for possible future interventions.

Limitations/Delimitations

One limitation of the current study is that the sample has limited diversity. Nationally, the American Physical Therapy Association reports the membership (this is only physical therapists that pay to be a member) in 2016 was 88.5% white, and 67% female. Our program in 2021 with all three cohorts was 92% white, and 63.4% female. It is similar to the national percentages but may not be representative for demographics of some regions.

Another limitation is this is one sample of one program in a specific region of the United States. The sample size is fairly small.

The influence of the COVID pandemic caused another limitation due to an increased hybrid or online learning. Prior to the start of the pandemic, our students spent most of their days together as a cohort due to their schedule of classes and clinic time. This set up an environment of students doing a majority of studying at school during the day some with classmates and some on their own and only studying at home in the evenings. Once the pandemic started in March of 2020, it changed not only how the classes were taught but where students had to study. Many students did not have internet at their homes; they used the university internet or went to community areas with free internet. When the pandemic began, those options were closed. After the hurdle of securing home internet, students also had to change to taking classes online from home and studying from home. Each cohort in this study experienced a different level of COVID impact throughout their three years in the program. The 2020 cohort was minimally impacted because they only had the last 8 weeks of their program to complete online. The class of 2021 was the most greatly affected. They were set to start their second clinical March of 2020, and over 50 % did not complete 2 weeks of a 9-week clinical. They also had a fully online summer semester and hybrid fall semester. The class of 2022, which is ongoing at the time of this writing, had to complete their spring semester of 2020 online including hands-on labs. They were all able to complete their first clinical through the summer, but in the fall had to have "make up" labs for all the practical and hands on content that was missed in the spring. The class of 2023 was only affected in the summer of 2020 with their gross anatomy course being fully online and no cadaver dissection. The class of 2024 has not had any changes to their course work due to COVID restrictions.

The students participating were enrolled in a doctorate of physical therapy program where I work. I am in a position of power over each student for final grades, clinical placements,

and successful completion of clinicals. Due to this consideration, each student's inventory was kept anonymous. Individual identifiers were maintained on initial data to allow the research staff to match data for students.

Research Questions

The first research question asked what is the factor structure of the LASSI for this unique sample. Investigation into the factor structure of the LASSI for this sample was challenging. When exploring possible factor structures none were obviously strong. The 6-factor model seemed the best for this sample, but was not supported with CFA. The model investigated could be too complex as evident by finding 18 of the items loaded above .30 on multiple factors making it difficult to determine the most relevant factor for that item. Another possible reason is the latent trait of study skills is different in doctorate of physical therapy students. This variation could be due to their differences in demographics, such as being older and already completing a degree. As this sample is more advanced in age has more education than the initial samples from the LASSI authors, it does seem the structure might be different from the ten subscales. Recent research found the LASSI to not be as highly correlated with GPA/grades for postsecondary students (Fong et al., 2020). After completing the 6 factor analysis, determining if a single factor would hold to help support the use of a total score for the LASSI was able to show that the LASSI does show evidence of being beneficial as a single factor and maybe a single latent trait of study skills, with only one item shown not to be significant and a small amount of other items loading less than .30 it would support the use of the LASSI as it exists and future researchers could use this data to inform their data collections as it relates to multi and single factor analysis.

To fully determine if a six-factor model is the most appropriate for this population more samples would need to be collected and from additional programs. Researchers could analyze

using factor scores. For this data set the items that did not load on any item would have a factor score close to zero and would be the equivalent of deleting the item, but maintaining the full integrity of the LASSI for administering. A reason to keep all the items for analysis is to allow students to self-report on all areas in the LASSI and get the full report of their results. Additionally, interventions could then be more focused on items or subscales that have a greater factor score.

The second research question was determining if students improve their study skills as they advance through the program. If there is no change in study skills from undergrad to graduate work, this would show no increased maturity of study habits. The results found significant different in LASSI scores using both cross sectional and longitudinal analyses. A significant differences between the most advanced students getting ready to graduate and both of the younger cohorts was found, with the most mature cohort having significantly lower LASSI scores and longitudinally the class of 2021 but not for the class of 2022. This first appears to be a result that would show a decline in doctoral physical therapy students study skills. These results could also be a single anomaly and study skills are stable throughout graduate school. However, Khalil (2017) showed similar results in medical students. In his research he found medical students had lower LASSI scores in second year of medical school versus their first year. The conclusion was that the second year might be a more accurate measure of the medical students' study skills. This could make sense as medical students like physical therapy students have been very successful in their undergraduate degrees with the strategies they have chosen to use. The LASSI self-reported scores when they have just been accepted into a competitive program could be inflated. As the students' progress with the rigorous graduate school course work, they might find new challenges and less success (lower GPA's or challenges with course

work) and so have a more realistic self-assessment of their study skills. This has been evident in our program with self-efficacy, as student report a decline in self-efficacy after one year of course work and clinical.

The previous discussion was cross sectional. Could there be a difference in a single class over time? For the graduating classes of 2021 and 2022, students took the LASSI two times. Significant differences were found in the class of 2021 but not the class of 2022. The significant results were similar to the cross-sectional data and showed that more mature students had a lower LASSI score. There has been research demonstrating students mature their study skills from high school to college (Richardson, 1994, 1995). This is a big transition and maybe students have less changes as they move into graduate school. Without intervention students may only make minor changes in their study skills. The need for an intervention to have significant changes in LASSI score or study strategies was support by Ince and colleagues (1998), in their investigation of military academy students. As they found significant improvements in study skills in students that had interventions but not in their control groups. And this could drive further investigation into early intervention for students who struggle.

The third research question set out to determine if there was a relationship between the GRE scores used for admission to the program and LASSI scores obtained in the program. The GRE is used across the nation as a requirement for admission into graduate school. The GRE did not predict LASSI scores. The GRE has been used for admission to our program since the degree changed from a bachelor's to a master's program in 2001, and the department found that the GRE was positively correlated with pass rate of the NPTE.

Finally, the fourth research question examined the relationship between LASSI scores and standardized licensure exam scores. Investigating the relationship between study skills and

performance on high-stakes exams was one of the main driving forces of this research. The LASSI did significantly predict the PEAT exam, which is a retired board exam that test students' entry level physical therapy knowledge. In contrast, the LASSI was not significantly correlated to the NPTE scores, but did the LASSI did predict the NPTE when accounting for grad year and GRE score with regression analysis. The NPTE and the PEAT test the same areas to determine entry level physical therapy knowledge, but the NPTE is much higher stakes as it is required for licensure. Between the time the students take the PEAT exam (from January through March) and take the board exam (April through July), they have been given specific instruction on study skills and habits that are proven to be more effective and improve retention. Students are much more motivated to try new strategies during this time as the fear of not passing provides the additional incentive needed. It has been shown by this research that students have lower LASSI scores in the last year of the program, which is collected at the beginning of the last year. Their PEAT and NPTE are taken at the end of the year

Throughout the board preparation course, students take numerous quizzes that include self-reflection and group reflection. Students are instructed and provided evidence for more effective study skills and then allowed to try new study strategies throughout the eight weeks of a course. Many strategies are introduced after students take a practice PEAT exam to determine their current level using their self-selected study strategies. The students then trial their new strategies for multiple quizzes each week. In combination with strategies for studying at home and in groups, additional strategies for the exam day were practiced. These included "dump sheets," a cheat sheet they had practiced creating while studying of cues to help with memory and thinking about what they do the night before and their preparation for the morning of the exam. The students could practice and then adapt and change for the next exam, and this is a

strategy they can use in the board exam as they have a few minutes prior to starting to recreate this from memory. The dump sheet could be a new strategy they had not used when they took their LASSI to self-report their strategies at that time. Furthermore, creating one-page cheat sheets for examination preparation is beneficial if they are high quality, and if they are adapted to improve quality it has been shown to improve performance on examinations (Song & Thuente, 2015).

As this research has concluded, some questions have been answered, and some leave more questions or a need for further data collection to clarify the results given. As the GRE has been dropped as a requirement for admission to our doctorate of physical therapy program, the need to see if it can predict study skills might not be as valuable as it was prior to when these scores were collected for each applicant. The GRE has continued to be used by other programs and our program evaluates every year if we will require it again. It could possibly be reintroduced as part of the admission requirements. The LASSI as a tool to allow students to self-report their study skills and understand the strengths and weaknesses of their current strategies can be vital to help any struggling students. Although this sample did not support the factor structure initially determined by the LASSI creators, this instrument is still valuable for students and the faculty that support them. As a student completes the LASSI and receives the report of their study skills in the ten subscales, it allows them to investigate different study strategies and to have better conversations with faculty about ways to improve their performance and retention of content in courses.

Future Research

Determining an assessment tool to evaluate doctorate of physical therapy students study skills was valuable, and the LASSI has strengths in this sample. In the future using the LASSI in

a larger sample of doctorate of physical therapy students will be essential. This larger sample will help determine if the current 6 factor structure investigated with this research still holds. It would also be beneficial to perform analysis to find factor scores for each item for the most accurate analysis of the total score. Additionally, with the larger sample investigating to see if the pattern of decreasing LASSI scores over the three years of the program continues and possibly determine which year is the most accurate predictor for the NPTE.

The impact of anxiety and clinical education are additional areas not assessed in this research. If an instrument to assess anxiety could be also given coinciding with the administering of the LASSI then it could be evaluated for impact on PEAT and NPTE and also controlled for in predictive regression analysis. As clinical education is a large part of all doctorate of physical therapy programs it could have some influence on how students progress and could have an impact on NPTE scores and should be controlled for the final analyses as well.

One final area of future research could be around an intervention for study skills. This would entail an initial LASSI and then an explicit intervention of instruction for more efficient and effective study strategies and how to use them in the programs didactic content areas. Comparing some of the LASSI scores and NPTE with the cohorts in this study as controls could evaluate the success and what students have the greatest benefit from intervention.

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VITA

Kelly Stephens was born in New Mexico and lived there and Arizona for her childhood and then graduated high school on Missouri. Kelly attended the University of Missouri and received her Bachelor's degree in Fitness and Nutrition and a Master's degree in Physical Therapy.

After graduation Kelly practiced as a physical therapist until returning to pursue her Doctoral degree in Educational Psychology at the University of Missouri while also working as a teaching professor in the Department of Physical Therapy in the School of Health Professions.

Currently, Kelly is an Associate Professor for the Department of Physical Therapy and lives in Columbia Missouri with her family.