

UNDERSTANDING ATHLETIC TRAINERS' BELIEFS TOWARD IMPLEMENTING
A MULTIFACETED MANAGEMENT APPROACH AFTER A SPORT-RELATED
CONCUSSION: VALIDITY AND RELIABILITY MEASUREMENTS
OF AN APPLICATION OF THE THEORY
OF PLANNED BEHAVIOR

THESIS

Presented to the Graduate Council of
Texas State University-San Marcos
in Partial Fullfillment
of the Requirements

for the Degree

Master of SCIENCE

by

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San Marcos, TX

May 2010

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ACKNOWLEDGEMENTS

I would like to thank my family foremost for their support to me through out my endeavor with this project and master degree. My wife and children, JT and Lucy, have been with me for every step of the way. My parents taught me a good work-ethic which has greatly benifited me throughout my graduate studies. My committee, Dr. Denise Gobert and Dr. Jeff Housman, has been excellent in their dedication of guiding me and without Dr. Luzita Vela, my committee chair, I would not have been able to complete this project. My time at Texas State University-San Marcos has been invaluable, both educationally and clinically. I want to thank the faculty of the Graudate Athletic Training Program and Mark and Betsy, at Jack C. Hays High School, for their mentorship to me.

This manuscript was submitted on March 23, 2010.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS iv

LIST OF TABLES vii

LIST OF FIGURES ix

CHAPTER

I. INTRODUCTION 1

 Purpose.....4

 Hypothesis.....4

 Operational Definitions.....5

 Delimitations.....6

 Limitations and Assumptions6

 Significance of the Study7

II. A META-ANALYSIS: ARE THERE NEUROCOGNITIVE AGE RELATED DEFICITS BETWEEN HIGH SCHOOL AND COLLEGE ATHLETES AFTER A SPORT-RELATED CONCUSSION?12

 METHODS15

 Published Study Selection.....15

 Meta-Analysis17

 RESULTS18

 Quality Assessment.....18

 Meta-Analysis19

 DISCUSSION21

 CONCLUSION.....24

III. METHODS	35
Participants.....	36
Instrument	37
Procedures.....	39
Statistical Analysis.....	40
IV. UNDERSTANDING ATHLETIC TRAINERS’ BELIEFS TOWARD IMPLEMENTING A MULTIFACETED MANAGEMENT APPROACH AFTER A SPORT-RELATED CONCUSSION: VALIDITY AND RELIABILITY MEASUREMENTS OF AN APPLICATION OF THE THEORY OF PLANNED BEHAVIOR	44
METHODS	49
Participants.....	49
Instrument	51
Procedures.....	53
Statistical Analysis.....	54
RESULTS	56
DISCUSSION	58
Future Directions	63
CONCLUSION.....	63
APPENDIX.....	74

LIST OF TABLES

TABLE	PAGE
1. Modified Scale from Côté et al. ²³ for the Appraisal of the Methodologic Quality of Cohort Studies.....	25
2. Articles Included into College Group.....	26
3. Articles Included into High School Group	27
4. Item-Content Relevance Ratings of the Panel of Experts for the TPB Construct: Attitude	65
5. Item-Content Relevance Ratings of the Panel of Experts for the TPB Construct: Subjective Norms.....	65
6. Item-Content Relevance Ratings of the Panel of Experts for the TPB Construct: Perceived Behavior Control.....	66
7. Item-Content Relevance Ratings of the Panel of Experts for the TPB Construct: Behavior Intention	66
8. Primary Sport Assignment of Participants.....	67
9. Attitude Rotated Factor Loadings Following Confirmatory, Principle Component Analysis.....	67
10. Subjective Norms Rotated Factor Loadings Following Confirmatory, Principle Component Analysis.....	68
11. Perceived Behavior Control Rotated Factor Loadings Following Confirmatory, Principle Component Analysis	68
12. Attitude Rotated Factor Loadings Following Exploratory, Principle Component Analysis.....	69

13. Subjective Norms Rotated Factor Loadings Following Exploratory, Principle Component Analysis	69
14. Perceived Behavior Control Rotated Factor Loadings Following Exploratory, Principle Component Analysis	70
15. Behavior Intention Rotated Factor Loadings Following Exploratory, Principle Component Analysis	70

LIST OF FIGURES

FIGURE	PAGE
1. The Theory of Planned Behavior	9
2. Flow Chart for Selecting Articles to be Included in the Meta-Analysis.....	28
3. Meta-Analysis Outcomes for Memory across the Time Periods of, within 72, day 3, and day 5 Post-Concussion	29
4. Meta-Analysis Outcomes for Reaction Time and Visual-Motor Speed across the Time Period of, within 72 Post-Concussion.....	30
5. The Theory of Planned Behavior with the sub-components of each construct.	71

CHAPTER I

INTRODUCTION

Over the past decade there has been an increase in concussion research to allow for more evidence-based decision making. Due to the increasing knowledge regarding concussions, a number of organizations, including the International Ice Hockey Federations (IIHF), the Federation Internationale de Football Association Medical Assessment and Research Centre (FIFA, F-MARC), the International Olympic Committee Medical Commission (IOC), and the National Athletic Trainers Association (NATA), have developed guidelines to ensure proper prevention and management of sport-related concussions.¹⁻⁴ During the first International Conference on Concussion in Sport¹ a ten point protocol was established: 1) clinical history, 2) evaluation, 3) neuropsychological testing, 4) imaging procedures, 5) research methods, 6) management and rehabilitation, 7) prevention, 8) education, 9) future directions, 10) medicolegal considerations. This protocol gave rise to a specific way to evaluate and manage concussions, but also stated that future research was still needed to provide the best information for clinicians to properly deal with this unique injury. The NATA followed up two years later with a concussion management position statement⁴, which gave clinicians more specific information regarding appropriate instruments to use while evaluating and managing a sport-related concussion. The NATA position statement also added to the body of guidelines by introducing proper education techniques and post-

injury care for concussed athletes. Since the first International Conference on Concussion in Sport, the group of experts have met two other occasions in which they have better clarified the etiology of sport-related concussions, expanded the process of the first concussion protocol, and determined chronic effects of this injury.^{2,3}

When examining these guidelines it is clear that concussion management experts believe a set of procedures should be followed and certain tools used to manage sport-related concussions. This multifaceted approach includes the use of: 1) clinical examination, 2) self-reported concussion symptom checklist, 3) neuropsychological testing, and 4) postural stability measures. In addition to using these tools, the guidelines suggest the completion of baseline testing prior to competition such that a direct comparison can be accomplished if an athlete sustains a concussion.

Since the publication of the current concussion management guidelines there has been an increased implementation of the multifaceted approach, but not all athletic trainers are following the current guidelines. While surveying college program directors and clinicians from accredited athletic training education programs, Covassin et al.⁵ found that 33.3% use computerized neuropsychological testing and 28.4% use the Balance Error Scoring System (BESS), a simple postural stability test. There was an increase in the use of computerized neuropsychological testing found by Covassin et al. compared to a similar study that Notebaert and Guskiewicz⁶ performed four years previous, which they found only 14.6% used computerized neuropsychological testing and 16% used the BESS. The difference between the studies may be due to an increase in the usage of this type of test, but also may be due to the samples that were taken.

Covassin et al. recruited a sample of only college athletic trainers while Notebaert and Guskiewicz used a random sample of athletic trainers across all settings.

The Theory of Planned Behavior

The Theory of Planned Behavior (TPB) is an extension of the Theory of Reasoned Action⁷ which is based on the assumption that behavior intention is an immediate predictor of behavior and that intention, in turn, is determined by attitude and subjective normative factors.

The attitude component of the model is suggested to be a function of the individual's beliefs about a specific behavior, as well as how the individual perceives a potential outcome, such as good or bad and pleasant or unpleasant. Subjective norms are composed of the beliefs of others that the individual deems important to them during their decision-making process. Another factor of subjective norms is the individual's motivation to comply with these people and their beliefs. These two variables are able to predict a person's beliefs regarding a specific behavior, but Ajzen suggested that the Theory of Reasoned Action may be insufficient.^{8,9} This theory does not account for moments that are not completely independent from outside factors. Therefore, the TPB was developed to include perceived behavior control (Figure 1). This new construct reflect on how easy or difficult an individual feels performing a specific behavior will be given his or her resources and/or opportunities.¹⁰ In the TPB, as a general rule, the stronger an individual's attitude and subjective norms toward the behavior and the more perceived control an individual has concerning the specific behavior the more likely behavior intention will reflect actual behavior.

Using the TPB to understand concussion management is warranted because the key to changing behavior is to understand peoples' beliefs.¹¹ Understanding why athletic trainers choose to follow or not follow concussion management guidelines will help in developing education techniques regarding important concussion management recommendations.¹²

Purpose

The purpose of this study is to create a valid and reliable survey instrument using the constructs of the Theory of Planned Behavior, which can be used in the future to understand the beliefs of athletic trainers toward evaluating and managing athletes with a sport-related concussion.

Hypothesis

It is hypothesized that ...

1. The survey instrument will be found valid by the expert panel, meaning the instrument: 1) correctly measures the constructs of the TPB and 2) appropriately represents the important points of the concussion management guideline statements used which are: 1) *Summary and agreement statement of the first International Conference on Concussion in Sport, Vienna 2001, regarding sport-related concussions*,¹ 2) *Summary and Agreement Statement of the 2nd International Conference on Concussion In Sport, Prague 2004*,² 3) *Consensus Statement on Concussion in Sport 3rd International Conference on Concussion in Sport Held in Zurich, November 2008*,³ and 4) *National*

*Athletic Trainers; Association Position Statement: Management of Sport-Related Concussion.*⁴

2. The survey reliability assessed by internal consistency will be found acceptable after a Cronbach's alpha analysis (range of 0.7 – 0.9).

3. There will be 7 factor loadings of the TPB after a factor analysis. These factors are hypothesized to be: 1) two sub-factors of attitude, 2) two sub-factors of subjective norms, 3) two sub-factors of perceived behavioral control, and 4) behavior intention.

Operational Definitions

1. Concussion is defined by the 3rd International Conference on Concussion in Sport Held in Zurich, November 2008, which states a concussion is a complex pathophysiological process affecting the brain caused by a direct blow or “impulsive” force to the head that result in a graded set of clinical symptoms that resolves spontaneously.³

2. Baseline testing is represented by the process of the athlete performing specific testing before participation in his/her competitive sport to establish an athlete's score under normal conditions which may be compared to if an injury occurs.

3. Return-to-play is a term used to signify the time when an athlete is cleared for full participation by either the team physician or athletic trainer after a concussion.

4. A multifaceted concussion evaluation and management approach is the use of clinical examination, graded symptom checklist, postural stability testing, and neuropsychological testing while the athlete presents with signs and symptoms of a concussion.

5. A graded return-to-play protocol is the process in which activity is gradually increased, from light to sport specific activities, after an athlete is determined asymptomatic at rest until return-to-play is warranted. The 3rd International Conference on Concussion in Sport Held in Zurich, November 2008 gives the following protocol: 1) no activity, 2) light aerobic exercise, 3) sport-specific exercise, 4) non-contact training drills, 5) full contact practice, and 6) return-to-play.³

6. The Theory of Planned Behavior is composed of three constructs which are believed to predict behavior intention, which in turn is thought to be a direct predictor of actual behavior. These three constructs include: 1) attitude defined as beliefs concerning the outcomes of the intended behavior, 2) subjective norms defined as beliefs about normative expectations of the intended behavior, and 3) perceived behavior control defined as their perceived power to perform the intended behavior.

Delimitations

1. This study is delimited by the recruitment of athletic trainers in either high school, high school and clinic, junior college, and university and college settings to best represent the population most often evaluating and managing sport-related concussive injuries.
2. This study is delimited by the recruitment of athletic trainers that are members of the National Athletic Trainers Association to ensure a random sample of the population.

Limitations and Assumptions

1. This studies is limited be the use of an expert panel for measuring the validity of the instrument. Each member of the panel will be asked to participate due to their expertise

on the TPB or concussion management, but there is a subjective component when asking the opinions of others. It is assumed that the experts will judge the instrument to the best of their knowledge.

2. It is assumed that each subject will truthfully respond when answering the questions of the instrument.

3. This study is limited by inherent problems associated with survey research such as low response rate, and prospective recall of events.

Significance of the Study

In the last decade there has been an increased awareness of the potential risks of sport-related concussions. With raised awareness, researchers are continuing to develop and refine a better way to evaluate and manage sport-related concussions. These guidelines are clearly stated in four recently published statements which are: 1) *Summary and agreement statement of the first International Conference on Concussion in Sport, Vienna 2001, regarding sport-related concussions*,¹ 2) *Summary and Agreement Statement of the 2nd International Conference on Concussion In Sport, Prague 2004*,² 3) *Consensus Statement on Concussion in Sport 3rd International Conference on Concussion in Sport Held in Zurich, November 2008*,³ and 4) *National Athletic Trainers; Association Position Statement: Management of Sport-Related Concussion*.⁴ As a health care profession it is important to incorporate evidence-based medicine into clinical practice. One important component of evidence based medicine is the implementation of current research. Over the past five years there has been an increased use of a multifaceted sport-

related concussion assessment and management approach, but it is still reported that only about 1/3 of athletic trainers follow all of the guidelines.⁵

There may be various reasons why all athletic trainers do not follow the current guidelines. Athletic trainers may believe that following all concussion management guidelines may be too difficult or unnecessary. Another factor that may deter athletic trainers from using the multifaceted approach for concussion management are the opinions of the athletic director, coaches and team physicians that work with or employ the athletic trainer.

The low percentage of athletic trainers using the multifaceted approach could also be due to other factors that are believed to be outside their control. Perceived barriers such as low budget allocations or overworked athletic trainers may be reasons for the low numbers. Advanced neuropsychological testing such as computer tests (e.g. ImPACT or CogSport) may be difficult for a high school to purchase or finding extra time to set up serial evaluations of neuropsychological testing and postural stability may be difficult. But to provide the best care to each injured athlete it is vital that athletic trainers follow the guidelines to the best of their ability.

There are many reasons why an athletic trainer may or may not choose to follow the current guidelines for concussion management. Understanding beliefs of athletic trainers regarding the use of a multifaceted approach is significant in changing behavior and providing better care for each concussed athlete. The use of the TPB has been chosen to do such, but it is important to make sure the survey instrument that will be used to understand these beliefs is valid and reliable. This study aims to develop a valid and

reliable instrument that can be used in a future study to clearly understand athletic trainers' beliefs toward the concussion management protocol in order to change behavior.

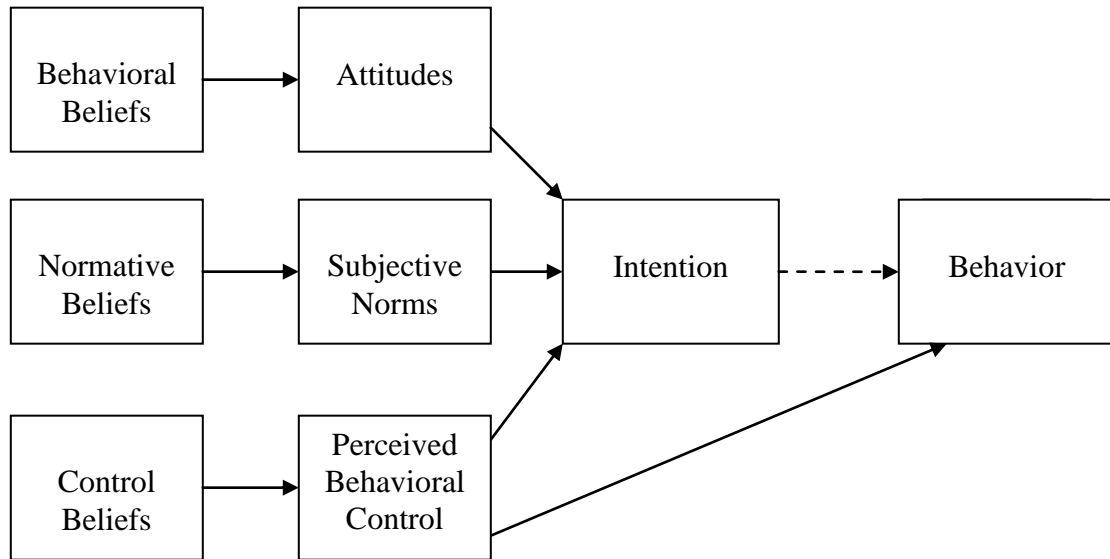


Figure 1. The Theory of Planned Behavior

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CHAPTER II

A META-ANALYSIS: ARE THERE NEUROCOGNITIVE AGE RELATED DEFICITS BETWEEN HIGH SCHOOL AND COLLEGE ATHLETES AFTER A SPORT-RELATED CONCUSSION?

Context: More than 300 000 sport-related concussions occur each year in the U.S. with greater than 60 000 cases occurring in the high school population. Little research has been performed to understand neurocognitive differences in high school when compared to a collegiate population.

Objective: To answer the question: Does neurocognitive status differ between high school and college aged athletes who have sustained a sport-related concussion?

Data Source: CINAHL, MEDLINE, and SPORTDiscus entries from 1979 to September 2009, using the search terms *concussion, mild traumatic brain injury, high school, college, adolescent, adult, neurocognitive, neuropsychological, sport, and return to play.*

Study Selection: We included studies that met 3 criteria: 1) assessed neurocognitive status, using a test battery, 2) measured baseline and post-injury neurocognitive function, and 3) met the concussion definition provided by the 3rd International Conference on Concussion in Sport. Only studies that analyzed one specific population, high school or college, or compared both were included.

Data Extraction: We calculated outcomes for high school and college aged studies that included data using either a computerized or a paper and pencil battery of tests between baseline and three different time periods: within 72 hours of injury, day 3, and day 5 post-

injury. We analyzed three areas of the test battery to assess neurocognitive recovery: 1) memory, 2) visual-motor speed, and 3) reaction time.

Data Synthesis: We included thirteen articles after identifying 274. Eight articles evaluated collegiate athletes, four evaluated high school athletes, and one evaluated both groups. The thirteen articles had an average methodological scale score of 16.23 ± 1.48 (range: 13-18) out of 22 using a modified rating scale from Côté et al. created by the Quebec Task Force for prospective studies. We found the overall quality of the literature was a 1B based on the Strength of Recommendation Taxonomy (SORT). In the high school group ($d = -0.311$, $Z = 2.77$, $P = 0.006$, 95% CI = -0.692, -0.293), a negative outcome trend was noted when compared to the college aged group for memory on day 3 post-concussion ($d = 0.003$, $Z = 0.03$, $P = 0.98$, 95% CI = -0.187, 0.193). We also found greater deficits when comparing visual-motor speed of the high school group ($d = -1.341$, 95% CI = -1.711, -0.971) to the college aged group ($d = -0.492$, $Z = 4.84$, $P < 0.001$, 95% CI = -0.692, -0.293) within the time of 72 hours post-concussion.

Conclusion: It does appear that there are greater neurocognitive deficits when comparing high school and college age athletes after a sport-related concussion. More testing needs to be done to determine if long-term effects do exist. It is imperative to implement neurocognitive testing and cognitive rest into a concussion management protocol.

It is estimated that more than 300 000 sport-related concussions occur each year in the United States with more than 60 000 cases occurring in the high school population.¹ On average, athletic trainers have reported assessing 8.2 concussions a year,² but research has documented that sport-related concussions are commonly under-reported.³ With the rise in reported cases of sport-related concussion and known under-reporting, there has been a heightened interest in developing safer return-to-play guidelines. Organizations and conferences have published guidelines associated with the management of concussions in sport.⁴⁻⁷ Within these guidelines a multifaceted approach to managing sport-related concussions has been developed. This approach includes clinical examination, symptom checklist, postural control assessment, and neurocognitive testing. Research has demonstrated the importance of each one of these tools used in a multifaceted approach to concussion assessment and management,⁸⁻¹¹ but the clinician use of all these tools has lagged behind.^{2,12}

Neurocognitive testing has been deemed the “cornerstone” of the multifaceted concussion management approach due to the objective information that it provides.⁵ Traditionally, paper and pencil tests were established to test the components of neurocognitive function specifically; information processing, planning, and memory, and were proven effective in detecting deficits following a concussion.¹³⁻¹⁶ Now, computerized neurocognitive testing has become common in evaluating sport-related concussion. Despite the increasing availability of neurocognitive testing and the importance of objective reporting, only a small percentage of athletic trainers utilize these tools.^{2,12,17}

Adolescents are at an important brain development period of their lives and it is important to manage a sport-related concussion correctly. There are a number of alarming negative effects found in adolescent athletes after repeated concussions including memory deficits^{18,19} and more alarming catastrophic events, such as Second Impact Syndrome. The risk for greater negative effects in adolescents comes from a theorized increased post-concussion recovery period,²⁰ which suggests a greater need for cognitive rest in high school-aged athletes with sport-related concussion when compared to adults.^{21,22}

To date, little research has directly been performed to determine differences in neurocognitive testing between college and high school aged athletes after a sport-related concussion. Thus, the purpose of this systematic review is to answer the following question: In athletes that have sustained a sport-related concussion as defined by the 3rd International Conference on Concussion in Sport, does neurocognitive status, measured by a neurocognitive test battery, differ between high school and college-aged athletes?

METHODS

Published Study Selection

Search Strategy. Using the databases of CINAHL, MEDLINE, and SPORTDiscus, we searched for articles from 1979 to September 2009, using a combinations of the search terms *concussion, mild traumatic brain injury, high school, college, adolescent, adult, neurocognitive, neuropsychological, sport, and return to play*. Throughout our search 272 articles were identified (Figure 1).

Criteria for Selecting Studies. We included studies that assessed neurocognitive function in mild to moderate concussions by using a computerized or paper and pencil

battery of neurocognitive tests. We chose to identify types of tests that focus on attention, concentration, short-term memory, processing speed, and reaction time. All included studies had to assess both baseline and post-injury neurocognitive function. The 3rd International Conference on Concussion in Sport was used as a standard for inclusion when determining if a study was assessing mild to moderate concussions. This statement defines a concussion as a complex pathophysiological process affecting the brain caused by a direct blow or “impulsive” force to the head that result in a graded set of clinical symptoms that resolves spontaneously.⁷ There are a few studies that directly compared high school vs. collegiate athletes, therefore to answer our question studies were included if data was stratified between the two groups or if the study only investigated one of the sample groups, either high school or collegiate athletes.

Assessment of Methodologic Quality. Studies that met the inclusion criteria were assessed using a modified version of the critical appraisal criteria previously used by Côté et al.²³ (Table 1). The modified version of the Côté scale was used because concussion research studies use a prospective cohort design. Two authors (JHR and RE), rated each article out of the presence of the other. The authors then discussed the scores and a consensus was reached to obtain the final methodological score reported. If a consensus was not obtained by the first two authors, we used a third reviewer (LV) to correct any disputes.

The Strength of Recommendation Taxonomy. The Strength of Recommendation Taxonomy (SORT)²⁴ was used to assess the strength of the evidence reviewed in this paper. The SORT grading scale was used because the studies that were reviewed examined patient-oriented outcomes. The levels of evidence are based on a

numerical (1-3) and an alphabetical (A-C) grade. Level 1, 2, and 3 indicate good-quality and patient-oriented evidence, limited-quality and patient-oriented evidence, and non-patient-oriented evidence, respectively. Level A, B, and C indicate consistent evidence, inconsistent evidence, and non-patient-oriented evidence, respectively.

Meta-Analysis

Data Extraction. For each study sample sizes plus baseline (or control group if baseline values were not given) and post-concussion means and standard deviations were extracted by one author (JHR) and checked by the second (RE) in order to calculate effect sizes (Cohen's d) and 95% confidence intervals (CIs). In most included studies, multiple tests, usually paper and pencil, or multiple results of a computerized neurocognitive test assessed the same component of neurocognitive function (i.e. memory, visual-motor speed, and reaction time). We entered each test or component separately and defined it as a single case. Effect sizes were calculated so that a negative effect size indicates a decrease in neurocognitive function. Effect sizes were calculated across three time periods (within 72 hours, day 3, and day 5 post-concussion) for the neurocognitive component memory. Effect sizes for the neurocognitive components of visual-motor speed and reaction time were only calculated for one time period (within 72 hours post-concussion) because no long-term data was presented by the included studies.

Statistical Methods. We used Meta-Analysis with Interactive eXplanations (MIX) version 1.7 (Sagamihara city, Kanagawa, Japan) to complete the statistical analysis. Means and SDs were entered as either baseline and post-concussion test results ($n = 7$ studies) or post-concussion injured vs. control ($n = 1$ study) for three time periods across memory and one time period across visual-motor speed and reaction time. From

this data the meta-analysis outcome were calculated. Before calculating the meta-analysis outcome, the Q statistic was determined. The sample was deemed heterogeneous and a random-effect model was used if the Q statistic was found to be significant ($p \leq 0.05$). Otherwise, a fixed-effect model was used to calculate the meta-analysis outcome.

Bias Assessment. Publication bias was assessed in two ways. First, funnel plots were assessed to visually inspect the data. When a funnel plot is found to be approximately symmetrical, the assessed studies are free from bias. We used a trim-and-fill analysis to confirm the funnel plots.

RESULTS

Quality Assessment

Thirteen^{14,16,21,22,25-33} of our original thirty-two articles met the inclusion criteria with 8 assessing collegiate athletes (Table 2) and 4 evaluating high school athletes (Table 3). One article, Fields et al,²² assessed both collegiate and high school athletes and grouped them separately allowing us to compare the data. The mean methodological score for the included articles was 16.4 on a twenty-two point scale. The college and high school group had average methodological scores of 16.44 ± 1.24 (range: 15-18) and 15.75 ± 1.82 (range: 13-18), respectively.

Based on the SORT algorithm, the level of evidence of our articles warrants a grade of 1B. All of the studies reported adequate subject follow-up, but findings were inconsistent even though their methodological quality was good.

Meta-Analysis

A total of 417 concussed subjects were evaluated in the seven studies included for analysis. In the eight studies there were 63 total cases evaluated. All but one study used a method of comparing baseline scores to post-concussion score. Schatz et al.³³ utilized a control vs. injured method.

Memory. Twenty-four cases of college ($n = 19$) and high school ($n = 5$) subjects were analyzed for memory scores taken within 72 hours post-concussion. We found no heterogeneity across either the college ($Q = 24.85$, $df = 18$, $P < 0.129$) or high school ($Q = 1.20$, $df = 4$, $P < 0.879$) groups. Using a fixed-effect model we found the effect sizes to be -0.506 ($Z = 8.08$, $P < 0.001$, 95% CI = -0.629 , -0.383) and -0.590 ($Z = 4.83$, $P < 0.001$, 95% CI = -0.830 , -0.351) for the college and high school groups, respectively (Figure 2).

We analyzed ten cases of college ($n = 6$) and high school ($n = 4$) subjects for memory scores taken on day 3 after the initial concussion. Again, we found no heterogeneity across either the college ($Q = 4.21$, $df = 5$, $P = 0.519$) or high school ($Q = 5.30$, $df = 3$, $P = 0.151$) groups. We used a fixed-effect model to calculate effect sizes and found them to be 0.003 ($Z = 0.03$, $P = 0.98$, 95% CI = -0.187 , 0.193) and -0.311 ($Z = 2.77$, $P = 0.006$, 95% CI = -0.692 , -0.293) for the college and high school groups, respectively (Figure 2).

Fourteen cases of college ($n = 10$) and high school ($n = 4$) subjects were analyzed for memory scores taken on day 5 post-concussion. We found the college group to be heterogeneous ($Q = 18.58$, $df = 9$, $P = 0.29$) and a random-effects model was used. The high school group was found to be homogenous ($Q = 0.52$, $df = 3$, $P = 0.914$) prompting us to use a fixed-effect model. When calculating the effect sizes we found them to be -

0.113 ($Z = 0.99$, $P = 0.321$, 95% CI = -0.336, 0.110) and -0.387 ($Z = 2.36$, $P = 0.018$, 95% CI = -0.708, -0.066) for the college and high school groups, respectively (Figure 2).

Reaction Time. Due to the number of studies that reported reaction time, we were limited to analyzing reaction time to the time period of within 72 hours post-concussion. There was also only one high school study that reported reaction time. Therefore, we compared the effect size of the one high school study to the meta-analysis outcome effect size of the college cases ($n = 6$) and found the results to be -1.019 ($Z=8.45$, $P < 0.001$, 95% CI = -1.255, -0.783) and -1.116 (95% CI = -1.470, -0.753) for the college and high school groups, respectively. We used the fixed-effect model in calculating the effect size for the college group, because there was no heterogeneity found ($Q = 8.10$, $df = 5$, $P = 0.151$) (Figure 3).

Visual-Motor Speed. As with reaction time, we were only able to calculate visual-motor speed for the time period of within 72 hours post-concussion. We also had to compare the effect size of the one high school study, -1.341 (95% CI = -1.711, -0.971) to the meta-analysis outcome effect size of the college cases ($n = 7$) and found the results of the college cases to be -0.492 ($Z = 4.84$, $P < 0.001$, 95% CI = -0.692, -0.293). We did not find the college cases to be heterogeneous ($Q = 10.38$, $df = 6$, $P = 0.110$), therefore we used a fixed-effect model in calculating the effect size (Figure 3).

Publication Bias Assessment. The funnel plots for the meta-analysis were inspected and found to be approximately symmetric, except for the memory day 3 results for high school cases. The trim-and-fill analysis revealed that one study had to be imputed in order to reach symmetry. Therefore, the reported result of the high school cases for memory day 3 has been adjusted to account for the confirmed publication bias.

DISCUSSION

High school athletic participation continues to rise, with more than 7.5 million students participating in sports from 2008-2009.³⁴ With this rise in participation there has been a documented sport-related concussions increase in high school athletes when compared to older athletes.^{35,36} Given this documented increase of concussions, it may be important to develop age-specific guidelines, but little research has been conducted to determine if there are age-related neurocognitive differences between high school and college athletes. Thus, we studied the question; are there age-related neurocognitive deficits between high school and college athletes after sustaining a sport-related concussion defined by the 3rd International Conference of Concussion in Sport? We only found one study that directly compared neurocognitive function between high school and college-aged athletes. Field et al.²² reported significant differences between concussed college and high school athletes using the Hopkins Verbal Learning Test (HVLT), a verbal memory test, at day 3 post-concussion and high school concussed athletes continued to have deficits on day 7 when compared to uninjured control subjects. Furthermore, Field et al.²² found that college athletes had no significant differences from control subjects by day 5 with the HVLT.

As may be expected, we found that both the college and high school groups have similar neurocognitive deficits immediately post-concussion (within 72 hours). We found no clinical difference between college and high school concussed athletes in memory or reaction time. When analyzing visual-motor speed we found that the high school athletes have greater deficits at this time period. There are no known studies that have directly compared the visual-motor speed of college and high school aged athletes

post-concussion and with the small number of studies we used to assess visual-motor speed, it is impossible for us to hypothesize why the high school athletes had greater deficits.

Where our results are most significant and agree with the findings of Fields et al.²² occurs in day 3 memory results. The college-aged group has a smaller memory effect size at day 3 indicating that college-aged athletes have fewer memory deficits, but the high school athletes continue to have negative effects. This negative effect is clinically meaningful when compared to the college population. Due to these results stricter management care, such as a longer disqualification time-period, should be considered with adolescent athletes after a concussion. According the guidelines presented by the International Conference on Concussion in Sport in Zurich,⁷ an athlete should begin a step-wise progression once asymptomatic post-concussion and continue on with this progression as long as they stay asymptomatic. We propose with these results that high school-aged athletes may need to be disqualified from advancing on this step-wise progression longer than their college-aged counterparts.

Return-to-play guidelines currently assume a standard implementation for all levels of athletes, and none of the current guidelines take in account age-related differences. In a sample of Athletic Training Education Programs (ATEP) program directors it was reported that a third of clinicians used computerized neurocognitive testing and, at most, only 23% used a full multi-faceted approach toward concussion management.¹² One of the most popular methods of assessing concussions symptom status, other than the clinical examination, is the use of symptom checklists.^{2,12,17} Even though an athlete may report being symptom free, there is evidence demonstrating that

neurocognitive performance lags behind in the recovery process.^{10,22,25} Our evidence suggests that a more conservative approach should be taken with high school athletes that sustain a concussion, and thorough neurocognitive testing should be implemented as a tool to evaluate sport-related concussions.

The 3rd International Conference on Concussion in Sport developed guidelines for cognitive rest. A sport-related concussion produces a metabolic cascade³⁷ that can be worsened with greater amounts of activity.³⁸ High school and collegiate athletes are students and therefore, cognitive rest may be hard. Nonetheless, it is important for recovery. Our results show a greater memory and visual-motor function decrease in high school athletes when compared to college-aged athletes. Student-athletes that have decreased neurocognitive functioning will not be able to perform to the best of their ability while symptomatic. It is important to have a campus wide plan for concussed athletes, which may include reducing coursework, shortening the school day, and/or rescheduling examinations. Further research needs to be conducted to understand and develop guidelines associated with cognitive rest.

There are limitations to our study. First, few studies specifically assessed high school athletes. During our search there were a number of studies that included high school subjects, but did not stratify results by age groups (college versus high school). As already mentioned, there was only one study that directly compared differences in neurocognitive memory function between high school and college athletes. In order to combat this problem, we found studies that looked at either one group or the other, but this may have lead to problems in comparing the data.

When performing a meta-analysis the outcomes are stronger when more studies are analyzed. We were only able to include seven studies, which lead to relatively weak data and in some cases we only had one data point to compare the two concussed groups, college and high school. Further research should divide the age groups to completely understand if there are neurocognitive deficits, short-term and long-term, between adolescents and adults after a concussion. Due to the nature of concussions, all our included studies used a prospective cohort design. We found difficulty in choosing a methodological scale that matched the experimental designs of concussion studies. A randomized controlled trial scale, such as the PEDro scale, was too strict with regards to randomization. There is not a standard, widely accepted scale for prospective cohort studies. We elected to use the scale developed by Côté et al.²³ due to its focus on subject recruitment and outcome measures. Further development is warranted for a better methodological scale to be used with prospective cohort and concussion studies.

CONCLUSION

Neurocognitive deficits after a sport-related concussion are associated with age, where high school athletes demonstrate a worse neurocognitive performance, especially with memory and visual-motor speed. Because of this data it is important to recommend the use of neurocognitive testing be implemented with adolescent athletes to ensure safety and proper return-to-play guidelines. Cognitive rest should be considered as a primary tool during the acute stage of concussion management.

Table 1. Modified Scale from Côté et al.²³ for the Appraisal of the Methodologic Quality of Cohort Studies.

GENERAL METHODOLOGICAL CRITERIA

1. Research question is well stated	Yes	No
2. Source population is identified	Yes	No
3. Inclusion criteria are described and appropriate	Yes	No
4. Exclusion criteria are described and appropriate	Yes	No
5. Participation rate is reported and appropriate	Yes	No
6. Follow-up is reported, explained, and reasonable	Yes	No
7. Loss to follow-up is equal in both groups	Yes	No
• If only one group is used mark yes		
8. Sample size is preplanned and provides adequate statistical power	Yes	No
• If not given in study mark no		
9. Statistical analysis is appropriate	Yes	No
10. The results are verifiable from the data	Yes	No
• The results are truthful of the evidence given		

CRITERIA FOR COHORT STUDIES

11. Zero time is identified	Yes	No
12. Baseline comparability of various groups is reported	Yes	No
• If not given in study mark no; if only one group mark yes		
13. Same data collection is used for all members of the cohort	Yes	No
14. Important baseline variables are measured, valid, and reliable	Yes	No
15. All aspects of the prognostic factor are measured (dose, level, duration)	Yes	No
• All portion of test battery were completed		
16. Prognostic factor was adequately measured (previous baseline, follow-up)	Yes	No
17. Regular follow-up periods are maintained	Yes	No
• If follow-up was adequate to answer question mark yes		
18. Other prognostic factors are measured	Yes	No
19. Duration for follow-up is adequate	Yes	No
• If duration was adequate to answer question mark yes		
20. Outcome is defined and measurable	Yes	No
• Investigators must provide a clear and sensible definition of adverse outcomes before the study starts		
21. Outcome is valid	Yes	No
• Is the instrument used to obtain the outcome valid		
22. Outcome assessment was blind	Yes	No

SCORE

Table 2. Articles Included into College Group.

Authors	Methodologic Quality Score	Study Design	Length of Postconcussion Evaluation	Concussion Subjects	Comparison Criteria	Outcome Measure
Broglia et al. ²⁵	18	Prospective Cohort	Within 72 hours and when asymptomatic	21	When asymptomatic	ImPACT
Broglia et al. ²⁶	17	Prospective Cohort	Within 24 hours	75	Baseline	Hopkins Verbal Learning Test; Trail Making Test; Symbol Digit Modalities Test; Digit Span; Controlled Oral Word Association Test; HeadMinder CRI; ImPACT
Collins et al. ¹⁶	15	Prospective Cohort	Within 24 hours and days 3, 5, and 7	19	Control group N=36	Hopkins Verbal Learning Test; Trail-Making Tests, A and B; Digit Span Test; Symbol Digit Modalities Test; Grooved Pegboard Test; Controlled Oral Word Association Test
Covassin et al. ²⁷	17	Prospective Cohort	Days 1 and 5	57	Concussion history	ImPACT
Field et al. ²²	15	Prospective Cohort	Within 24 hours, Day3, 5, and 7	35	Control group N=18	Hopkins Verbal Learning Test; Digit Span Test; Symbol Digit Modalities Test; Trailmaking Test, A and B; Controlled Oral Word Association Test
Guskiewicz et al. ²⁸	18	Prospective Cohort	Days 1, 3, and 5	36	Control group N=36	Trail-Making Test, A and B; Wechsler Digit Span Test; Stroop Color Word Test; Hopkins Verbal Learning Test
Macciocchi et al. ²⁹	16	Prospective Cohort	Within 24 hours and days 5 and 10	24	Concussion history	Paced Auditory Serial Addition Task; Trail-Making Tests, A and B; Symbol Digit Test
McCrea et al. ³⁰	15	Prospective Cohort	Days 1, 2, 3, 5, 6, and 90	94	Control group N=56	Hopkins Verbal Learning Test; Trail-Making Test, A and B; Symbol Digit Modalities Test; Stroop Color-Word Test; Controlled Oral Word Association Test
Peterson et al. ¹⁴	17	Prospective Cohort	Days 1, 2, 3, and 10	28	Control group N=18	Hopkins Verbal Learning Test; Halsted-Reitan Trail Making Test; Aaron Smith's Symbol Digit Modality Test; Wechsler Digit Span Test; Controlled Oral Word Association Test

Table 3. Articles Included into High School Group.

Authors	Methodologic Quality Score	Study Design	Length of Postconcussion Evaluation	Concussion Subjects	Comparison Criteria	Outcome Measure
Field et al. ²²	15	Prospective Cohort	Within 24 hours, Day3, 5, and 7	19	Control group N=20	Hopkins Verbal Learning Test; Digit Span Test; Symbol Digit Modalities Test; Trailmaking Test, A and B; Controlled Oral Word Association Test
Lau et al. ³¹	16	Prospective Cohort	Within 72 hours and until time of recovery	108	Simple vs. Complex	ImPACT
Lovell et al. ³²	18	Prospective Cohort	Within 36 hours and days 4 and 7	64	Control group N=24	ImPACT
Schatz et al. ³³	13	Prospective Cohort	Within 72 hours	72	Control group N=66	ImPACT
Sim et al. ²¹	16	Prospective Cohort	Serially reevaluated up to 10 school days and day 45	14	Control group N=405	ANAM

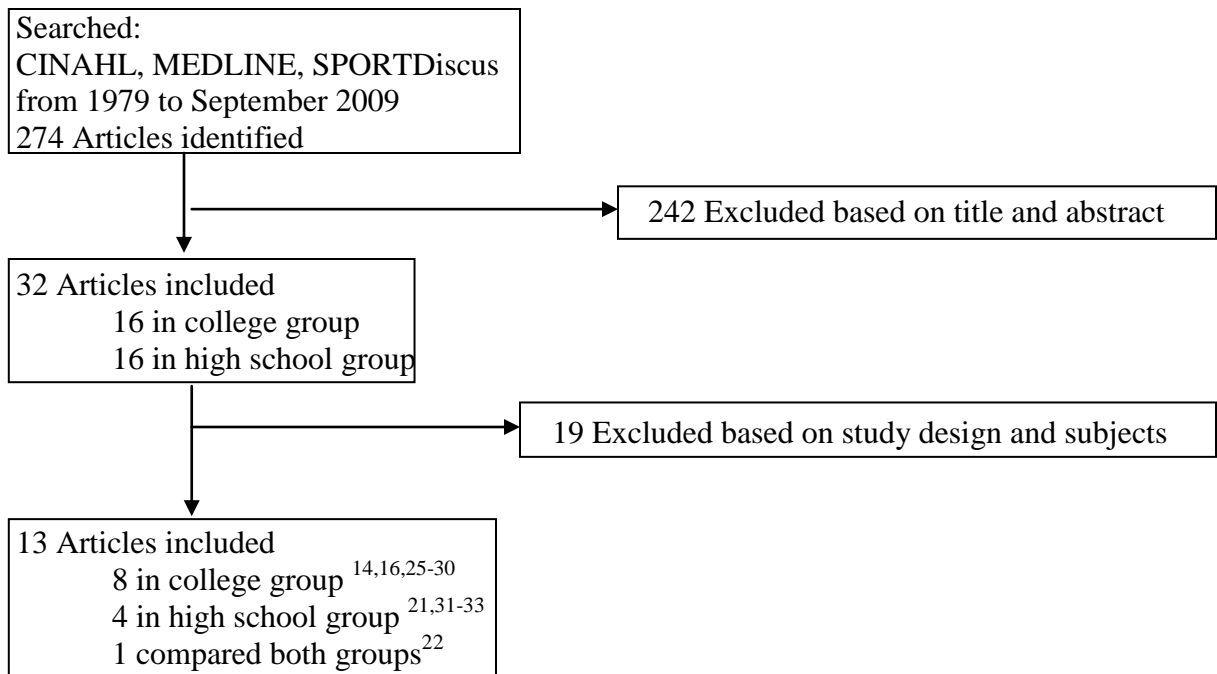


Figure 2. Flow Chart for Selecting Articles to be Included in the Meta-Analysis.

Memory

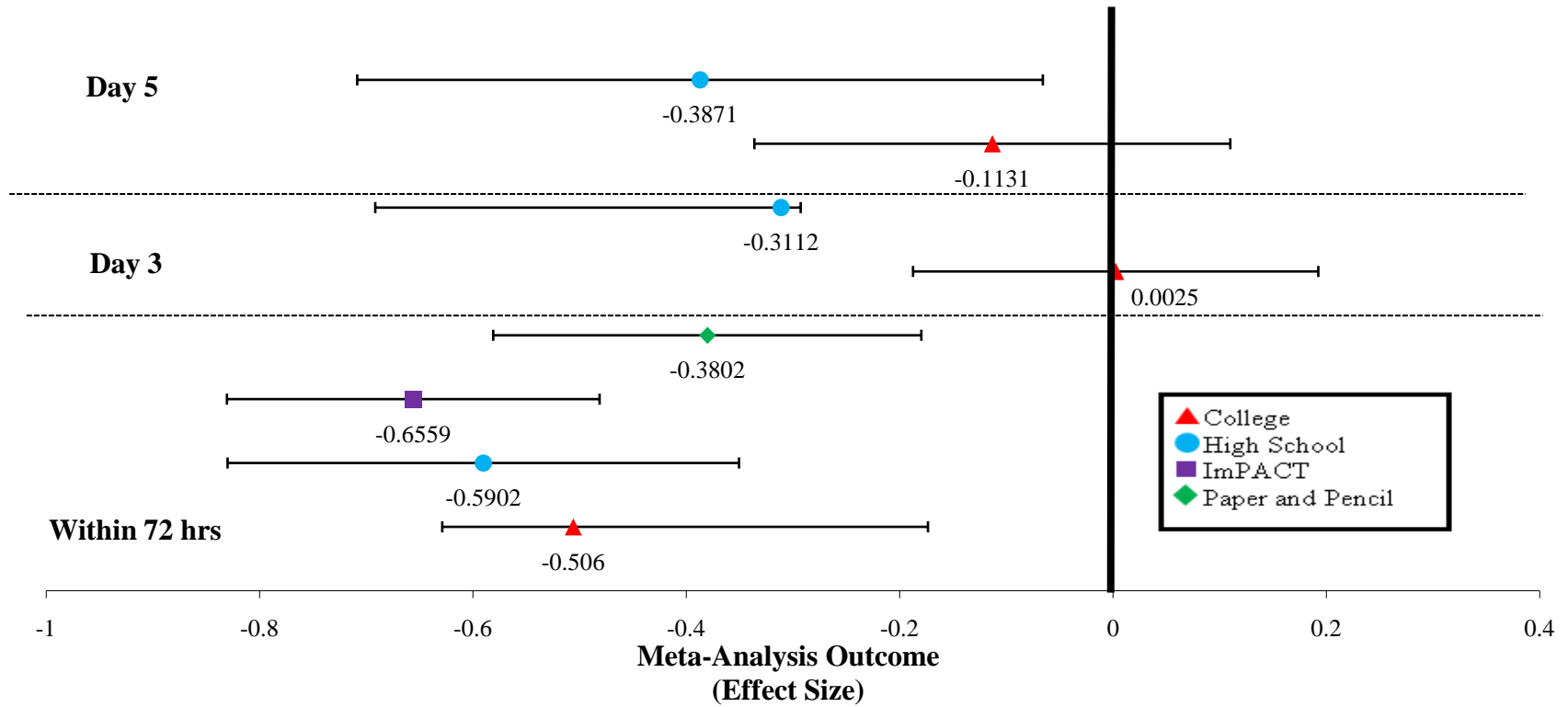


Figure 3. Meta-Analysis Outcomes for Memory across the Time Periods of, within 72, day 3, and day 5 Post-Concussion.

Within 72 Hours

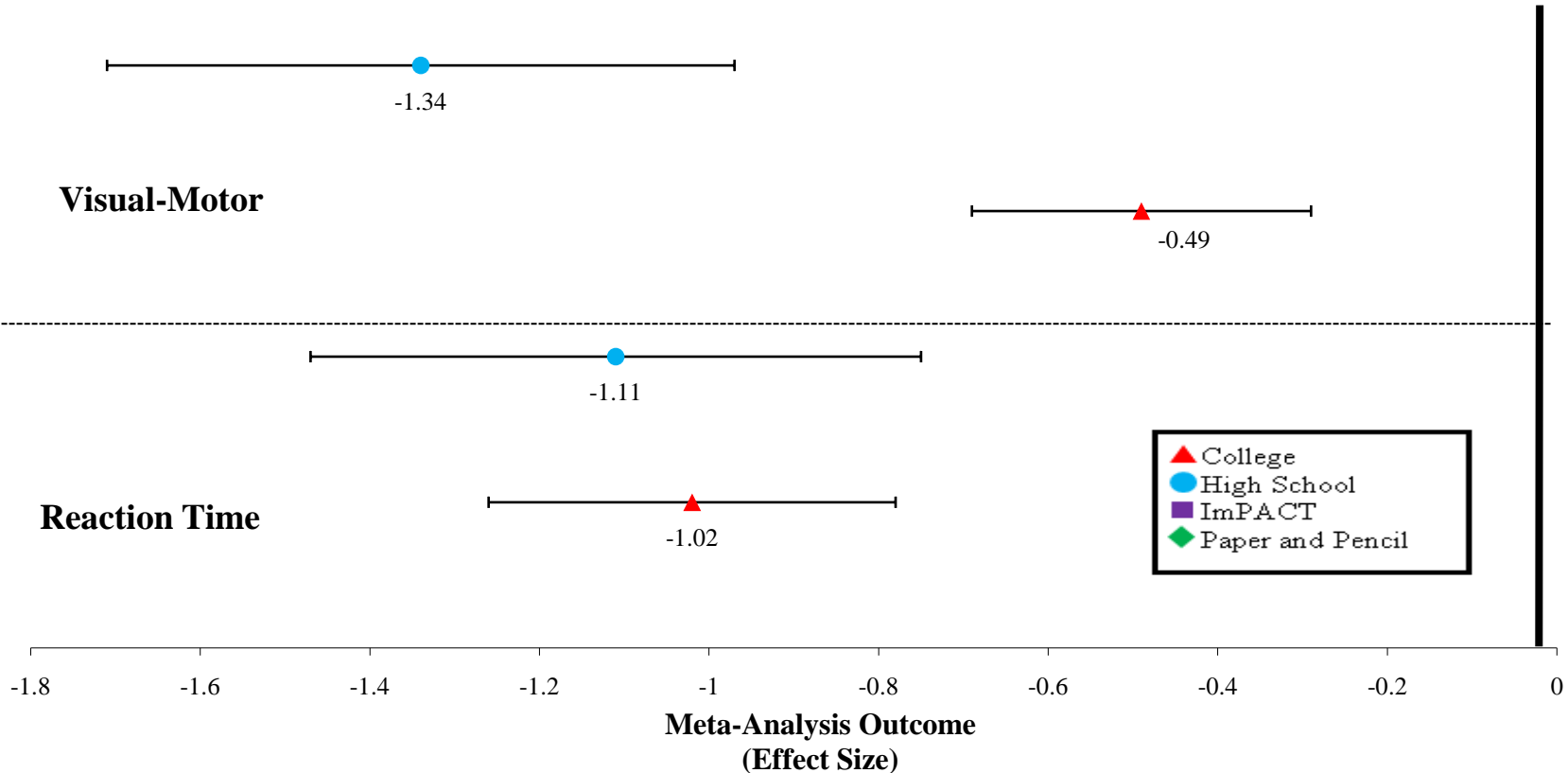


Figure 4. Meta-Analysis Outcomes for Reaction Time and Visual-Motor Speed across the Time Period of, within 72 Post-Concussion.

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CHAPTER III

METHODS

Over the past decade multiple statements have been published regarding the evaluation and management of sport-related concussions.¹⁻⁴ Experts in concussion management have developed a multifaceted management approach of concussions utilizing; clinical evaluation, graded symptom checklist, postural stability and neuropsychological testing. Also, incorporating a daily incremental activity challenge of light activity, sport-specific exercise, non-contacting drills, full contact practice, return-to-play is essential to determine if an athlete is ready to return-to-play.⁴ Athletic trainers usually play a vital role in running the sports medicine team and often are the first health care provider to evaluate and manage a sport-related concussion.

Recently published literature reported that approximately 1/3 of athletic trainers are following the suggested guidelines for managing sport-related concussions.⁵ In order to change this behavior and better educate athletic trainers it is imperative to understand their current beliefs. The purpose of this study is to create a valid and reliable survey instrument, which uses the constructs of the Theory of Planned Behavior (TPB), which can be used in the future to understand the beliefs of athletic trainers toward evaluating and managing athletes with a sport-related concussion.

Participants

To assess the validity and reliability of the developed survey instrument participants will be recruited in three stages during the study. First, a group of experts on concussion management (n=4) and TPB (n=4) will be asked to assess the content validity of the survey. The expert panel will be selected by contacting individuals that have recently published literature or has a known research interest in one of the two areas of concern in this study, concussion management and TPB. The second stage of participant recruitment will involve purposive sampling to recruit the intended audience for a focus group, which are high school (n=3) and college (n=3) athletic trainers.

Finally, a random sample of athletic trainers will be used in a pilot study to assess the reliability and factor structure of the instrument. A randomly generated list of emails will be requested from the National Athletic Training Association (NATA) to include athletic trainers from all 50 states. It will be requested that regular or student certified NATA members working in high school, high school and clinic, junior college, and university and college settings be included in the email list. It is desired that at least a sample of 100 responses is generated. Because sample size is important in factor analysis, we chose to use the rule of 100, when requesting the randomly generated email list of athletic trainers from NATA. The rule of 100 when pertaining to factor analysis states that the number of subjects should be the larger of 5 times the number of variables, or 100. The TPB has 4 constructs of attitude, subjective norms, perceived behavior control, and behavior intention where the first three are hypothesized in our instrument to be further broken down into two sub-components equaling 7 factors. The rule would indicate a sample size of 100 will be needed due to the small number factors the instrument has. A response rate of 30-40% is typical during survey research, therefore a

required 333-250 surveys will need to be sent out via the randomly generated list of athletic trainers. To ensure proper sampling, 350 emails of athletic trainers will be requested from the NATA. This study will be reviewed and approved by the Institutional Review Board (IRB) at Texas State University-San Marcos before subject participation begins.

Instrument

A questionnaire will be developed to establish and understand athletic trainers' beliefs in regards to evaluation and return-to-play decisions in concussed athletes. Two instrument sections will be included: 1) Theory of Planned Behavior (TPB) questions, and 2) demographic questions. The questionnaire will use the *National Athletic Trainers' Association Position Statement: Management of Sport-Related Concussion*¹ and the three statements established by the International Conference on Concussion in Sport: 1) *Summary and agreement statement of the first International conference on concussion in sport, Vienna 2001*², 2) *Summary and Agreement Statement of the 2nd International Conference on Concussion in Sport, Prague 2004*³, 3) *Consensus Statement on Concussion in Sport 3rd International Conference on Concussion in Sport Held in Zurich, November 2008*⁴, as the bases of all questions with emphasis on the diagnosis, management, and decision making regarding sport-related concussions. Components of these statements support the use of a multifaceted approach for concussion evaluation and management including: clinical examination, graded symptoms checklist, neuropsychological testing, and postural stability testing. In addition, a graduated return-to-play protocol after concussion symptoms have resolved is advocated.

Theory of Planned Behavior

The TPB helps to understand relationships between four constructs: 1) attitude toward the behavior, 2) subjective norm, 3) perceived behavioral control, and 4) behavior intention toward actual behavior.⁶

Attitude toward the behavior is an individual's belief of the behavior and if they perceive it to be good or bad. Subjective norm is a function of how an individual believes that their peers want them to act when performing a specific behavior and if they are motivated to comply with others' influences. Perceived behavior control is determined by how much an individual is thought to have control in being able to perform the specific behavior. The following is an example of the TPB when assessing concussion management guidelines. An athletic trainer may feel that it is important to use neuropsychological testing after every concussion (attitude), but the head coach feels that it takes too much time and is not necessary (subjective norms). Because the head coach feels that it is not necessary he has convinced that athletic director to use allocated funds differently than to purchase the neuropsychological testing and it is now difficult for the athletic trainer to do this testing (perceived behavior control).

The development of the survey instrument will utilize a table of specification following Ajzen's considerations for constructing a TPB questionnaire.⁷ All TPB constructs will be rated with 10-15 belief statements each on a 5 point Likert-type scale, ranging from strongly agree to strongly disagree. The survey will differ on subjective norm questions for high school and college athletic trainers based on the different people that are believed to influence each setting's clinical decisions.

Behavior and Demographics

Behavior and demographic questions will be asked to understand if behavior intention predicts actual behavior. A group of 15-20 behavior questions will be developed to understand sport-related concussion multifaceted of management and return-to-play decision-making of athletic trainers. The instrument developed by Ferrara et al.⁸ and used in subsequent studies will serve as the background during the development process.^{5,9} See appendix.

Procedures

Expert Panel

A recruited panel of experts in the field of concussion management (n=4) and TPB (n=4) will be asked to assess the content validity of the survey instrument using methods reported by Dunn et al.¹⁰ and developed by Aiken.¹¹ The concussion management expert judges will rate each item's appropriateness when compared to the four concussion management statements used to construct the instrument using a 1-5 scale. A rating of five represents an excellent match to concussion guideline recommendations whereas a poor match is represented by a one. TPB experts will be asked to assess each question using a 1-5 scale, rating each scale to the intended TPB construct. A rating of five represents an excellent match whereas a poor match is represented by a one to the intended TPB construct. The experts will also be asked to make any comments on each question regarding topics such as, wording, appropriate language, misleading information, and any other matter that the expert feels relevant.

Modification to the survey instrument will be then made based on the item content relevance analysis and feedback from the expert panel.

Focus Group

A focus group of high school and college athletic trainers will meet together to discuss the survey instrument. During the meeting, the moderator will lead a discussion regarding each item of the instrument. The discussion will try to resolve any problems that practicing athletic trainers perceive with the instrument's format, language, word usage, and/or question clarity. The instrument will be modified based on feedback from the focus group.

Pilot Study

Once the survey instrument has been modified based on ideas from a panel of experts and focus group a pilot study will be conducted. Using the randomly generated email list from the NATA the survey will be sent out with an accompanying cover letter. Participants will have one month to complete the survey. A reminder notice with another link to the survey will be sent two weeks to those who have not submitted a response. After a month the survey will be closed and prepared to analyze the data.

Statistical Analysis

Validity

A validity coefficient (V) will be calculated from the responses of the expert panel concerning appropriate concussion material and TPB constructs. A three step

process will be used to calculate the V coefficient. First, each rater's score will be converted into a validity rating ($s=r-lo$) where r equals the judges rating for each item for each construct and lo equals the lowest possible fit value (1 in this case). The next step is to sum all the experts to produce S. Finally, the V coefficient is calculated by $V=S/[n(c-10)]$ (for n experts and c successive integers on the rating scale).^{8,9}

Reliability

The reliability of the instrument will be assessed in two ways. First, Cronbach's alpha for the combined scale items will be measured to determine internal consistency. A desired value will be 0.70-0.90. Second, the item-total correlation will be used to assess the correlation of each item with the total score if the scale item was omitted. An item-total threshold of 0.20 will be used to drop items from the scale.

Factor Structure

A confirmatory, principle component analysis with varimax rotation (PCA) will be performed to determine that each item loads on the correct factor associated with the constructs of the TPB. The Kaiser criterion will be used so that eigenvalues that approaches or greater than 1 confirms the correct number of variables in our instrument. In addition, a scree plot will be used to further determine the factor structure. SPSS 17.0 (SPSS Inc, Chicago, IL) will be used to analyze all data.

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CHAPTER IV

UNDERSTANDING ATHLETIC TRAINERS' BELIEFS TOWARD IMPLEMENTING A MULTIFACETED MANAGEMENT APPROACH AFTER A SPORT-RELATED CONCUSSION: VALIDITY AND RELIABILITY MEASUREMENTS OF AN APPLICATION OF THE THEORY OF PLANNED BEHAVIOR

Context: Practice guidelines have been set by various organizations recommending a multifaceted approach to evaluating and managing a sport-related concussion. Relatively few athletic trainers (ATs) completely follow these recommendations. Therefore, it is important to understand ATs' beliefs toward following the guidelines in order to create better compliance.

Objective: To develop a survey instrument using the Theory of Planned Behavior (TPB) to measure the sport-related concussion management beliefs of ATs and to provide evidence of the reliability and validity of the scale.

Design: A three-stage process was used: 1) expert panel, 2) focus group and 3) pilot study.

Setting: Experts with research interests in the TPB and sport-related concussions participated in the expert panel. ATs working in high school, clinic/outreach, junior college or college/university settings participated in a focus group or received internet link of the 65-item survey instrument through an email.

Patients or Other Participants: Five experts with research interests in the TPB ($n = 2$) and sport-related concussions ($n = 3$). The focus group consisted of nine ATs working

in either high school ($n = 3$) or college/university ($n = 6$) settings. 131 ATs completed the pilot survey instrument.

Main Outcome Measure(s): We asked the expert panel to complete an item content relevance analysis for the instrument to explain the content validity of the instrument. Means and SD and a validity coefficient were calculated in order to determine the questions that best represented the concussion management guidelines and constructs of the TPB. A Cronbach's alpha coefficient was calculated in order to understand the reliability of the instrument. We performed a confirmatory factor analysis to verify the loadings of items on the correct component of each TPB construct.

Results: All included questions in the final instrument had an item content relevance score above 3.00 indicating an acceptable match to the TPB and concussion guidelines. The Cronbach's alpha score of all TPB questions was 0.880 and 0.744, 0.795, 0.801, and 0.759 for each TPB construct; attitude, subjective norms, perceived behavior control, and behavior intention, respectively. The confirmatory factor analysis revealed the presence of the TPB constructs. The items that loaded incorrectly were either deleted from the instrument or the wording was changed to better match the TPB.

Conclusion: Evidence for the reliability of the developed survey instrument was demonstrated. An expert panel confirmed the content validity and a confirmatory factor analysis established the construct validity of the instrument. After minor modifications, the instrument can be used to understand ATs' beliefs toward using a multifaceted concussion management approach.

Key Words: Sport-related concussion, Theory of Planned Behavior

With estimates of 1.6 to 3.8 million sport-related concussions occurring each year,¹ it is important for sport-medicine professionals to evaluate and manage each concussion properly. In most cases of athletic injuries, a sport-medicine team can clearly define the presence and severity of an injury. However, sport-medicine teams have a harder time clearly explaining the severity of a concussion due to a number of factors associated with the recovery of the injury, such as the athlete's age,² sex,³ and the location and magnitude of the impact.⁴ To help sport-medicine professionals account for these variables a number of organizations have proposed the use of a multifaceted approach to evaluate and manage sport-related concussions.⁵⁻⁸ The guidelines established by these organizations for the evaluation and management of sport-related concussions include using a clinical examination, symptom checklist, postural control assessment, and neuropsychological testing. When available, baseline testing should be utilized for high concussion risk athletes, in order to have individualized comparative data in case a concussion occurs. In addition, once an athlete has been deemed symptom free, it is important to follow-up with a daily increase in activity to ensure complete symptoms resolution before an athlete is cleared to play without restrictions. Other suggestions include focusing on the injured athlete's symptoms to make return-to-play decisions rather than grading a concussion based on a scale that has a predetermined return-to-play time timeline and asking a neuropsychologist to interpret the athletes' neuropsychological tests.⁵⁻⁸

The current recommendation of using a multifaceted approach to evaluate and manage concussions has been offered to clinicians since 2002.⁵ Some clinicians have adopted this practice, but the majority of sport-medicine professionals have been slow to

incorporate these guidelines into clinical practice. Before the guidelines were proposed by the various organizations, Ferrara et al.⁹ surveyed approximately 900 attendees of a session at the 1999 National Athletic Trainers' Association (NATA) Annual Meeting and Clinical Symposia. They found that 15.3% utilized neuropsychological testing to assess a concussion, and only 1.9% incorporated it into their return-to-play decision making. He also found that 5% of subjects used the Balance Error Scoring System (BESS), a simple postural stability measure, when assessing a concussion.

One year after the NATA released their position statement regarding sport-related concussions Notebaert and Guskiewicz¹⁰ surveyed 927 athletic trainers to understand the compliance rate with the position statement. Their results showed an increased use of symptom checklists and the BESS into clinical practice compared to the results of Ferrara et al. Symptom checklist use, during the evaluation of a sport-related concussion, increased from 35.7% to 85.0% and the use of the BESS by athletic trainers also increased from 5% to 16%. When comparing the studies, athletic trainers improved slightly in the inclusion of neuropsychological testing into clinical practice. Four years later, Covassin et al.¹¹ surveyed 513 college program directors and clinicians from accredited athletic training education programs and found that 33.3% and 28.4% of sport-medicine clinicians were now utilizing neuropsychological testing and the BESS, respectively, to evaluate concussions.

Since the introduction of practice-based concussion management guidelines, sport-medicine professionals have slowly increased their compliance to the recommendations, but it is important for all clinicians to try to incorporate these standards. In order to change behaviors it is important to understand peoples' beliefs.¹²

As a profession, if we can understand why so few sport-medicine professionals utilize concussion management guidelines then we can understand how to create a change.

Interventions can be developed to help increase the number of sport-medicine professionals that utilize the multifaceted approach to managing sport-related concussions.

The Theory of Planned Behavior (TPB) was developed to help understand people's beliefs toward a specific action.¹³ The TPB helps to understand relationships among four constructs: 1) attitude toward a behavior, 2) subjective norm, 3) perceived behavioral control, and 4) behavior intention toward actual behavior (Figure 1).¹⁴ Each of the first three constructs has two sub-components that clearly define the construct. *Attitude toward the behavior* is an individual's belief regarding a behavior, such as whether the individual perceives the behavior as good or bad, and secondly, their beliefs of the expected outcome of the behavior. *Subjective norms* are a function of an individual's belief of how his/her peers wants him/her to act when performing a specific behavior and if he/she is motivated to comply with others' influences. *Perceived behavior control* is determined by an individual's belief about access to necessary resources and opportunities to perform a specific behavior and weighted by the perceived control of each factor. The following is an example of the TPB when assessing concussion management guidelines. An athletic trainer may feel that it is important to use neuropsychological testing after every concussion (attitude), but the head coach feels that it takes too much time and is not necessary (subjective norms). Because the head coach believe it is not necessary, he has convinced that athletic director to use allocated

funds differently than to purchase the neuropsychological testing and it is now difficult for the athletic trainer to do this testing (perceived behavior control).

These three constructs (attitude toward the behavior, subjective norms, and perceived behavior control) collectively compose *behavior intention*. Behavior intention is theorized to predict actual behavior. That is, the TPB implies that a person's intention to complete (or not complete) the behavior is the immediate antecedent of the behavior in question. But if a person feels that they don't have control over the situation, perceived behavior control may also play a factor in determining if the person follows through with their behavioral intention indicating that perceived behavior control may have a direct influence on actual behavior.

In order to understand why a small percentage of sport-medicine professionals are currently applying the concussion guidelines we would like to understand their beliefs and perception regarding the guidelines. Therefore, the purpose of our study was to create a survey instrument utilizing the TPB to understand athletic trainers' beliefs toward implementing a multifaceted management approach after a sport-related concussion, and to provide evidence of the reliability and validity of the instrument.

METHODS

Participants

Participants were recruited in three stages during the study to assess the validity and reliability of the developed survey instrument. First, a group of experts on concussion management (n = 4) and TPB (n = 3) were asked to assess the content validity of the survey. The expert panels were selected by contacting individuals that had

recently published literature in the subject matter area or who had a known research interest in one of the two areas of concern in this study, concussion management and TPB. The second stage of participant recruitment used purposive sampling to recruit an intended audience for a focus group, which were high school (n=3) and college (n=6) athletic trainers.

Finally, a random sample of athletic trainers (n = 131) participated in a pilot study to assess the reliability and factor structure of the instrument. A randomly generated list of regular or student certified members' emails were requested from the NATA. The randomly generated list included athletic trainers from all 50 states working in high school, high school and clinic, junior college, and university and college settings. Because sample size is important in factor analysis, we used the rule of 100,¹⁵ when requesting the randomly generated email list of athletic trainers from the NATA. The rule of 100 when pertaining to factor analysis states that the number of subjects should be the larger of 5 times the number of expected variables, or 100. The TPB has 4 constructs of attitude, subjective norms, perceived behavior control, and behavior intention where the first three are hypothesized in our instrument to be further broken down into two sub-components equaling 7 variables. If we created a desired sample size using the number of expected variables utilized in our instrument the number would be 35. According to the rule, we then choose to collect a sample size of 100. In anticipation of a 35% response rate, 350 emails of athletic trainers were requested from the NATA. The study was reviewed and approved by the Institutional Review Board (IRB) at Texas State University-San Marcos before participation began.

Instrument

We developed an instrument (see appendix) to establish and understand athletic trainers' behavior in regards to evaluation and return-to-play decisions in concussed athletes. Two sections were included in the survey: 1) Theory of Planned Behavior (TPB) questions (n = 70) and 2) demographic questions (n = 18). The questionnaire used the *National Athletic Trainers' Association Position Statement: Management of Sport-Related Concussion*⁸ and the three statements established by the International Conference on Concussion in Sport: 1) *Summary and agreement statement of the first International conference on concussion in sport, Vienna 2001*,⁵ 2) *Summary and Agreement Statement of the 2nd International Conference on Concussion in Sport, Prague 2004*,⁶ and 3) *Consensus Statement on Concussion in Sport 3rd International Conference on Concussion in Sport Held in Zurich, November 2008*⁷ as the bases for all questions. Question emphasis was based on the diagnosis, management, and decision making regarding sport-related concussions sections of the statements. Components of these statements support the use of a multi-faceted approach for concussion evaluation and management including the use of clinical examination, graded symptoms checklist, neuropsychological testing, and postural stability testing. In addition, a gradual return-to-play protocol is advocated after concussion symptoms have resolved.

Theory of Planned Behavior

The development of the survey instrument utilized a table of specification following Ajzen's considerations for constructing a TPB questionnaire.¹³ Each TPB belief statement was rated on a 7 point Likert type scale, ranging from strongly agree to

strongly disagree. *Attitude toward the behavior* questions (n = 27) were created to understand if athletic trainers believe they should or should not follow certain components of the concussion guidelines, and if they believe the guidelines will result in positive outcomes regarding sport-related concussions. *Subjective norms* (n = 21) were measured by understanding athletic trainers' beliefs of social expectations (i.e. team physicians, athletes, coaches, parents/guardians, and employer opinions) and their willingness to comply with these people. *Perceived behavior control* (n = 12) was measured with statements to understand if athletic trainers believe that they have the control (e.g. It is difficult for me to ...) and opportunity (e.g. If I wanted to, I could ...) to follow the concussion management guidelines. *Behavior intention* (n = 10) statements were measured by the athletic trainers intention to comply with the certain components of the concussion guidelines. The scoring on all statements that were negatively phrased was reversed to ensure proper scaling. During the development of the instrument, a variety of statements were created with plans to reduce the number of statements after review by the expert panel.

Demographics

Demographic questions (n = 18) were asked to understand athletic trainers' current practice patterns for diagnosing and managing sport-related concussions. The instrument developed by Ferrara et al.⁹ and used in subsequent studies^{10,11} served as the foundation for developing demographic questions. Since the demographic questions were adapted and modified from an already published source, a statistical analysis was not performed on these questions.

Procedures

Expert Panel

We recruited a panel of experts in the field of concussion management (n=4) and TPB (n=3) to assess the content validity of the survey items using methods reported by Dunn et al.¹⁶ and developed by Aiken.¹⁷ The concussion management expert judges rated each item's appropriateness when compared to the four concussion management statements using a 1-5 scale with a score of five representing an excellent match and a score of 1 representing a poor match. TPB experts assessed each question using a 1-5 scale, rating each scale to the intended TPB construct. A rating of five represents an excellent match whereas a poor match is represented by a one to the intended TPB construct. The experts made any comments on each question including feedback regarding wording, language, misleading information, and any other matter that the expert felt relevant. Using the item content relevance analysis and feedback from the expert panel, the most appropriate questions to represent each TPB construct; attitude (n = 13), subjective norms (n = 15), perceived behavior control (n= 9), and behavior intention (n = 10), were selected. The minimum criterion for selection was based on the mean item content relevance rating of the experts for each question. In order to be included into the final instrument for the pilot study a question had to have an average of at least 3 on the rating scale indicating an acceptable match. A validity coefficient for each question was also calculated for further analysis and added to the information during the selection process. Questions that were not found to be significant according to the validity coefficient, but had specific comments from the expert panel were accepted after modifications.

Focus Group

After the validity assessment, we completed a focus group (mean years of experience = 9.00 ± 8.76) with practicing high school ($n = 3$) and college ($n = 6$) athletic trainers to discuss the survey instrument. The premise of the study was described to the focus group in order for each member to understand the TPB constructs and concussion guidelines. Following the instruction, we asked the focus group to read and make notes for all questions and a discussion of the questions for the indicated TPB construct concluded each segment. The discussion resolved any problems that practicing athletic trainers may perceive with the instrument's format, language, word usage, and/or question clarity. The instrument was modified based on feedback from the focus group.

Pilot Study

Once the survey instrument was modified based on feedback from the expert panel and focus group a pilot study was conducted. Using the randomly generated email list from the NATA the survey was sent out with an accompanying cover letter (see appendix). Participants had one month to complete the survey. A follow-up email (see appendix) using the same randomly generated email list from the NATA was sent out two weeks after the initial email.

Statistical Analysis

Validity

The content validity of the instrument was assessed by calculating the means (\pm SD) and validity coefficient from the responses of the expert panel concerning appropriate concussion material and TPB constructs in the item content relevance

analysis. We used a three step process to calculate the V coefficient. First, each rater's score will be converted into a validity rating ($s=r-lo$) where r equals the judges rating for each item for each construct and lo equals the lowest possible fit value (1 in this case). The next step is to sum all the experts to produce S. Finally, the V coefficient is calculated by $V=S/[n(c-10)]$ (for n experts and c successive integers on the rating scale).^{16,17}

Reliability

We assessed the reliability of the instrument in two ways. First, Cronbach's alpha for the combined scale items determined internal consistency. A desired value of 0.70-0.90 was used.¹⁸ Second, the item-total correlation assessed the correlation of each item with the total score if the scale item was omitted. An item-total threshold of 0.20 was used to drop items from the scale.

Factor Structure

We performed a confirmatory, principle component analysis with varimax rotation (PCA) to confirm that each item loaded on the correct factor associated with the constructs of the TPB. The TPB constructs of attitude, subjective norms, and perceived behavior control are theorized to have two components to each of them while behavior intention has one component. The main goal of the factor analysis was to confirm the correct loadings of the components in each TPB construct. The Kaiser criterion was used so that eigenvalues of 1.0 or greater set the minimum number of variables in our instrument. We confirmed the correct number of factors with a scree plot. In cases

where there were more than the expected factor loadings, an exploratory, principle component analysis (PCA) with varimax rotation was performed. The exploratory factor analysis was performed in order to understand how questions loaded. SPSS 17.0 (SPSS Inc, Chicago, IL) was used to analyze all data.

RESULTS

Validity

Five experts participated in determining the content validity of the survey instrument by completing either the item content relevance analysis and survey feedback portion or both (concussion management (n=3), and TPB (n=2)). One TPB expert did not complete the item content relevance portion, but did provide feedback. The expert panel mean years of experience in their field of interest was 7.5 (\pm 3.22). The item-content relevance analysis scores for each survey item are found in Tables 4-7. According to a right tailed binomial probability table provided by Aiken,¹⁷ an item content relevance analysis with 4 judges should yield a validity coefficient that is equal or greater to $V=0.88$ to be statistically significant at $p=.05$. There were 4, 0, 7, and 3 questions that were significant according the item content relevance analysis for each of the TPB constructs; attitude, subjective norms, perceived behavior control, and behavior intention, respectively.

Pilot Study

A total of 131 participants successfully completed the online survey, for a response rate of 37.4%. Participants averaged 2.66 (\pm 1.01) years of experience with the

majority being female (61.1%). The most common responses for employment setting were high school (66/131 [50.4%]), college/university (45/131 [34.4%]), and clinic/outreach (15/131 [11.5%]). Participants reported being employed most as head athletic trainers (31/131 [46.6%]), assistant athletic trainers (45/131 [34.4%]), and graduate assistant athletic trainers (13/131 [9.9%]). Participants had a variety of different sport assignments which are found in Table 8. The average number of concussions managed in a month by the participants was 1.63 (\pm 1.16).

Reliability

The Cronbach's alpha score of all TPB items ($n = 47$) was 0.880 and 0.744, 0.795, 0.801, and 0.759 for each TPB construct; attitude, subjective norms, perceived behavior control, and behavior intention, respectively. All items in the instrument demonstrated an item-total correlation above 0.20, indicating that no items should be removed at this time period.

Factor Structure

Scree plots for the TPB constructs, attitude and perceived behavior control, confirmed that there were two main factors accounting for 39.3% and 54.4% of the total variance in their respective TPB construct. During the confirmatory factor analysis, four questions (30.8%) did not load onto the correct sub-component of attitude. Also, four perceived behavior control questions (44.4%) did not load onto the correct sub-component. According to the scree plot, subjective norms had four factor loadings, but the confirmatory factor analysis revealed the correct expected loadings of all subjective norm questions onto the two components of subjective norms, the perception of others

and the motivation to comply with others. These two factors explained 47.2% of the variance of the TPB construct. The confirmatory rotated factor loadings for each TPB construct are found in Tables 9-11. Since there was only one expected component of behavior intention we were not able to perform a confirmatory factor analysis with this TPB construct.

For all TPB constructs, more than the expected number of factors were indicated by eigenvalues that were equal or greater than one. An exploratory factor analysis revealed that there were 5, 5, 3, and 4 factor loadings for the TPB constructs; attitude, subjective norms, perceived behavior control, and behavior intention, respectively when using the Kaiser criteria. The five factor loadings associated with attitude and subjective norms accounted for 68.0% and 73.7% of the variance in their respective TPB construct. The three factor loadings associated with perceived behavior control accounted for 66.3% of the total variance and the four factor loadings of behavior intention accounted for 72.3% of the variance in their respective TPB construct. The exploratory rotated factor loadings for each TPB are found in Tables 12-15.

DISCUSSION

With a small percentage of sport-medicine professional implementing a multifaceted approach during the management of sport-related concussions it is imperative to understand the beliefs toward these practice-based recommended guidelines. Once the beliefs are understood, interventions may be applied to improve the use of these guidelines and create better care for our athletes. Our purpose was to develop a survey instrument using the constructs of the TPB; attitude toward the

behavior, subjective norms, perceived behavior control, and behavior intention, to understand sport-medicine professionals' beliefs of the multifaceted approach of concussion management and to provide evidence of the reliability and validity of the instrument.

Evidence for the reliability of the survey was provided due to all four constructs of the TPB resulted in 4 α coefficients greater than 0.70. Nunnally¹⁸ stated that an α coefficients equal to or greater than 0.70 were considered good measures of internal consistence.

The content validity of instrument items was determined by a panel of expert judges in the fields of TPB and concussion management. We were limited by the number of judges that responded to our request of completed the item content relevance of the instrument. With only four judges completing the item content relevance a validity coefficient of 0.88 had to be reached in order to be found significant at the $p \leq 0.05$ level. We initially planned on determining the content validity by only calculating a validity coefficient, using methods reported by Dunn et al.¹⁶ and developed by Aiken,¹⁷ for each component of the instrument, the concussion guidelines and TPB. Due to the small number of experts that responded we combined the scores from the concussion and TPB experts. This method resulted in a challenge of selecting the best questions to accept into the final version of the survey, because of the different opinions between the experts. The concussion experts were confused on the wording of the TPB and vice versa for the TPB experts causing low validity coefficients in some cases. Due to the low validity coefficient results we decided to base the content validity and include questions off of the average item content rating scores and comments of the experts instead of solely by the

validity coefficient. Therefore we included questions where the experts had specific comments and suggests for changes to be made. Also, all questions that were included into the final instrument for the pilot study had a mean item content relevance score above 3.0 indicating that the experts deemed the questions to be an acceptable match.

We determined the construct validity of the survey by analyzing the data using a factor analysis. We were able to confirm the presence of each of the four TPB constructs by analysis the scree plot and finding four principle factors. We continued to try to confirm the construct validity of the instrument by looking at the loadings of each TPB construct in hopes of defining the two components of attitude toward the behavior, subjective norms, and perceived behavior control. The only construct that loaded as was expects into two components was subjective norms. When analyzing the data for the TPB construct, attitude toward the behavior, we believe that the questions' wording may have played a factor in unexpected loadings. There were three statements of the attitude's component, individual's belief regarding a behavior, which loaded on the opposite factor of perceived expected outcomes. We believe that the participants unconsciously may have added an expected outcome to the end of each statement. For example, if the question read: I should use a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) during the management of sport-related concussions, the participant may have added unconsciously, in order to provide good information for my coach, to the end of the question, changing the type of attitude component being measured. In the final instrument these questions, will be changed to include the wording, "I believe", at the beginning to ensure that the statement measures individual's beliefs regarding the behavior. Question 12 will be removed from the survey

due to its inability to properly load on a component of attitude. The reliability of the instrument is not negatively affected by the removal of this question (α if deleted = 0.879).

Perceived behavior control was added to Ajzen's original theory, the Theory of Reasoned Action,¹⁹ which stated only the constructs of attitude toward the behavior and subject norms explained behavior intentions. Ajzen realized that his original theory could only apply to straight forward behaviors that were completely under volitional control. To expound on his theory, in order to understand behaviors where complete volitional control is not found, Ajzen added the construct of perceived behavior control.¹⁴ Perceived behavior control has in turn been linked to one's behavior intention as well actual behavior. That is, the implementation of a behavior intention is based on personal and environmental barriers. Therefore, the execution of a behavior cannot be solely predicted by the construct behavior intention.²⁰ During our confirmatory factor analysis, four statements did not load onto the expected component of perceived behavior control. After examining the statements we believe that the items that we expected to load onto the resources and opportunity factor did not because a time period was not defined in the statement. For example, one of the statements reads: if I wanted to, I could measure baseline values of neurocognitive function on contact, collision, or high-risk athletes. Ajzen's table of specifications¹³ suggests that in order to understand if the participant truly has the resources and opportunity to volitionally execute the course of action the statement should include a time period of when the behavior should start. That is, if the participant has the resources and opportunity then he/she should be able to start at the indicated reasonable time period. To resolve this problem the phrase, "from now on",

will be added to the end of each perceived behavior control statement that is intended to measure the component of resources and opportunity. Questions 34 and 35 also did not load on the expected component of perceived behavior control, an individual's perceived control, and will be removed from the instrument due to a consensus that the wording is too confusing to clearly define it as a good statement of the intended component of perceived behavior control (α if deleted = 0.875 and 0.876, respectively). These two questions did not clearly load on one factor and the deletion of these questions will not affect the reliability results of the instrument.

The TPB has been widely used to understand general behaviors associated with health issues, such as smoking and exercise, but this is the first time to our knowledge that this theory has been used with such specific guidelines. We believe the use of this theory with such specific guidelines outlined by the NATA and International Conference on Concussion in Sport may explain the large number of factors we found that have eigenvalues that are greater than 1.0. Our exploratory factor analysis revealed that three out of the four statements associated with the TPB constructs attitude, perceived behavior control, and behavior intention also loaded on factors associated with the specific components of the concussion guidelines. We believe that the TPB can be utilized with such guidelines, but it is more important that the wording of the statements are more specific to the language of the TPB rather than the guidelines. We had some difficulty capturing this wording in a few statements. As noted some corrections will be made to better understand the constructs of the TPB during the final use of the instrument.

Future Directions

With this evidence, we believe that the survey instrument demonstrates being reliable and valid. We plan on using this instrument in a future study in order to measure the beliefs of athletic trainers toward the practice-based medicine concussion guidelines, established by the International Conference on Concussion in Sport and NATA.⁵⁻⁸ With the future knowledge that we hope to gain from this instrument we hope that interventions may be established to help sport-medicine teams better evaluate and manage sport-related concussions.

Few modifications need to be made to the survey before the future use of the instrument. As noted, the phrasing of two types of questions in the sections of attitude toward the behavior and perceived behavior control need to be changed to better match the TPB's wording. We also determined that actual behavior questions need to be measured in the future to be able to understand how each construct of the TPB plays a role in the concussion management approach.

CONCLUSIONS

The evidence of the instrument survey demonstrates the reliability of the instrument. The content validity was assessed by receiving feedback from an expert panel and a validity coefficient was calculated for each question. The construct validity was analyzed through a factor analysis revealing the presence of four main factors associated with the constructs of the TPB; attitude toward the behavior, subjective norms, perceived behavioral control, and behavior intention.

The survey instrument can be a beneficial tool for understanding the beliefs of sport-medicine professional in implementing a multifaceted approach to managing sport-related concussions. During the future use of this instrument, the beliefs of sport-medicine professionals can be determined in order to create interventions to be able to help more athletic trainers follow the recommended practice-based guidelines.

Table 4. Item-Content Relevance Ratings of the Panel of Experts for the TPB Construct: Attitude

Item	Mean ± SD	VALIDITY COEFFICIENT	Item	Mean ± SD	VALIDITY COEFFICIENT
1 ^b	4.50 ± 0.58	0.88 ^a	15	4.00 ± 2.00	0.75
2 ^b	3.00 ± 1.41	0.50	16	3.75 ± 1.50	0.69
3	2.00 ± 1.15	0.25	17	4.00 ± 2.00	0.75
4	4.00 ± 2.00	0.75	18 ^b	4.75 ± .050	0.94 ^a
5 ^b	4.75 ± 0.50	0.94 ^a	19	3.00 ± 1.63	0.50
6 ^b	4.00 ± 2.00	0.75	20	4.00 ± 1.73	0.67
7	4.00 ± 1.41	0.75	21	4.00 ± 2.00	0.75
8	2.00 ± 0.82	0.25	22 ^b	4.75 ± 0.50	0.94 ^a
9 ^b	3.75 ± 1.50	0.69	23 ^b	4.00 ± 1.41	0.75
10 ^b	3.75 ± 1.89	0.69	24 ^b	3.75 ± 1.89	0.69
11 ^b	3.25 ± 2.06	0.56	25	3.75 ± 0.96	0.69
12	3.75 ± 1.89	0.69	26	3.25 ± 1.71	0.56
13	3.00 ± 2.31	0.50	27 ^b	3.25 ± 1.50	0.56
14 ^b	4.00 ± 2.00	0.75			

^aP<0.05. ^bUsed in final draft for pilot study.

Table 5. Item-Content Relevance Ratings of the Panel of Experts for the TPB Construct: Subjective Norms

Item	Mean ± SD	VALIDITY COEFFICIENT	Item	Mean ± SD	VALIDITY COEFFICIENT
1 ^b	4.25 ± 0.50	0.81	12 ^b	4.00 ± 1.41	0.75
2 ^b	3.75 ± 1.89	0.69	13	3.00 ± 1.83	0.50
3 ^b	3.00 ± 1.83	0.50	14 ^b	4.00 ± 1.41	0.75
4	3.50 ± 1.73	0.63	15 ^b	4.00 ± 1.41	0.75
5	2.75 ± 1.26	0.44	16	3.50 ± 1.73	0.63
6	2.25 ± 1.89	0.31	17 ^b	3.00 ± 1.41	0.50
7 ^b	3.00 ± 1.83	0.50	18 ^b	1.00 ± 0.00	0.00
8 ^b	3.50 ± 1.73	0.63	19 ^b	2.33 ± 2.31	0.33
9 ^b	2.50 ± 1.73	0.38	20 ^b	2.33 ± 2.31	0.33
10	2.50 ± 1.73	0.38	21 ^b	2.33 ± 2.31	0.33
11 ^b	2.50 ± 1.73	0.38			

^aP<0.05. ^bUsed in final draft for pilot study.

Table 6. Item-Content Relevance Ratings of the Panel of Experts for the TPB Construct: Perceived Behavior Control

Item	Mean ± SD	VALIDITY COEFFICIENT
1 ^b	4.25 ± 0.96	0.81
2 ^b	3.00 ± 1.83	0.50
3 ^b	4.50 ± 0.58	0.88 ^a
4	4.50 ± 0.58	0.88 ^a
5	4.50 ± 0.58	0.88 ^a
6	4.50 ± 0.58	0.88 ^a
7 ^b	4.50 ± 0.58	0.88 ^a
8 ^b	3.50 ± 1.73	0.63
9 ^b	4.50 ± 0.58	0.88 ^a
10	4.50 ± 0.58	0.88 ^a
11 ^b	4.25 ± 0.50	0.81
12	3.25 ± 3.25	0.56

^aP<0.05. ^bUsed in final draft for pilot study.

Table 7. Item-Content Relevance Ratings of the Panel of Experts for the TPB Construct: Behavior Intention

Item	Mean ± SD	VALIDITY COEFFICIENT
1 ^b	4.75 ± 0.50	0.94 ^a
2 ^b	3.75 ± 1.89	0.69
3 ^b	3.75 ± 1.89	0.69
4 ^b	3.75 ± 1.89	0.69
5 ^b	4.75 ± 0.50	0.94 ^a
6 ^b	4.75 ± 0.50	0.94 ^a
7 ^b	4.75 ± 0.50	0.94 ^a
8 ^b	3.75 ± 1.89	0.69
9 ^b	3.75 ± 1.89	0.69
10 ^b	3.50 ± 1.73	0.63

^aP<0.05. ^bUsed in final draft for pilot study.

Table 8. Primary Sport Assignment of Participants. Asked to mark all that applied.

Primary Sport Assignment	n	Percentage	Primary Sport Assignment	n	Percentage
All sports	50	38.2	Lacrosse	17	13.0
All male sports	1	0.8	Soccer (M)	50	38.2
All female sports	1	0.8	Soccer (F)	55	42.0
Baseball	46	35.1	Softball	15	11.5
Basketball (M)	55	42.0	Swimming/Diving	30	22.9
Basketball (F)	55	42.0	Tennis	32	24.4
Field hockey	12	9.2	Track and field	46	35.1
Football	52	39.7	Volleyball (M)	16	12.2
Gymnastics (M)	2	1.5	Volleyball (F)	44	33.6
Gymnastics (F)	12	9.2	Wrestling	38	29.0
Ice hockey (M)	11	8.4	Other	17	13.0
Ice hockey (F)	4	3.1			

Table 9. Attitude Rotated Factor Loadings Following Confirmatory, Principle Component Analysis

	Belief	Perceived Expected Outcome
1	0.847 ^a	-0.020
2	0.762 ^a	0.000
3	0.529 ^a	0.188
4	0.320	0.530
5	0.357	0.598 ^a
6	0.140	0.478
7	0.025	0.648 ^a
8	0.081	0.588
9	0.026	0.709 ^a
10	0.227	0.578 ^a
11	0.140	0.493 ^a
12	0.349	0.309
13	-0.151	0.465 ^a

^a loaded on correct component of attitude construct.

Table 10. Subjective Norms Rotated Factor Loadings Following Confirmatory, Principle Component Analysis

	Perception of Others	Motivation to Comply
14	0.591 ^a	0.191
15	0.475 ^a	0.078
16	0.524 ^a	-0.078
17	0.680 ^a	0.078
18	0.682 ^a	0.091
19	0.710 ^a	0.076
20	0.720 ^a	0.008
21	0.647 ^a	-0.074
22	0.689 ^a	-0.068
23	0.389 ^a	0.139
24	0.165	0.520 ^a
25	0.039	0.883 ^a
26	0.063	0.899 ^a
27	-0.026	0.816 ^a
28	-0.014	0.759 ^a

^a loaded on correct component of subjective norms construct.

Table 11. Perceived Behavior Control Rotated Factor Loadings Following Confirmatory, Principle Component Analysis

	Control	Resources and Opportunity
29	0.641 ^a	0.043
30	0.620	0.449
31	0.575	0.276
32	0.087	0.837 ^a
33	-0.013	0.810 ^a
34	0.451	0.518
35	0.420	0.610
36	0.685 ^a	0.324
37	0.747 ^a	-0.096

^a loaded on correct component of perceived behavior control construct.

Table 12. Attitude Rotated Factor Loadings Following Exploratory, Principle Component Analysis

	Concussion Guideline Component				
	Concussion Protocol	Using a Battery of Tests	Neuropsychological Testing	Postural Stability and RTP	Incremental Increase of Activity
1	0.855				
2	0.815				
3		0.566 ^a			
4		0.819			
5		0.863			
6			0.807		
7			0.782		
8				0.509	
9			0.555		
10				0.815	
11				0.853	
12					0.716
13					0.648 ^a

^a Loads on factor, but question pertains to different concussion guideline component not associated with major factors identified by analysis.

Table 13. Subjective Norms Rotated Factor Loadings Following Exploratory, Principle Component Analysis

	Believed Subjective Norms for Athletic Trainers				
	Physician	Athlete and Coach	Parent/Guardian	Employer	Motivation to Comply with Others
14	0.841				
15	0.764				
16	0.768				
17		0.601			
18		0.647			
19		0.812			
20		0.819			
21			0.852		
22			0.789		
23				0.868	
24					0.455
25					0.888
26					0.899
27					0.862
28					0.730

Table 14. Perceived Behavior Control Rotated Factor Loadings Following Exploratory, Principle Component Analysis

	Concussion Guideline Component		
	Neuropsychological Testing	Postural Stability	Concussion Protocol and RTP
29			0.680
30	0.747		
31	0.882		
32		0.787	
33		0.800	
34			0.634
35			
36	0.651		
37			0.736

Table 15. Behavior Intention Rotated Factor Loadings Following Exploratory, Principle Component Analysis

	Concussion Guideline Component			
	Concussion Protocol	Using a Battery of Tests	Neuropsychological Testing	Postural Stability
38	0.826			
39				0.877
40			0.847	
41 ^a				
42				0.857
43			0.855	
44		0.883		
45		0.870		
46	0.790			
47			0.738	

^a Did not clearly load on one factor

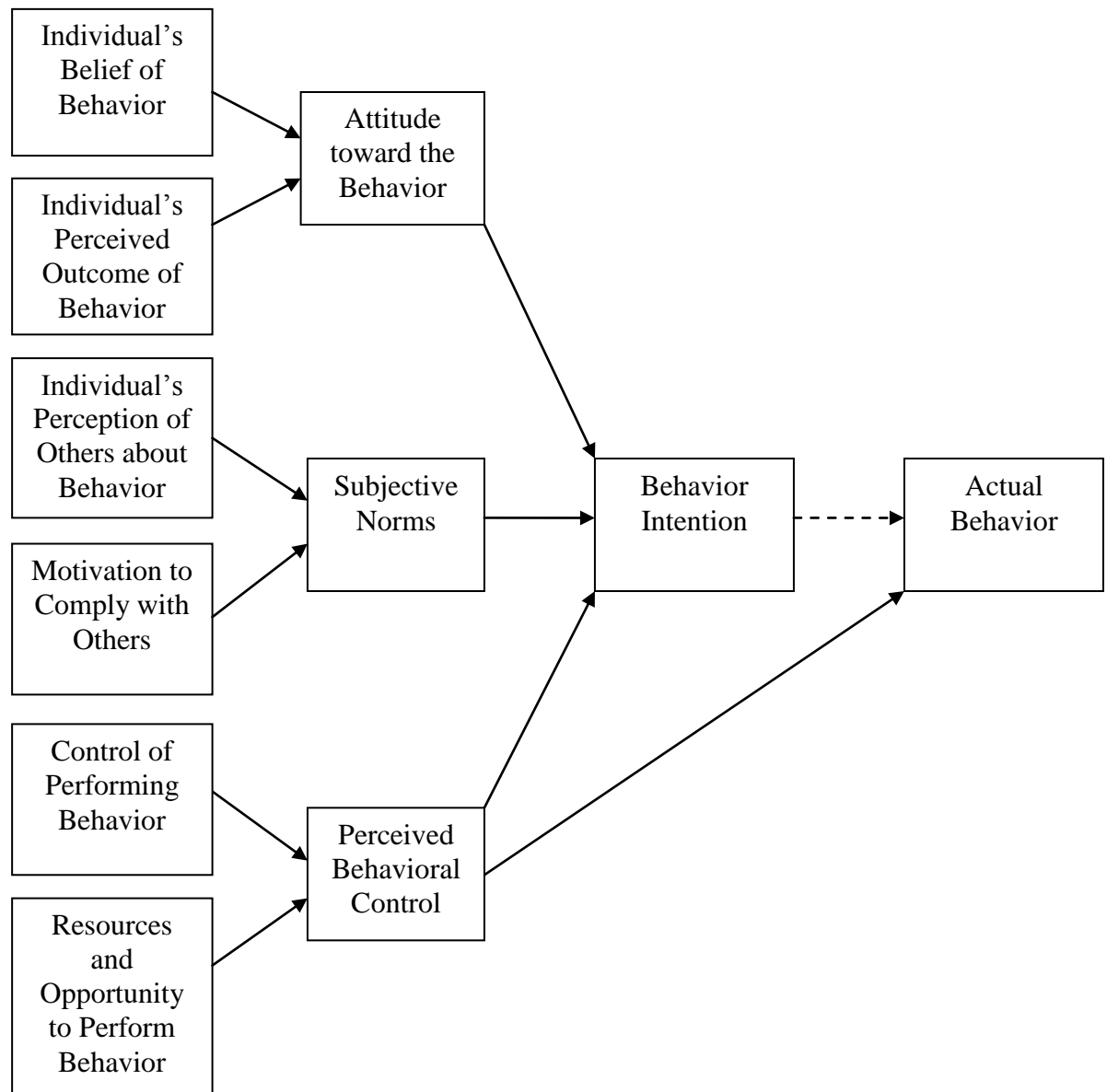


Figure 5. The Theory of Planned Behavior with the sub-components of each construct.

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APPENDIX

INSTRUMENT AND COVER LETTERS

Proposed Concussion Management Survey Instrument

*Subheadings are going to be removed after revisions to the instrument

Section I

For each question, please indicate the number that most accurately applies to you.

Attitude

1. My team physician and I should agree on a protocol for managing sport-related concussions.

Strongly Agree 5 4 3 2 1 Strongly Disagree

2. Agreeing on a protocol for managing sport-related concussions with my team physician protects me against liability.

Strongly Agree 5 4 3 2 1 Strongly Disagree

3. Having an agreed upon protocol with my team physician helps protect my athletes from developing prolonged neurocognitive impairments.

Strongly Agree 5 4 3 2 1 Strongly Disagree

4. When making return-to-play decisions, I should focus on the athlete's symptom recovery instead of using a concussion grading scale with a pre-determined recovery time-table.

Strongly Agree 5 4 3 2 1 Strongly Disagree

5. Focusing on the athlete's recovery of symptoms after a concussion is a good way to individualize each return-to-play decision.

Strongly Agree 5 4 3 2 1 Strongly Disagree

6. I should use a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) during the management of sport-related concussions.

Strongly Agree 5 4 3 2 1 Strongly Disagree

7. Using a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) to manage sport-related concussions helps decrease the risk of second impact syndrome.

Strongly Agree 5 4 3 2 1 Strongly Disagree

8. Using a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) to manage sport-related concussions helps protect against the risk of sustaining subsequent concussions.

Strongly Agree 5 4 3 2 1 Strongly Disagree

9. Using a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) to manage sport-related concussions helps support me when disqualifying an athlete from competition.

Strongly Agree 5 4 3 2 1 Strongly Disagree

10. I should measure all of my athletes' baseline neurocognitive function before the athlete participates in athletics.

Strongly Agree 5 4 3 2 1 Strongly Disagree

11. Comparing pre-season baseline neurocognitive function to post-injury function is a good way to understand if an athlete is asymptomatic.

Strongly Agree 5 4 3 2 1 Strongly Disagree

12. I should measure all of my athletes' baseline postural stability before the athlete participates in athletics.

Strongly Agree 5 4 3 2 1 Strongly Disagree

13. Comparing pre-season baseline postural stability tests to post-injury tests is a good way to understand if an athlete is asymptomatic.

Strongly Agree 5 4 3 2 1 Strongly Disagree

14. An athlete should return-to-play only after they have returned to pre-participation baseline values on all tests.

Strongly Agree 5 4 3 2 1 Strongly Disagree

15. I should use a graded symptom checklist during the management of sport-related concussions.

Strongly Agree 5 4 3 2 1 Strongly Disagree

16. Using a graded symptom checklist to manage sport-related concussions ensures the safety of an athlete when they return-to-play.

Strongly Agree 5 4 3 2 1 Strongly Disagree

17. I should use neurocognitive tests (e.g. SAC, ImPACT, CogSport, and/or paper and pencil tests) during the management of sport-related concussions.

Strongly Agree 5 4 3 2 1 Strongly Disagree

18. Using neurocognitive tests to manage sport-related concussions is a good way to provide objective information.

Strongly Agree 5 4 3 2 1 Strongly Disagree

19. Using neurocognitive tests to managing sport-related concussion ensures the safety of an athlete when they return-to-play.

Strongly Agree 5 4 3 2 1 Strongly Disagree

20. Using neurocognitive tests to manage sport-related concussions would help prevent an athlete to return-to-play while symptomatic.

Strongly Agree 5 4 3 2 1 Strongly Disagree

21. I should use postural stability tests (e.g. BESS and/or NeuroCom or other force plate measures) during the management of sport-related concussions.

Strongly Agree 5 4 3 2 1 Strongly Disagree

22. Using postural stability tests to manage sport-related concussions is a good way to provide objective information.

Strongly Agree 5 4 3 2 1 Strongly Disagree

23. Using postural stability tests to manage sport-related concussions would help prevent an athlete to return-to-play while symptomatic.

Strongly Agree 5 4 3 2 1 Strongly Disagree

24. An athlete should perform a daily incremental activity challenge (e.g. light activity, sport-specific exercise, non-contacting drills, full contact practice, return-to-play) once asymptomatic to determine return-to-play.

Strongly Agree 5 4 3 2 1 Strongly Disagree

25. Performing a daily incremental activity challenge (e.g. light activity, sport-specific exercise, non-contacting drills, full contact practice, return-to-play) would help prevent return-to-play while symptomatic.

Strongly Agree 5 4 3 2 1 Strongly Disagree

26. A Neuropsychologist is best trained to read my athletes' neurocognitive tests.

Strongly Agree 5 4 3 2 1 Strongly Disagree

27. Having a neuropsychologist read my athletes' neurocognitive tests would help me understand my athletes' neurocognitive deficits better.

Strongly Agree 5 4 3 2 1 Strongly Disagree

Subjective Norms

1. My team physician would support the use of a mutually agreed upon management protocol for sport-related concussion.

Strongly Agree 5 4 3 2 1 Strongly Disagree

2. My team physician would support me focusing on the athlete's symptom recovery to manage a concussion instead of using a concussion grading scale with a pre-defined time-table.

Strongly Agree 5 4 3 2 1 Strongly Disagree

3. My team physician would support me using neurocognitive testing (e.g. SAC, ImPACT, CogSport, and/or paper and pencil tests) on every athlete.

Strongly Agree 5 4 3 2 1 Strongly Disagree

4. My team physician would support me using postural stability (e.g. BESS and/or NeuroCom or other force plate measures) testing on every athlete.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
5. My athletes would support me using a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) to evaluate their concussion.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
6. My athletes would support me disqualifying them from competition until they report being asymptomatic on a graded symptom checklist.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
7. My athletes would support me putting them through a daily incremental increase of activity challenge (e.g. light activity, sport-specific exercise, non-contacting drills, full contact practice, return-to-play) before they return-to-play.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
8. My coach would agree that the team physician and I should agree on a protocol to manage sport-related concussions.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
9. My coach would support my measuring baseline postural stability (e.g. BESS and/or NeuroCom or other force plate measures) on every athlete.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
10. My coach would support my testing neurocognitive function (e.g. SAC, ImPACT, CogSport, and/or paper and pencil tests) on every athlete post-injury.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
11. My coach would support me using a daily incremental increase of activity challenge (e.g. light activity, sport-specific exercise, non-contacting drills, full contact practice, return-to-play) before the athlete can return-to-play.
- Strongly Agree 5 4 3 2 1 Strongly Disagree

12. My athletes' parent(s) or guardian(s) would support me holding their child out of competition until they have returned to baseline values of neurocognitive functioning (e.g. SAC, ImPACT, CogSport, and/or paper and pencil tests).

Strongly Agree 5 4 3 2 1 Strongly Disagree

13. My athletes' parent(s) or guardian(s) would support me disqualifying their child from competition until they have returned to baseline values of postural stability (e.g. BESS and/or NeuroCom or other force plate measures).

Strongly Agree 5 4 3 2 1 Strongly Disagree

14. My athletes' parent(s) or guardian(s) would support me using a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) to evaluate return-to-play decisions.

Strongly Agree 5 4 3 2 1 Strongly Disagree

15. My employer would support a protocol that my team physician and I agree upon to manage sport-related concussions.

Strongly Agree 5 4 3 2 1 Strongly Disagree

16. My employer would support me if there were any disputments regarding the management of sport-related concussions.

Strongly Agree 5 4 3 2 1 Strongly Disagree

17. Generally speaking, I want to do what my team physician wants me to do.

Strongly Agree 5 4 3 2 1 Strongly Disagree

18. Generally speaking, I want to do what my athletes want me to do.

Strongly Agree 5 4 3 2 1 Strongly Disagree

19. Generally speaking, I want to do what my coach wants me to do.

Strongly Agree 5 4 3 2 1 Strongly Disagree

20. Generally speaking, I want to do what my athletes' parent(s) or guardian(s) want me to do.

Strongly Agree 5 4 3 2 1 Strongly Disagree

21. Generally speaking, I want to do what my employer wants me to do.

Strongly Agree 5 4 3 2 1 Strongly Disagree

Perceived Behavioral Control

1. I have plenty of opportunities to discuss and agree upon a protocol for managing sport-related concussions with my team physician.

Strongly Agree 5 4 3 2 1 Strongly Disagree

2. If I wanted to I can focus on the athlete's symptom recovery to manage a concussion instead of using a concussion grading scale with a pre-defined timetable.

Strongly Agree 5 4 3 2 1 Strongly Disagree

3. If I wanted to, I could measure baseline values of neurocognitive function on all of my athletes.

Strongly Agree 5 4 3 2 1 Strongly Disagree

4. If I wanted to, I could have a Neuropsychologist read my athletes' neurocognitive tests.

Strongly Agree 5 4 3 2 1 Strongly Disagree

5. If I wanted to, I could measure my athletes' postural stability (e.g. BESS and/or NeuroCom or other force plate measures) post-injury.

Strongly Agree 5 4 3 2 1 Strongly Disagree

6. If I wanted to, I could measure my athlete's symptoms on a graded symptom checklist.

Strongly Agree 5 4 3 2 1 Strongly Disagree

7. It is difficult for me to use a battery of tests (e.g. graded symptom check-list, SAC, neurocognitive tests, and BESS) to manage sport-related concussions.

Strongly Agree 5 4 3 2 1 Strongly Disagree

8. It is difficult for me to use a daily incremental physical activity challenge (e.g. light activity, sport-specific exercise, non-contacting drills, full contact practice, return-to-play) before an athlete is cleared to returned-to-play without my coaches support.

Strongly Agree 5 4 3 2 1 Strongly Disagree

9. It is difficult for me to use objective tests (e.g. SAC, neurocognitive tests, and NeuroCom or other force plate measures) to manage sport-related concussions without my employers support.

Strongly Agree 5 4 3 2 1 Strongly Disagree

10. It is difficult for me to use neurocognitive testing to manage sport-related concussions due to budget restrictions.

Strongly Agree 5 4 3 2 1 Strongly Disagree

11. There are factors outside my control that could cause me to return an athlete to play while they are reporting symptoms.

Strongly Agree 5 4 3 2 1 Strongly Disagree

12. There are factors outside my control that could cause me to allow an athlete return-to-play before they have returned to baseline values of postural stability tests (e.g. BESS and/or NeuroCom or other force plate measures)

Strongly Agree 5 4 3 2 1 Strongly Disagree

Behavior Intention

1. I intend to agree upon a protocol for managing sport-related concussions with my team physician.

Strongly Agree 5 4 3 2 1 Strongly Disagree

2. I intend to measure baseline postural stability (e.g. BESS and/or NeuroCom or other force plate measures) for a comparison to post-injury tests when managing a sport-related concussion.

Strongly Agree 5 4 3 2 1 Strongly Disagree

3. I intend to measure baseline neurocognitive functioning (e.g. SAC, neurocognitive tests, and NeuroCom or other force plate measures) for a comparison to post-injury tests when managing a sport-related concussion.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
4. I intend to use a graded symptom checklist when managing a sport-related concussion to determine when an athlete is asymptomatic.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
5. I intend to use postural stability tests when managing a sport-related concussion to determine when an athlete is asymptomatic.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
6. I intend to use neurocognitive tests when managing a sport-related concussion to determine when an athlete is asymptomatic.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
7. I intend to use a battery of tests (e.g. graded symptom check-list, SAC, neurocognitive tests, and BESS) to evaluate a sport-related concussion.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
8. I intend to use a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) when making a return-to-play decisions after a sport-related concussion.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
9. I intend to use a daily incremental physical activity challenge (e.g. light activity, sport-specific exercise, non-contacting drills, full contact practice, return-to-play) once an athlete is asymptomatic at rest to determine when an athlete can return-to-play.
- Strongly Agree 5 4 3 2 1 Strongly Disagree
10. I intend to have a Neuropsychologist read all of the athletes' post-injury neurocognitive tests.
- Strongly Agree 5 4 3 2 1 Strongly Disagree

Section II

Please complete the following questions.

Behavior

1. Please indicate your gender.
 - Male
 - Female

2. Please indicate the number of years experience as a certified athletic trainer.
_____ years

3. Indicate your current position.
 - Head Athletic Trainer
 - Assistant Athletic Trainer
 - Graduate Assistant
 - Faculty/Staff in Athletic Training
 - Other (please specify)

4. What is your primary employment setting?
 - College/University
 - Junior College
 - High School
 - Clinic/Outreach
 - Other (please specify)

5. What is your primary sport assignment?
 - Baseball
 - Basketball (M)
 - Basketball (F)
 - Field hockey
 - Football
 - Gymnastics
 - Ice hockey
 - Soccer (M)
 - Soccer (F)
 - Swimming/Diving
 - Track and field
 - Volleyball (M)
 - Volleyball (F)
 - Wrestling
 - All sports
 - All male sports
 - All female sports
 - Other (please specify)

6. Please indicate the number of concussions that you manage in a calendar year.
_____ concussions
7. What methods do you typically utilize to assess and diagnose concussion? (check all that apply)
 - Clinical examination
 - Head CT/Brain MRI
 - Graded symptom checklists
 - Balance Error Scoring System (BESS)
 - Force-plate postural stability measures
 - Standardized Assessment of Concussion (SAC)
 - Neuropsychological testing (computerized)
 - Neuropsychological testing (paper/pencil)
 - Sport Concussion Assessment Tool (SCAT)
 - Other(please specify)
8. Rank the methods that you typically utilize to assess and diagnose concussion from most important to least important.
 - Answers based on those that were checked for question #7
9. Do you use the same protocol on every concussed athlete to assess and diagnose concussion?
 - Always
 - Sometimes
 - Never
10. What methods do you typically utilize to make decisions about return-to-play after concussion? (check all that apply)
 - Clinical examination
 - Physician recommendations
 - Head CT/Brain MRI
 - Standardized Assessment of Concussion (SAC)
 - Neuropsychological testing (computerized)
 - Neuropsychological testing (paper/pencil)
 - Balance Error Scoring System (BESS)
 - Force-plate postural stability measures
 - Graded symptom checklists
 - Sport Concussion Assessment Tool (SCAT)
 - Concussion grading scales
 - Return-to-play guidelines
 - Player self-report

11. Rank the methods that you typically utilize to make decisions about return-to-play after concussion from most important to least important.
 - Answers based on those that were checked for question #9

12. Do you use the same protocol on every concussed athlete to make decisions about return-to-play after concussion?
 - Always
 - Sometimes
 - Never

13. What baseline concussion management tests do you perform before the beginning of the athletes' season?
 - Balance Error Scoring System (BESS)
 - Force-plate postural stability measures
 - Standardized Assessment of Concussion (SAC)
 - Neuropsychological testing (computerized)
 - Neuropsychological testing (paper/pencil)
 - Graded symptom checklist
 - Sport Concussion Assessment Tool (SCAT)
 - None
 - Other (please specify)

14. Do you have a protocol with you team physician regarding the management of sport-related concussions?
 - Yes
 - No

15. Do you use a daily incremental increase of activity challenge (e.g. light activity, sport-specific exercise, non-contacting drills, full contact practice, return-to-play) before returning an athlete to play?
 - Always
 - Sometimes
 - Never

16. Do you have access to a Neuropsychologist to read your athletes' neuropsychological tests?
 - Always
 - Sometimes
 - Never

17. What concussion guideline/grading scale do you use in your clinical setting?
(check all that apply)

- Colorado Medical Society
- American Academy of Neurology (AAN)
- Cantu
- National Athletic Trainer's Association Position Statement (NATA)
- TORG
- University of North Carolina (UNC)
- Jordan
- Internal Conference on Concussion In Sport
- None
- Other (please specify)

18. Rank the caregiver who is responsible for making return-to-play decision. (1st, 2nd, and 3rd)

- Athletic trainer
- Team physician
- Athlete's primary care physician
- Coach
- School nurse
- Athlete
- Parents
- Other (please specify)

Final Concussion Management Survey Instrument

Section I

For each question, please indicate the number that most accurately applies to you.

7 Strongly Agree	6 Agree	5 Somewha t Agree	4 Neither	3 Somewha t Disagree	2 Disagree	1 Strongly Disagree
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1. My team physician and I should agree on a protocol for managing sport-related concussions.
2. Agreeing on a protocol for managing sport-related concussions with my team physician helps protect me against future personal legal negligence.
3. Focusing on the athlete's recovery from concussion symptoms is a good way to individualize each return-to-play decision.
4. I should use a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) during the management of sport-related concussions.
5. Using a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) to manage sport-related concussions helps support me when disqualifying an athlete from participation.
6. I should measure baseline neurocognitive function of all contact, collision, or high-risk athletes before the athlete participates in athletics.
7. Comparing pre-participation baseline neurocognitive function to post-concussion neurocognitive function is a good approach to understanding if an athlete has recovered.
8. An athlete should only return-to-play after he/she has returned to pre-participation baseline performance on all tests.
9. Using neurocognitive tests (e.g. ImPact, CogSport, and/or paper and pencil tests) to manage sport-related concussions is a good way to provide objective information.
10. Using postural stability tests (e.g. BESS, Sensory Organizational Test and/or other balance measures) to manage sport-related concussions is a good way to provide objective information.

11. Using postural stability tests (e.g. BESS, Sensory Organizational Test and/or other balance measures) to manage sport-related concussions would help prevent an athlete from returning-to-play before the athlete has recovered.
12. Once asymptomatic, an athlete should perform a daily incremental activity (e.g. light activity, sport-specific exercise, non-contacting drills, and full contact practice) to determine return-to-play.
13. Having a neuropsychologist (PhD or PsyD) interpret my athletes' neurocognitive tests would help me with return-to-play decisions.
14. My team physician would support the use of a mutually agreed upon management protocol for sport-related concussions.
15. My team physician would support me focusing on the athlete's recovery from concussion symptoms instead of using a concussion grading scale with a pre-defined time-table.
16. My team physician would support my use of a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) on all contact, collision, or high-risk athletes.
17. My athletes would support me putting them through a daily incremental increase of activity (e.g. light activity, sport-specific exercise, non-contacting drills, and full contact practice) before they return-to-play.
18. My coach would agree that the team physician and I should agree on a protocol to manage sport-related concussions.
19. My coach would support my use of a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) on all contact, collision, or high-risk athletes.
20. My coach would support my use of a daily incremental increase of activity (e.g. light activity, sport-specific exercise, non-contacting drills, and full contact practice,) before the athlete can return-to-play.
21. My athletes' parent(s) or guardian(s) would support me holding their child out of competition until he/she has recovered from the concussion.
22. My athletes' parent(s) or guardian(s) would support my use of a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) to evaluate return-to-play decisions.
23. My employer would support a protocol that my team physician and I agree upon to manage sport-related concussions.

24. Generally speaking, I want to do what my team physician wants me to do.
25. Generally speaking, I want to do what my athletes want me to do.
26. Generally speaking, I want to do what my coach wants me to do.
27. Generally speaking, I want to do what my athletes' parent(s) or guardian(s) want me to do.
28. Generally speaking, I want to do what my employer wants me to do.
29. I have plenty of opportunities to discuss and agree upon a protocol for managing sport-related concussions with my team physician.
30. If I wanted to, I could measure baseline values of neurocognitive function on contact, collision, or high-risk athletes.
31. If I wanted to, I could have a neuropsychologist (PhD or PsyD) interpret my athletes' neurocognitive tests.
32. If I wanted to, I could measure my athlete's postural stability (e.g. BESS, Sensory Organizational Test and/or other balance measures) post-concussion.
33. If I wanted to, I could measure my athlete's symptoms on a graded symptom checklist.
34. It is difficult for me to use a battery of tests (e.g. graded symptom check-list, SAC, neurocognitive tests, and BESS) to manage sport-related concussions.
35. It is difficult for me to use objective tests (e.g. SAC, neurocognitive tests, BESS, and Sensory Organizational Test) to manage sport-related concussions without my employers' support.
36. It is difficult for me to use neurocognitive testing (e.g. ImPact, CogSport, and/or paper and pencil tests) to manage sport-related concussions due to budget restrictions.
37. There are factors outside of my control that could cause me to return an athlete to play before he/she has recovered.
38. I intend to discuss and agree upon a protocol for managing sport-related concussions with my team physician.

39. When managing a sport-related concussion, I intend to measure baseline postural stability (e.g. BESS, Sensory Organizational Test and/or other balance measures) on contact, collision, or high-risk athletes for a comparison to post-concussion postural stability.
40. When managing a sport-related concussion, I intend to measure baseline neurocognitive functioning (e.g. ImPact, CogSport, and/or paper and pencil tests) on contact, collision, or high-risk athletes for a comparison to post-concussion neurocognitive function.
41. When managing a sport-related concussion, I intend to use a graded symptom checklist to determine when an athlete is asymptomatic.
42. When managing a sport-related concussion, I intend to use postural stability tests (e.g. BESS and/or Sensory Organizational Test and/or other balance measures) to determine when an athlete has recovered.
43. When managing a sport-related concussion, I intend to use neurocognitive tests (e.g. ImPact, CogSport, and/or paper and pencil tests) to determine when an athlete has recovered.
44. I intend to use a battery of tests (e.g. graded symptom check-list, SAC, neurocognitive tests, and BESS) to evaluate a sport-related concussion.
45. After a sport-related concussion, I intend to use a battery of tests (e.g. graded symptom checklist, SAC, neurocognitive tests, and BESS) when making a return-to-play decision.
46. Once an athlete is asymptomatic at rest, I intend to use a daily incremental physical activity (e.g. light activity, sport-specific exercise, non-contacting drills, and full contact practice) to determine when an athlete may return-to-play.
47. I intend to have a neuropsychologist (PhD or PsyD) read all of the athletes' post-injury neurocognitive tests.

Section II

Please complete the following questions.

Behavior

1. Please indicate your gender.
 - Male
 - Female
2. Please indicate the number of years experience as a certified athletic trainer.
_____ years

3. Indicate your current position.
 - Head Athletic Trainer
 - Assistant Athletic Trainer
 - Graduate Assistant Athletic Trainer
 - Faculty/Staff in Athletic Training
 - Other (please specify)

4. What is your primary employment setting?
 - College/University
 - Junior College
 - High School
 - Clinic/Outreach
 - Other (please specify)

5. What is(are) your primary sport assignment(s)?
 - All sports
 - All male sports
 - All female sports
 - Baseball
 - Basketball (M)
 - Basketball (F)
 - Field hockey
 - Football
 - Gymnastics (M)
 - Gymnastics (F)
 - Ice hockey (M)
 - Ice hockey (F)
 - Lacrosse
 - Soccer (M)
 - Soccer (F)
 - Swimming/Diving
 - Tennis
 - Track and field
 - Volleyball (M)
 - Volleyball (F)
 - Wrestling
 - Other (please specify)

6. Please indicate on average the number of concussions that you manage in a month.
_____ concussions

7. What methods do you typically utilize to assess and diagnose a concussion?
(check all that apply)
- Clinical examination
 - Head CT/Brain MRI
 - Graded symptom checklists
 - Balance Error Scoring System (BESS)
 - Force-plate postural stability measures
 - Standardized Assessment of Concussion (SAC)
 - Neuropsychological testing (computerized)
 - Neuropsychological testing (paper/pencil)
 - Sport Concussion Assessment Tool (SCAT)
 - Other(please specify)
8. Rank the methods that you typically utilize to assess and diagnose concussions from most important (starting at 1) to least important.
- Answers based on those that were checked for question #7
9. Do you use the same protocol to assess and diagnose every concussed athlete?
- Always
 - Sometimes
 - Rarely
 - Never
10. What methods do you typically utilize to make decisions about return-to-play after concussion? (check all that apply)
- Clinical examination
 - Physician recommendations
 - Head CT/Brain MRI
 - Standardized Assessment of Concussion (SAC)
 - Neuropsychological testing (computerized)
 - Neuropsychological testing (paper/pencil)
 - Balance Error Scoring System (BESS)
 - Force-plate postural stability measures
 - Graded symptom checklists
 - Sport Concussion Assessment Tool (SCAT)
 - Concussion grading scales
 - Return-to-play guidelines
 - Player self-report
11. Rank the methods that you typically utilize to make decisions about return-to-play after concussion from most important (starting at 1) to least important.
- Answers based on those that were checked for question #10

12. Do you use the same protocol to make return-to-play decisions with every concussed athlete?
- Always
 - Sometimes
 - Rarely
 - Never
13. What baseline concussion management tests do you perform before athletes may participate? (check all that apply)
- Balance Error Scoring System (BESS)
 - Force-plate postural stability measures
 - Standardized Assessment of Concussion (SAC)
 - Neuropsychological testing (computerized)
 - Neuropsychological testing (paper/pencil)
 - Graded symptom checklist
 - Sport Concussion Assessment Tool (SCAT)
 - None
 - Other (please specify)
14. Do you have a protocol with your team physician regarding the management of sport-related concussions?
- Yes
 - No
15. Do you use a daily incremental increase of activity (e.g. light activity, sport-specific exercise, non-contacting drills, and full contact practice) before returning an athlete to play?
- Always
 - Sometimes
 - Rarely
 - Never
16. Do you have access to a neuropsychologist (PhD or PsyD) to interpret your athletes' neurocognitive test results?
- Always
 - Sometimes
 - Rarely
 - Never

17. What concussion guideline(s)/grading scale(s) do you use in your clinical setting?
(check all that apply)

- Colorado Medical Society
- American Academy of Neurology (AAN)
- Cantu
- National Athletic Trainer's Association Position Statement (NATA)
- TORG
- University of North Carolina (UNC)
- Jordan
- International Conference on Concussion In Sport
- None
- Other (please specify)

18. Rank the caregivers who are responsible for making final return-to-play decisions.
(1st, 2nd, and 3rd)

- Athletic trainer
- Team physician
- Athlete's primary care physician
- Coach
- School nurse
- Athlete
- Parents/Guardians
- Other (please specify)

Concussion Expert Cover Letter

December 17, 2009

Dear Expert Panel:

Thank you for agreeing to serve on an expert panel. You have been asked to serve on this panel because of your expertise in concussion research. My project aims to understand the beliefs of athletic trainers toward current concussion management guidelines through a self-reported instrument built around the Theory of Planned Behavior. The sample for this project is certified athletic trainers (ATCs) throughout the United States in the high school, high school and clinic, junior college, and university and college settings.

The Theory of Planned Behavior is based on the assumption that behavior intention is an immediate predictor of behavior. Behavior intention, in turn, is determined by attitude, subjective norms, and perceived behavior control, which also may have a direct impact on actual behavior. Each statement on the instrument intends to measure the Theory of Planned Behavior constructs in relationship to concussion evaluation and management guidelines established by the International Conference on Concussion in Sport and the National Athletic Trainers' Association.

The main points from the guidelines used in developing the instrument's statements are:

1. The ATC and team physician should agree upon a plan for the evaluation and return-to-play decision of a sport-related concussion.
2. Focus attention on the athlete's recovery of symptoms via a multi-faceted approach instead of using pre-determined grading scale.
3. Baseline testing of cognitive function and postural-stability should be implemented.
4. The use of a battery of tests which at least includes a symptom checklist, neuropsychological testing, and postural stability testing.
5. Once symptom free, re-test cognitive function and postural stability.
6. Once symptom free, an incremental activity challenge should be implemented.
7. The use of high quality objective tests.
8. The use a combination of sideline testing (e.g. SAC, BESS, symptom checklist) and more extensive testing (e.g. computerized neuropsychological testing and extensive postural stability measures).
9. The use a Neuropsychologist or other trained professional to read neuropsychological testing.

Attached is an evaluation form for the survey instrument. I ask that you do two things: 1) rate the question's appropriateness to the guidelines for concussion management established by the International Conference on Concussion in Sport and the National Athletic Trainers' Association (see references below) on a scale of 1 to 5 where 1 is a poor match and 5 is an excellent match, and 2) fill out the corresponding evaluation questions that assesses the question's wording and language. Feel free to complete the evaluation in MS Word and email it back to me. If you would rather write directly on the

evaluation, please mail or fax the completed evaluation to me. All contact information may be found below.

Please return the completed evaluation to me in 5 weeks time (approximately January 22, 2010). If you have any questions please do not hesitate to call (512-587-2374) or email me (jr1637@txstate.edu) at your convenience.

Sincerely,

Justin H. Rigby

Master Student in Athletic Training

Department of Health, Physical Education, and Recreation

Texas State University-San Marcos

601 University Dr.

San Marcos, TX 78666

Phone: 512-587-2374

Fax: 512-268-1888

Concussion Management Guideline References:

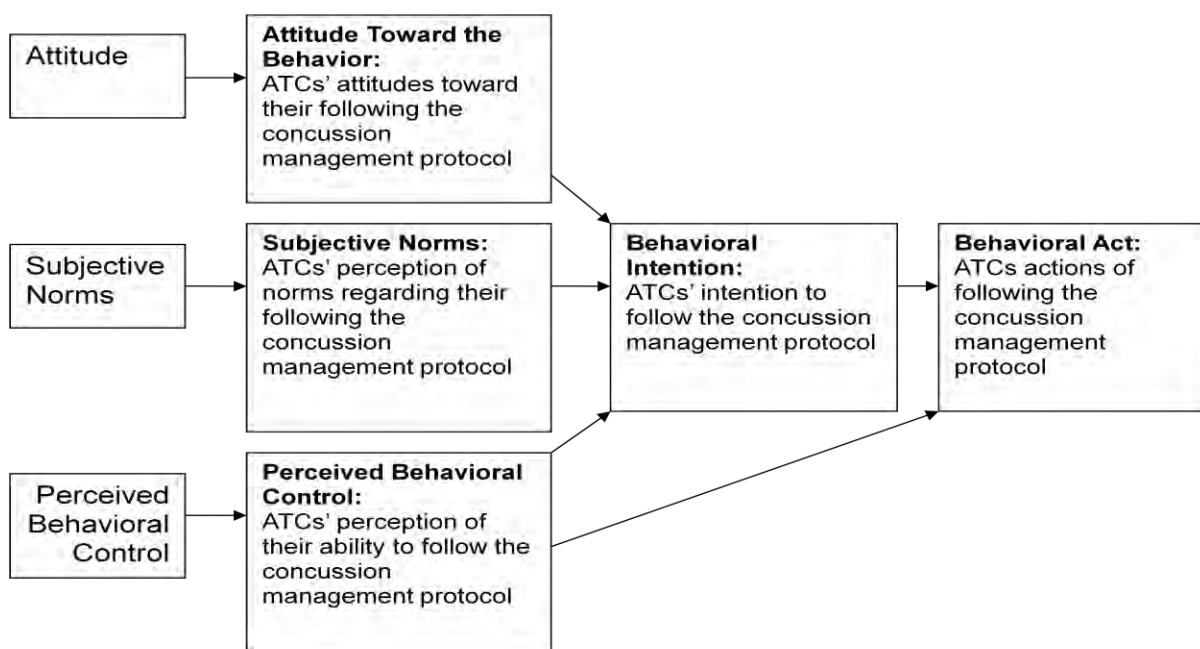
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Theory of Planned Behavior Cover Letter

December 17, 2009

Dear Expert Panel:

Thank you for agreeing to serve on an expert panel. You have been asked to serve on this panel because of your expertise in the Theory of Planned Behavior. My project aims to understand the beliefs of athletic trainers toward current concussion management guidelines through a self-reported instrument built around the Theory of Planned Behavior. The Theory of Planned Behavior is based on the assumption that behavior intention is an immediate predictor of behavior. Behavior intention, in turn, is determined by attitude, subjective norms, and perceived behavior control, which also may have a direct impact on actual behavior. The Theory of Planned Behavior is outlined below.



The sample for this project is certified athletic trainers (ATCs) throughout the United States in the high school, high school and clinic, junior college, and university and college settings.

Attached is an evaluation form for the survey instrument. I ask that you do two things: 1) rate the question's appropriateness to the designated Theory of Planned Behavior construct on a scale of 1 to 5 where 1 is a poor match to the designated construct and 5 is an excellent match to the designated construct, and 2) fill out the corresponding evaluation questions that assesses the question's wording and language. Feel free to complete the evaluation in MS Word and email it back to me. If you would rather write directly on the evaluation, please mail or fax the completed evaluation to me. All contact information may be found below.

Please return the completed evaluation to me in 5 weeks time (approximately January 22, 2010). If you have any questions please do not hesitate to call (512-587-2374) or email me (jr1637@txstate.edu) at your convenience.

Sincerely,
Justin H. Rigby
Master Student in Athletic Training
Department of Health, Physical Education, and Recreation
Texas State University-San Marcos
601 University Dr.
San Marcos, TX 78666
Phone: 512-587-2374
Fax: 512-268-1888

Pilot Study Cover Letter

Dear Fellow Certified Athletic Trainer:

As you may know, concussion research has been a topic at the forefront of athletic training recently. As a master's degree candidate at Texas State University and fellow certified athletic trainer, I am requesting your help in understanding athletic trainers' beliefs toward implementing a multi-faceted management approach for sport-related concussions. Your knowledge and opinions regarding this topic makes your input invaluable. Please take a few minutes to fill out this anonymous questionnaire you will find by clicking on this link and submit it by March 1, 2010. **When you complete the survey you will be entered into a drawing for a \$50 Visa gift card.** The questionnaire will take approxiametly 10-15 minutes.

You have the right to choose not to participate. The Texas State University Institutional Review Board has approved this study for the Protection of Human Subjects.

<http://survey.education.txstate.edu/mrIWeb/mrIWeb.dll?LProject=TPBCONCUSSION>

Thank you for your time and consideration.

Sincerely,

Justin H. Rigby, ATC, LAT
Texas State University
Department of Health, Physiscal Education and Recreation
601 University Drive
San Marcos, TX 78666-4616
jr1637@txstate.edu

Participants for this survey were selected at random from the NATA membership database according to the selection criteria provided by the student doing the survey. This student survey is not approved or endorsed by the NATA. It is being sent to you because of NATA's commitment to athletic training education and research

Pilot Study Follow-up Letter

Dear Fellow Certified Athletic Trainer:

Recently an email request regarding athletic trainers' beliefs toward a multi-faceted management approach for sport-related concussions was sent to you. If you have already completed the survey, please accept my sincere thanks. If not, please take a few minutes to fill out this anonymous questionnaire you will find by clicking on this link and submit it by March 1, 2010. **When you complete the survey you will be entered into a drawing for a \$50 Visa gift card.** The questionnaire will take approximately 15 minutes.

You have the right to choose not to participate. The Texas State University Institutional Review Board has approved this study for the Protection of Human Subjects.

<http://survey.education.txstate.edu/mrIWeb/mrIWeb.dll?I.Project=TPBCONCUSSION>

I am grateful for your help, because it is only through input from fellow certified athletic trainers I can understand concussion management care for our athletes.

Sincerely,

Justin H. Rigby, ATC, LAT
Texas State University
Department of Health, Physical Education and Recreation
601 University Drive
San Marcos, TX 78666-4616
jr1637@txstate.edu

Participants for this survey were selected at random from the NATA membership database according to the selection criteria provided by the student doing the survey. This student survey is not approved or endorsed by the NATA. It is being sent to you because of NATA's commitment to athletic training education and research

VITA

Justin Holbrook Rigby was born on July 31, 1982, in Salt Lake City, Utah to the parents of Diana Holbrook and Stephen S. Rigby. After completing his work at Westwood High School in Austin, Texas, in 2001, he went on a mission for The Church of Jesus Christ of Latter-day Saints to Quezon City, Philippines, from September 5, 2001 to September 12, 2003. Upon returning he entered into the University of Utah completing his Bachelor of Science on May 2, 2008, in Exercise and Sport Science with an Athletic Training emphasis. In August 2008, he entered the Graduate College of Texas State University-San Marcos.

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This thesis was typed by Justin H. Rigby.