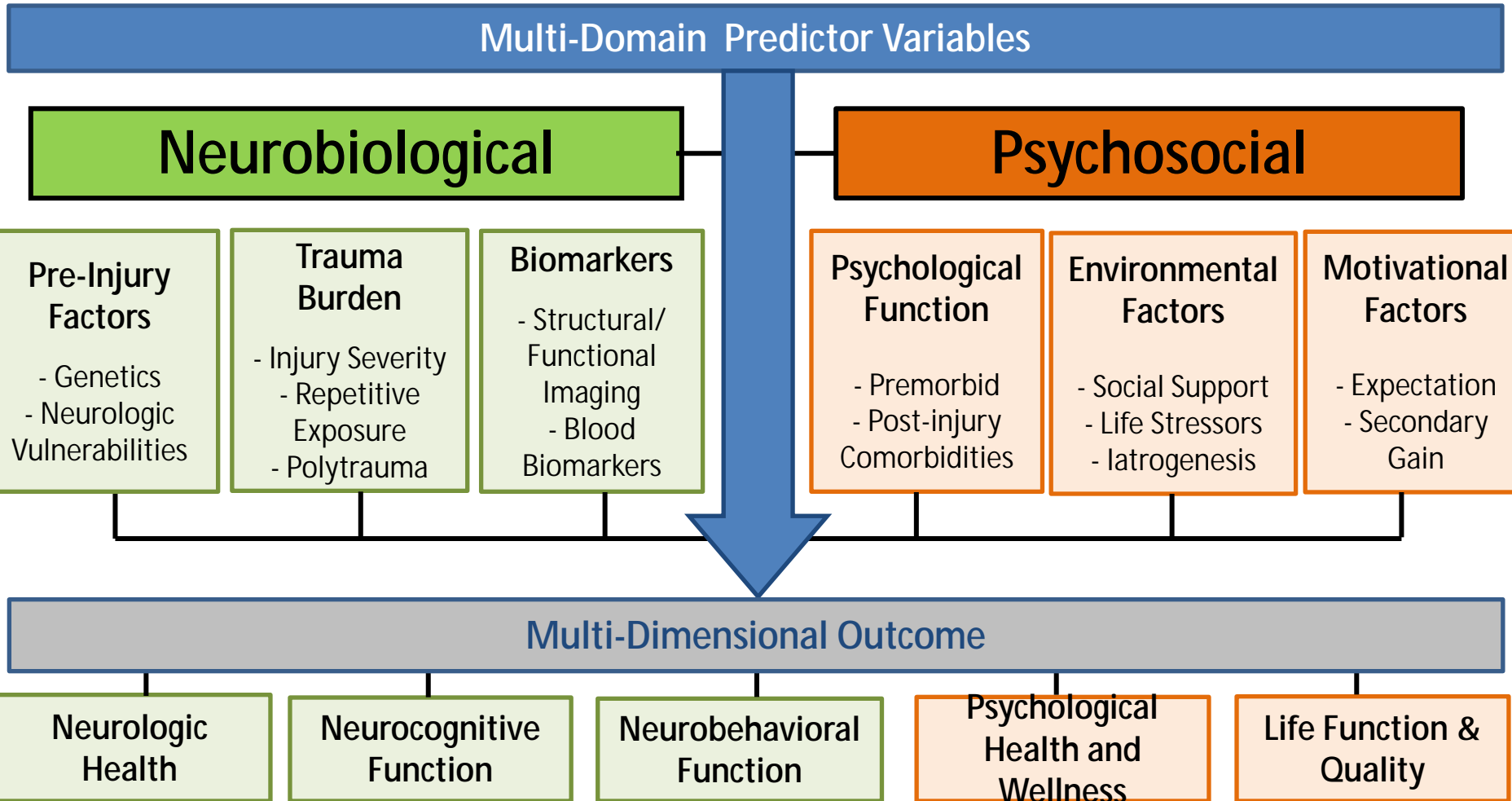
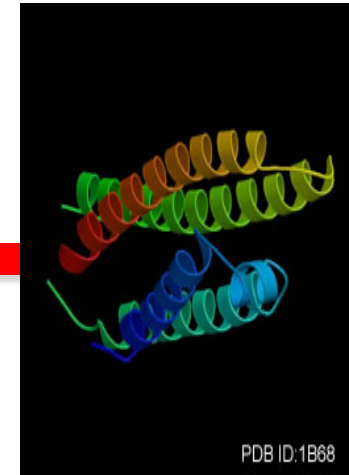
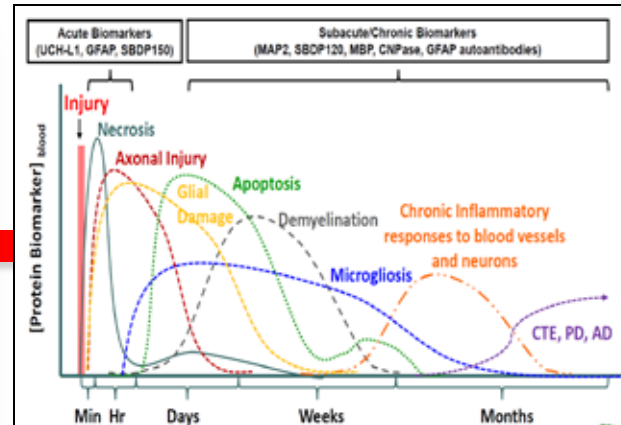
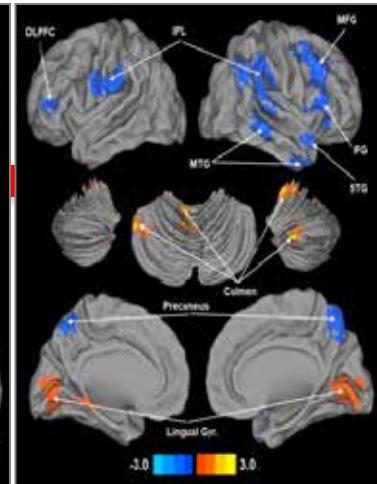
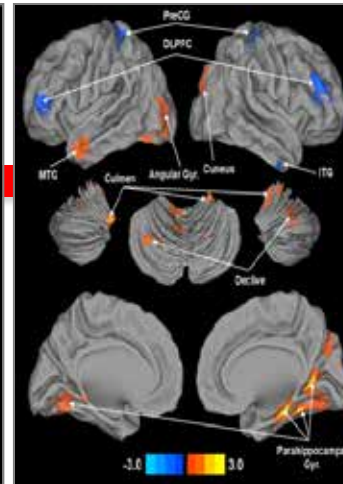
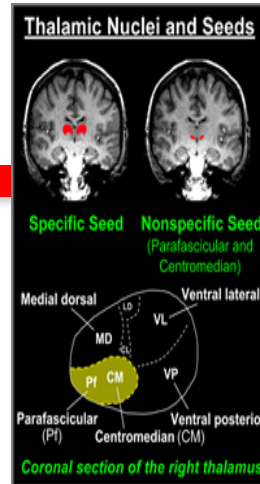


Neurobiopsychosocial Model of mTBI:

Multidimensional Prediction of Risk & Recovery



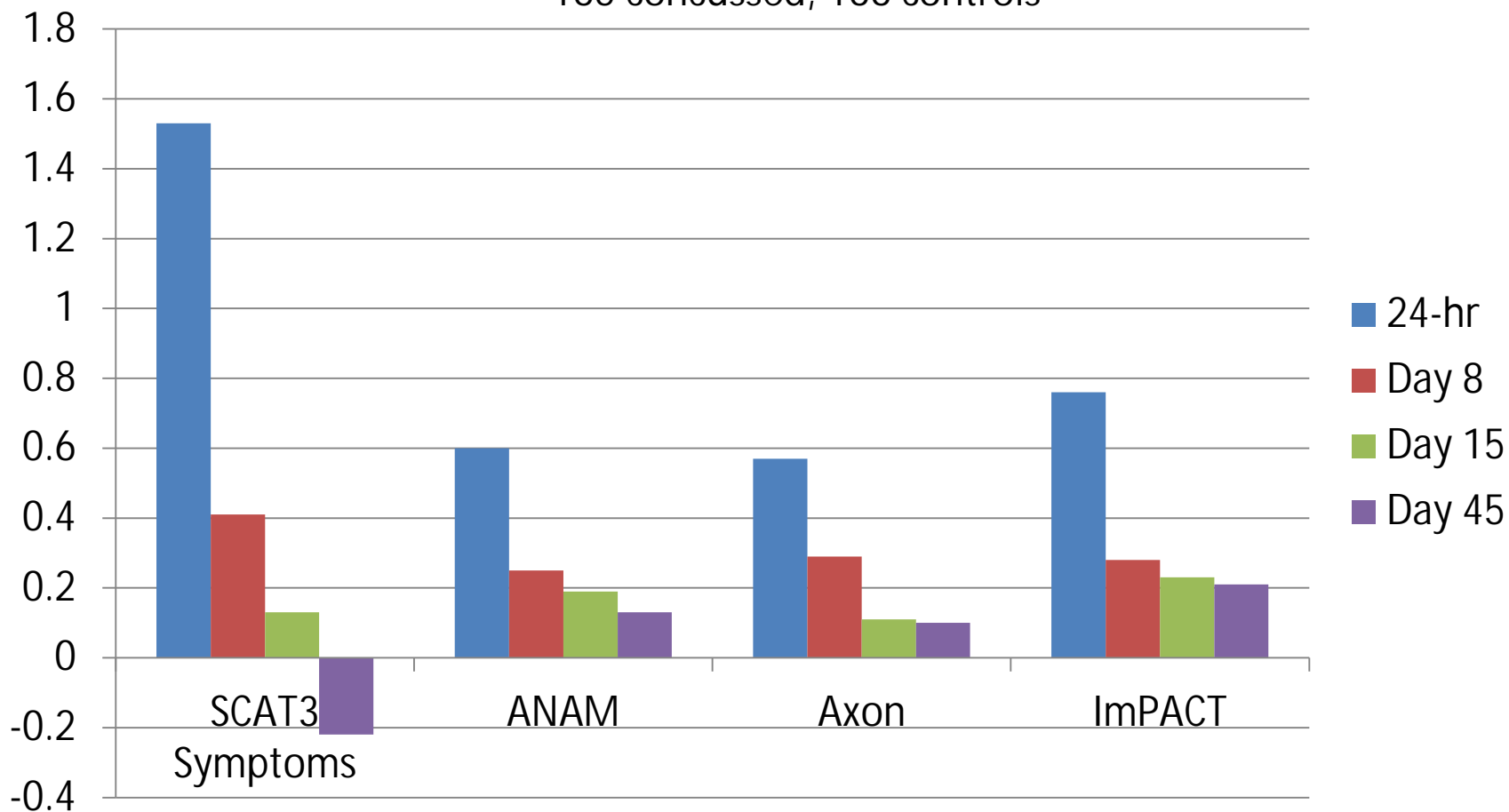
Future Directions: *Bringing it all Together*



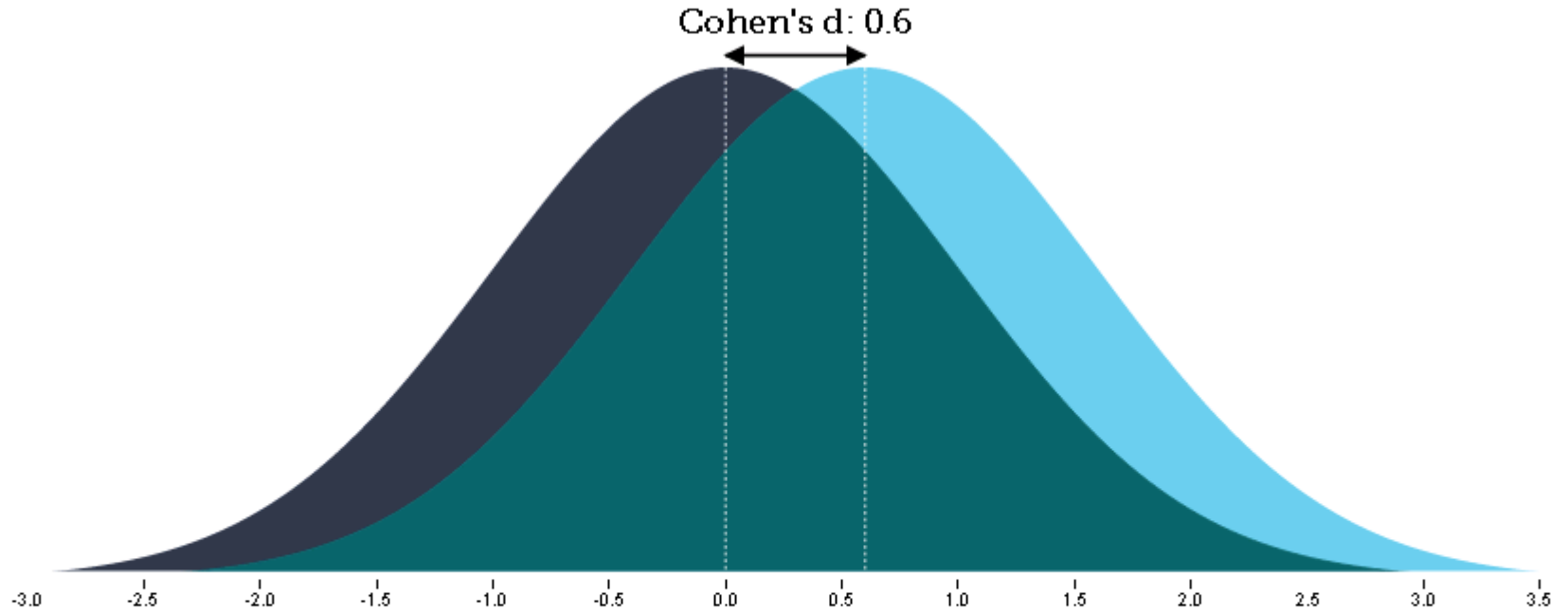
Understanding the True Natural History of Acute Injury & Recovery

: Test Validity

Effect Sizes (Cohen's d) From Day 1-45
 165 concussed, 166 controls



Nelson, LaRoche, Pfaller, Lerner, Hammeke, Randolph, Barr, Guskiewicz, & McCrea (2016) *J Int Neuropsychol Soc*, 22, 24-37.



Interpretation



Cohen's U_3



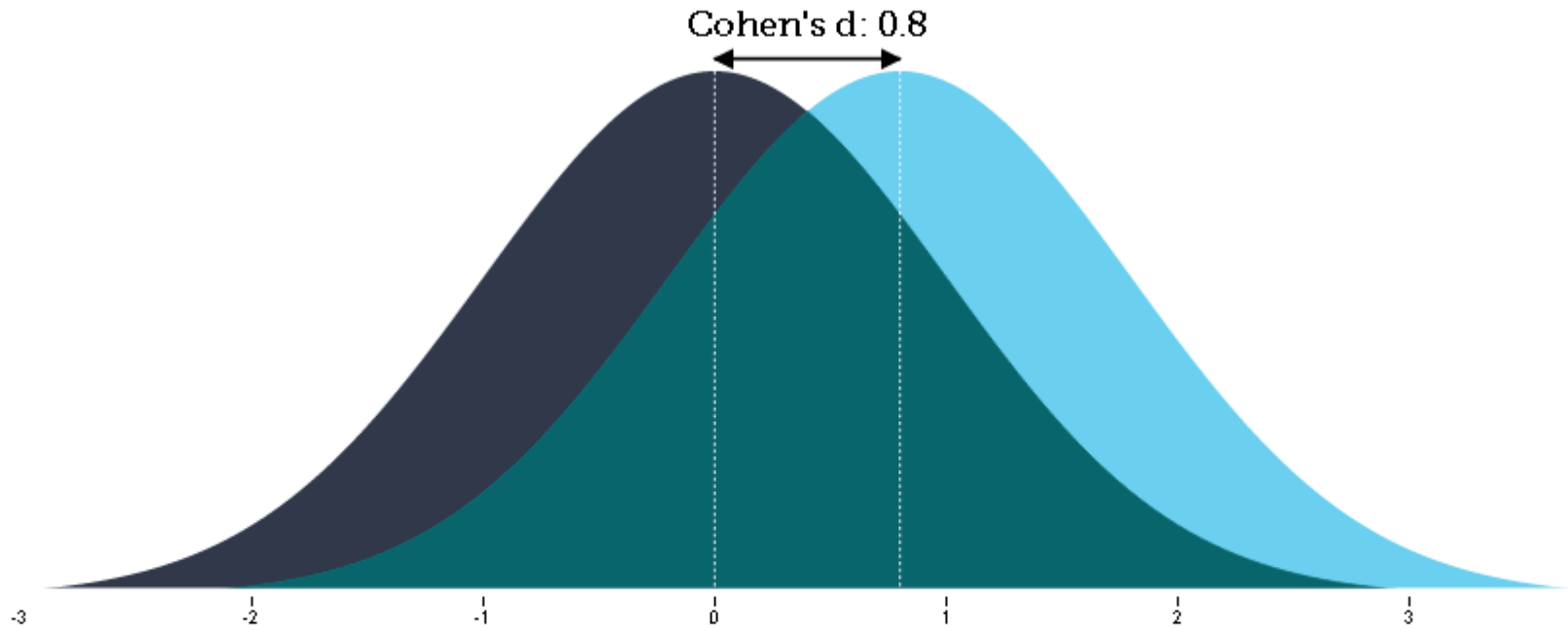
% Overlap



Probability of Superiority



Number Needed to Treat¹



Interpretation



Cohen's U_3



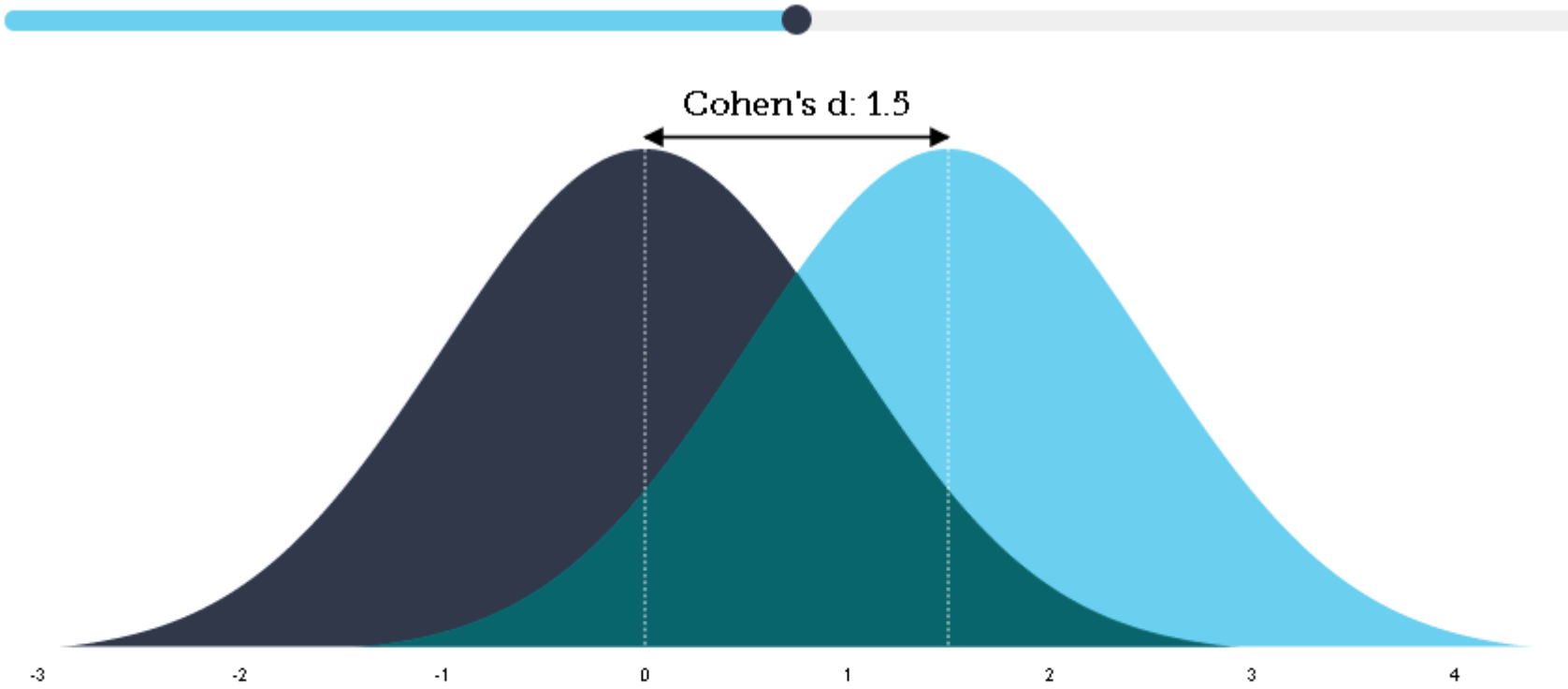
% Overlap



Probability of Superiority



Number Needed to Treat¹



Interpretation



Cohen's U_3



% Overlap



Probability of Superiority



Number Needed to Treat¹



Symptom Tracking Assessment for Concussion (STAC) Mobile App

New app tackles head trauma

By Marie Rohde | MARCH 9, 2016 | HEALTH | CHILDREN'S HEALTH



More than 120,000 young athletes experience a sports-related head injury each year. The University of Wisconsin-Milwaukee App Brewery and the Medical College of Wisconsin's Brain Injury Research Program are partnering on a free smartphone app that helps athletes, parents and coaches deal with head injuries.

Verizon 12:40 PM 79%

Symptom Checklist

INFO RETURN TO PLAY FEEDBACK

How do you feel?
You should score yourself on the following symptoms, based on how you feel right now.

NONE	MILD	MODERATE	SEVERE			
Headache						
0	1	2	3	4	5	6
Pressure In Head						
0	1	2	3	4	5	6
Neck Pain						
0	1	2	3	4	5	6
Nausea or Vomiting						
0	1	2	3	4	5	6
Dizziness						
0	1	2	3	4	5	6
Blurred Vision						
0	1	2	3	4	5	6
Balance Problems						
0	1	2	3	4	5	6

What about Youth Athletes?

Which symptom assessments and approaches are uniquely appropriate for paediatric concussion?

G A Gioia,¹ J C Schneider,¹ C G Vaughan,¹ P K Isquith²

Pediatric Sport-Related Concussion: A Review of the Clinical Management of an Oft-Neglected Population

Michael W. Kirkwood, PhD^{a,b}, Keith Owen Yeates, PhD^{c,d}, Pamela E. Wilson, MD^{a,b}

^aDepartment of Physical Medicine and Rehabilitation, Children's Hospital, Denver, Colorado; ^bUniversity of Colorado Health Sciences Center, Denver, Colorado; ^cDepartment of Pediatrics, Ohio State University, Columbus, Ohio; ^dCenter for Biobehavioral Health, Columbus Children's Research Institute, Columbus, Ohio

The authors have indicated they have no financial relationships relevant to this article to disclose.

Journal of Athletic Training 2006;41(4):399-408
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www.journalofathletictraining.org

original research

Psychometric and Measurement Properties of Concussion Assessment Tools in Youth Sports

Tamara C. Valovich McLeod*; William B. Barr†; Michael McCrea‡; Kevin M. Guskiewicz§

*Arizona School of Health Sciences, A.T. Still University, Mesa, AZ; †New York University School of Medicine, New York, NY; ‡Waukesha Memorial Hospital, Waukesha, WI, and Medical College of Wisconsin, Milwaukee, WI; §University of North Carolina at Chapel Hill, Chapel Hill, NC

Child-SCAT3™
Sport Concussion Assessment Tool for children ages 5 to 12 years
For use by medical professionals only

What is childSCAT3?™
The ChildSCAT3 is a standardized tool for evaluating injured children for concussion and can be used in children aged from 5 to 12 years. It supersedes the original SCAT and the SCAT2 published in 2005 and 2008, respectively. For older persons, ages 13 years and over, please use the SCAT3. The ChildSCAT3 is designed for use by medical professionals. If you are not qualified, please use the Sport Concussion Recognition Tool. Previous baseline testing with the ChildSCAT3 can be helpful for interpreting post-injury test scores.

Potential signs of concussion?
If any of the following signs are observed after a direct or indirect blow to the head, the child should stop participation, be evaluated by a medical professional and **should not be permitted to return to sport the same day** if a concussion is suspected.

Any loss of consciousness? Y N
"If so, how long?" _____
Balance or motor coordination (stumbles, slow/labored movements, etc.)? Y N
Disorientation or confusion (inability to respond appropriately to questions)? Y N
Loss of memory:
"If so, how long?" _____
"Before or after the injury?" _____
Blank or vacant look: Y N
Visible facial injury in combination with any of the above: Y N

2 Sideline Assessment – child-Maddocks Score³
I am going to ask you a few questions, please listen carefully and give your best effort!
Modified Maddocks questions (1 point for each correct answer)

Where are we at now?	0	1
Is it before or after lunch?	0	1
What did you have last lesson/class?	0	1
What is your teacher's name?	0	1
child-Maddocks score	0 out of 4	

Child-Maddocks score is for sideline diagnosis of concussion only and is not used for serial testing.

What is a concussion?
A concussion is a disturbance in brain function caused by a direct or indirect force to the head. It results in a variety of non-specific signs and/or symptoms (like those listed below) and most often does not involve loss of consciousness. Concussion should be suspected in the presence of any one or more of the following:

- Symptoms (e.g., headache), or
- Physical signs (e.g., unsteadiness), or
- Impaired brain function (e.g., confusion) or
- Abnormal behaviour (e.g., change in personality).

SIDELINE ASSESSMENT
Indications for Emergency Management

NOTE: A hit to the head can sometimes be associated with a more severe brain injury. If the concussed child displays any of the following, then do not proceed with the ChildSCAT3; instead activate emergency procedures and urgent transportation to the nearest hospital.

— Glasgow Coma score less than 15.

Future Directions in TBI Research: *Acute Effects, Recovery, & Outcome*

TRUE NATURAL HISTORY OF INJURY

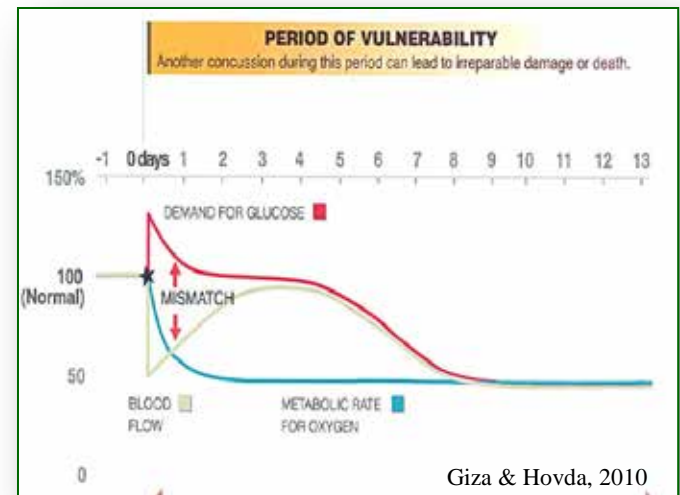
Acute Effects and Recovery Time Following Concussion in Collegiate Football Players
The NCAA Concussion Study

Michael McCrea, PhD
Kevin M. Guskiewicz, PhD, ATC
Stephen W. Marshall, PhD
William Barr, PhD
Christopher Randolph, PhD
Robert C. Cantu, MD
James A. Oate, PhD, ATC
Jingzhen Yang, MPH
James P. Kelly, MD

Context: Lack of empirical data on recovery time following sport-related concussion hampers clinical decision making about return to play after injury.

Objective: To prospectively measure immediate effects and natural recovery course relating to symptoms, cognitive functioning, and postural stability following sport-related concussion.

Design, Setting, and Participants: Prospective cohort study of 1631 football players from 15 US colleges. All players underwent preseason baseline testing on concussion assessment measures in 1999, 2000, and 2001. Ninety-four players with concussion (based on American Academy of Neurology criteria) and 56 noninjured controls underwent assessment of symptoms, cognitive functioning, and postural stability immediately, 3 hours, and 1, 2, 3, 5, 7, and 90 days after injury.



Clinical Recovery:

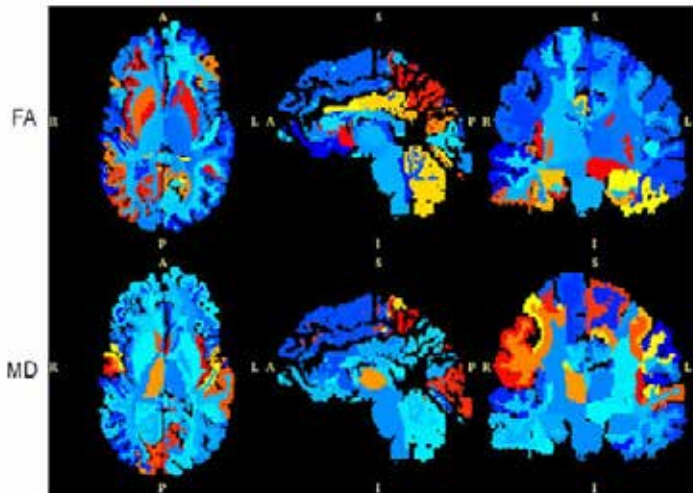
How long does it take for signs & symptoms to recover?

Physiological Recovery:

How long does it take for the *brain* to recover?

How Long is Long Enough?

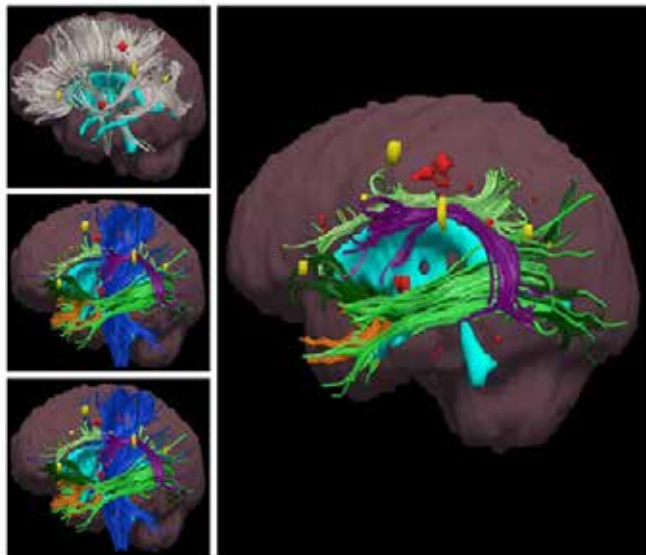
New Frontiers in Brain Injury Science



Journal of the International Neuropsychological Society (2013), 19, 863–872.
Copyright © INS. Published by Cambridge University Press, 2013.
doi:10.1017/S1355617713000702

Acute and Subacute Changes in Neural Activation during the Recovery from Sport-Related Concussion

Thomas A. Hammeke,¹ Michael McCrea,² Sarah M. Coats,³ Matthew D. Verber,⁴ Sally Durgierian,⁵ Kristin Flora,⁶ Gary S. Olsen,⁷ Peter D. Leo,⁵ Thomas A. Gennarelli,² AND Stephen M. Rao⁸



J Head Trauma Rehabil
Vol. 25, No. 4, pp. 1–10
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Acute Effects and Recovery After Sport-related Concussion: A Neurocognitive and Quantitative Brain Electrical Activity Study

Michael McCrea, PhD, ABPP-CN; Leslie Prichep, PhD; Matthew R. Powell, PhD, ABPP; Robert Chabot, PhD; William B. Barr, PhD, ABPP

How Long Does it Take for the *Brain* to Recover?



HEAD HEALTH CHALLENGE

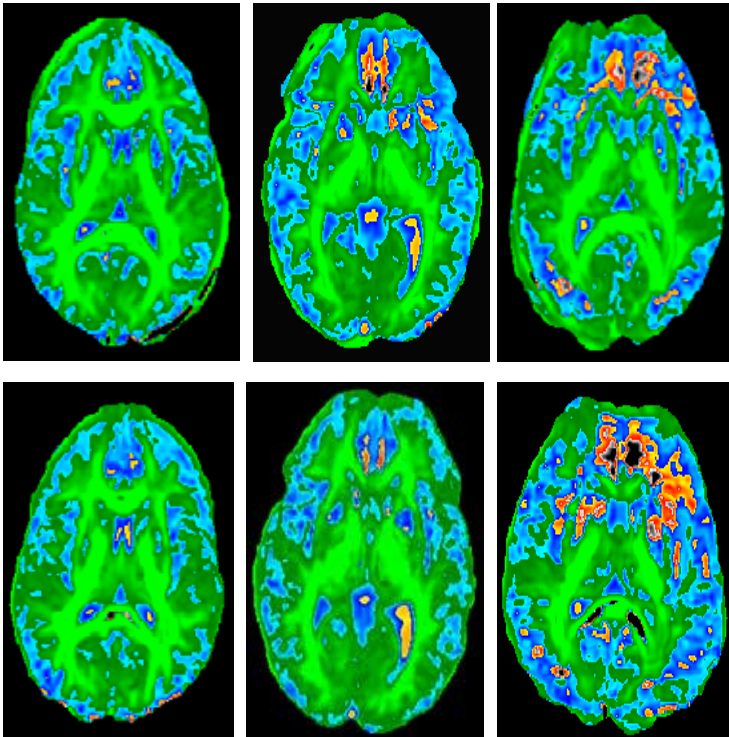
GE-NFL HEAD HEALTH CHALLENGE I

A Prospective Study of Advanced MRI Biomarkers to Determine Acute Physiological Effects and Longitudinal Recovery After Sport- Related Concussion

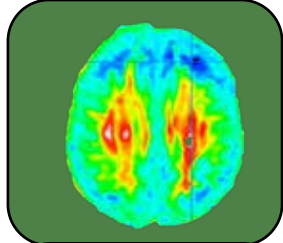
Investigative Team:

Michael McCrea, PhD (PI)

Andrew Nencka, PhD; Kevin Koch, PhD; L. Tugan Muftuler,
PhD; Yang Wang, MD; Shi-Jiang Li, PhD; Melissa Lancaster,
PhD; Lindsay Nelson, PhD



How long does it take for the *brain* to recover?



PROJECT HEAD TO HEAD II

Comprehensive Study of Acute Effects and Recovery After Concussion:

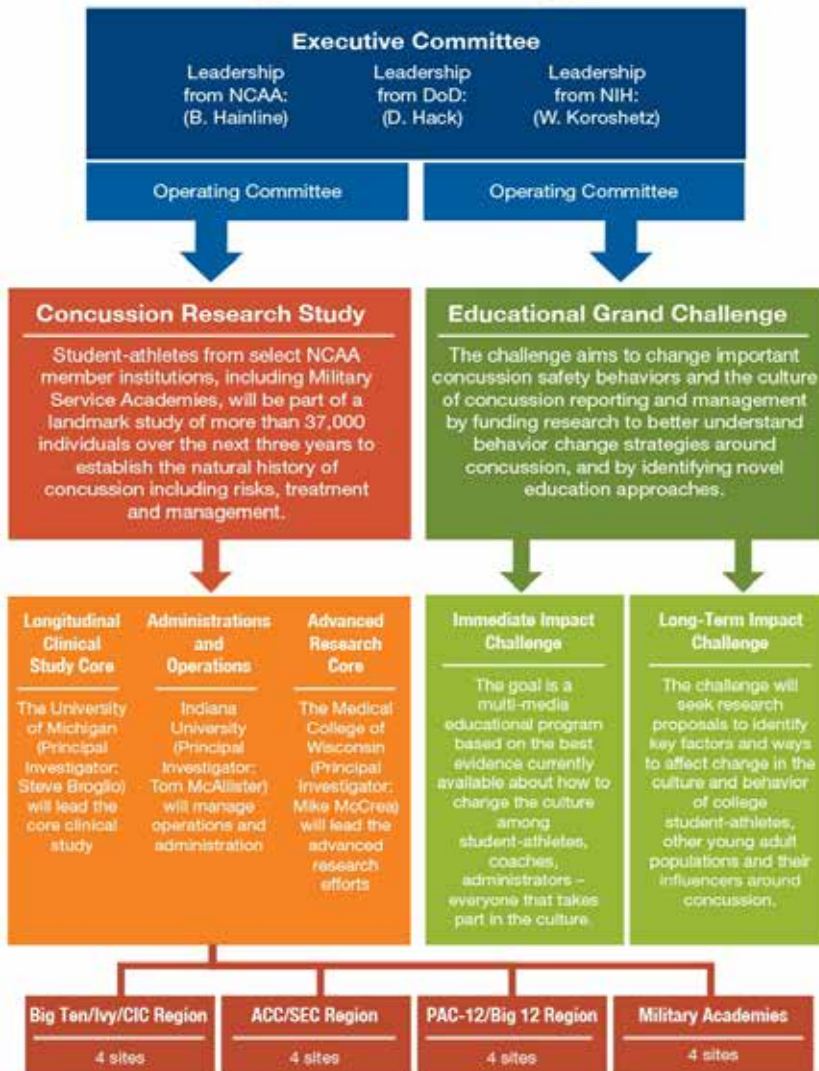
An Integrated Investigation of Head Impact Sensor Technology, Blood Biomarkers, Advanced Neuroimaging, Genetic Testing, and Clinical Outcome Measures

Funded by U.S. Dept. of Defense Combat Casualty Care Research Program

\$6M, 4 years

NCAA-DOD GRAND ALLIANCE

A Concussion Research and Education Initiative



Future Directions

Sponsored by United States Department of Defense (DoD) & National Collegiate Athletic Association (NCAA)

3 Years, \$23M



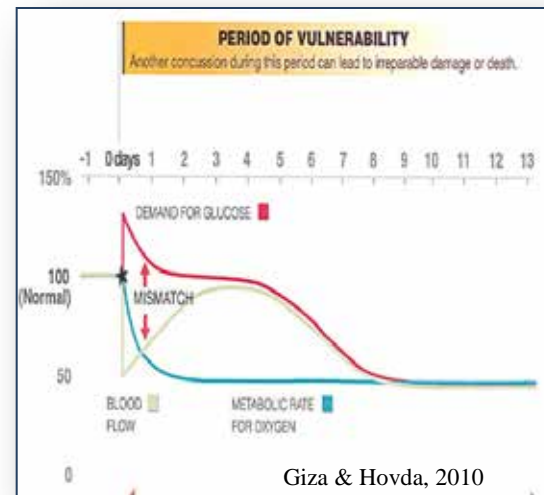
SCHOOL OF MEDICINE
INDIANA UNIVERSITY



Current Questions in SRC: *Acute Effects & Recovery*

Acute Effects and Recovery Time Following Concussion in Collegiate Football Players The NCAA Concussion Study	
Michael McCrea, PhD	Context: Lack of empirical data on recovery time following sport-related concussion hampers clinical decision-making about return to play after injury.
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Robert C. Cantu, MD	
James A. Oude, PhD, ATC	
Jingchen Yang, MPH	
James P. Kelly, MD	

+



Clinical Recovery:

Why do individuals vary
in recovery?

Physiological Recovery:

How long does it
take for the *brain* to
recover?

Individual Variability:

Who is at risk for prolonged clinical and
physiological recovery?

Thank You



Lindsay Nelson, PhD
Assistant Professor of Neurosurgery
and Neurology
Brain Injury Research Program
Medical College of Wisconsin

