Sports Related Concussion

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Disclosures

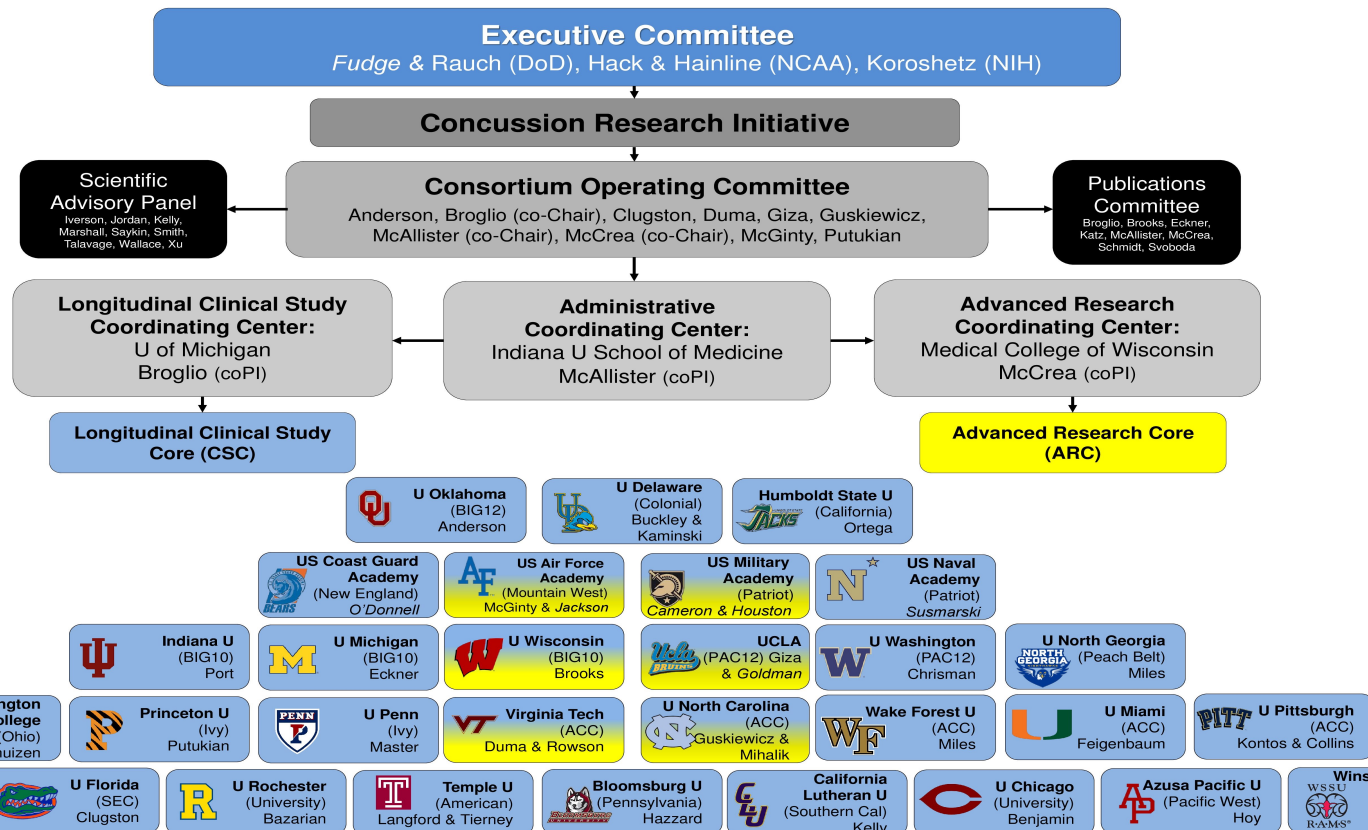- No relevant conflict of interest in relation to this presentation

Outline

- Background
- Evaluation
- Treatment
- Return to Play
- Return to Learn
- Future Diagnostic Tools
- Clinical Trajectories

CARE Consortium
(Concussion Assessment Research and Education)

- 30 Million dollar initiative between DoD, NIH, NCAA, NFL
- 30 NCAA schools and 4 service academies

Definition

- Sport related concussion is a traumatic brain injury induced by biomedical forces with possible associated factors:
  - Direct blow to the head, face, neck or elsewhere transmitting a force towards/through the head
  - Rapid onset of short-lived impairment of neurological function that resolves spontaneously
  - May result in neuropsychological changes
  - Range of clinical signs and symptoms +/- loss of consciousness

McCrory et al.

Risk Factors

Primary

- Sex
- Age
- Ethnicity
- ADHD/LD
- Anxiety/Depression

Secondary

- Prior concussion history
- Prior headache treatments
- Contact Sports
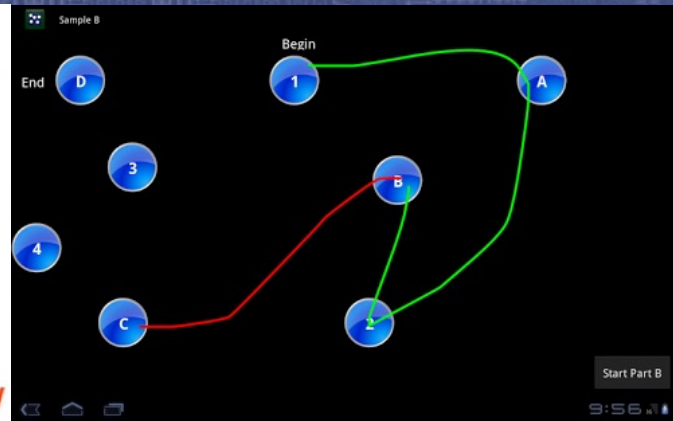- Impact exposures

Kerr et al.

Higher Sport Incident Rates

- Contact Sports
  - Wrestling
  - Men's and Women's Ice Hockey
  - Football
  - Soccer
- Non Contact
  - Baseball
  - Softball
  - Basketball

Kerr et al.

Evaluation/Testing

- ImPACT
- SCAT5
- BESS

- BSI-18
- KD Test
- VOMS
- SOT
- Accelerometers

Sport Concussion Assessment Tool (SCAT5)

OFFICE OR OFF-FIELD ASSESSMENT

Please note that the neurocognitive assessment should be done in a distraction-free environment with the athlete in a resting state.

STEP 1: ATHLETE BACKGROUND

Sport / team / school: _____

Date / time of injury: _____

Years of education completed: _____

Age: _____

Gender: M / F / Other

Dominant hand: left / neither / right

How many diagnosed concussions has the
athlete had in the past?: _____

When was the most recent concussion?: _____

How long was the recovery (time to being cleared to play)
from the most recent concussion?: _____ (days)

Has the athlete ever been:

Hospitalized for a head injury?	Yes	No
Diagnosed / treated for headache disorder or migraines?	Yes	No
Diagnosed with a learning disability / dyslexia?	Yes	No
Diagnosed with ADD / ADHD?	Yes	No
Diagnosed with depression, anxiety or other psychiatric disorder?	Yes	No

Current medications? If yes, please list:

_____

SCAT5 - Step 2

2

STEP 2: SYMPTOM EVALUATION

The athlete should be *given the symptom form* and asked to *read this instruction paragraph out loud* then complete the symptom scale. For the baseline assessment, the athlete should rate his/her symptoms based on how he/she typically feels and for the post injury assessment the athlete should rate their symptoms at this point in time.

Please Check: ☐ **Baseline** ☐ **Post-Injury**

Please hand the form to the athlete

	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
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6
Trouble falling asleep (if applicable)	0	1	2	3	4	5	6

Total number of symptoms:	of 22
Symptom severity score:	of 132
Do your symptoms get worse with physical activity?	Y N
Do your symptoms get worse with mental activity?	Y N
If 100% is feeling perfectly normal, what percent of normal do you feel?	

If not 100%, why?

SCAT5 - Step 3

STEP 3: COGNITIVE SCREENING
Standardised Assessment of Concussion (SAC)[4]

ORIENTATION

What month is it?	0	1
What is the date today?	0	1
What is the day of the week?	0	1
What year is it?	0	1
What time is it right now? (within 1 hour)	0	1
Orientation score		of 5

SCAT5 – Step 3 cont.

IMMEDIATE MEMORY

The Immediate Memory component can be completed using the traditional 5-word per trial list or optionally using 10-words per trial to minimise any ceiling effect. All 3 trials must be administered irrespective of the number correct on the first trial. Administer at the rate of one word per second.

Please choose EITHER the 5 or 10 word list groups and circle the specific word list chosen for this test.

I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order. For Trials 2 & 3: I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before.

List	Alternate 5 word lists					Score (of 5)		
						Trial 1	Trial 2	Trial 3
A	Finger	Penny	Blanket	Lemon	Insect			
B	Candle	Paper	Sugar	Sandwich	Wagon			
C	Baby	Monkey	Perfume	Sunset	Iron			
D	Elbow	Apple	Carpet	Saddle	Bubble			
E	Jacket	Arrow	Pepper	Cotton	Movie			
F	Dollar	Honey	Mirror	Saddle	Anchor			
				Immediate Memory Score			of 15	
				Time that last trial was completed				

List	Alternate 10 word lists					Score (of 10)		
						Trial 1	Trial 2	Trial 3
G	Finger	Penny	Blanket	Lemon	Insect			
	Candle	Paper	Sugar	Sandwich	Wagon			
H	Baby	Monkey	Perfume	Sunset	Iron			
	Elbow	Apple	Carpet	Saddle	Bubble			
I	Jacket	Arrow	Pepper	Cotton	Movie			
	Dollar	Honey	Mirror	Saddle	Anchor			
				Immediate Memory Score			of 30	
				Time that last trial was completed				

SCAT5 – Step 3 cont.

SCAT5 – Step 4

STEP 4: NEUROLOGICAL SCREEN

See the instruction sheet (page 7) for details of test administration and scoring of the tests.

Can the patient read aloud (e.g. symptom check-list) and follow instructions without difficulty?	Y	N
Does the patient have a full range of pain-free PASSIVE cervical spine movement?	Y	N
Without moving their head or neck, can the patient look side-to-side and up-and-down without double vision?	Y	N
Can the patient perform the finger nose coordination test normally?	Y	N
Can the patient perform tandem gait normally?	Y	N

BALANCE EXAMINATION

Modified Balance Error Scoring System (mBESS) testing[5]

Which foot was tested (i.e. which is the non-dominant foot) ☐ Left ☐ Right

Testing surface (hard floor, field, etc.) _____

Footwear (shoes, barefoot, braces, tape, etc.) _____

Condition	Errors
Double leg stance	of 10
Single leg stance (non-dominant foot)	of 10
Tandem stance (non-dominant foot at the back)	of 10
Total Errors	of 30

SCAT5 – Step 5

STEP 5: DELAYED RECALL:

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section. Score 1 pt. for each correct response.

Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order.

Time Started

Please record each word correctly recalled. Total score equals number of words recalled.

Total number of words recalled accurately: of 5   or   of 10

SCAT5 – Step 6

STEP 6: DECISION

Domain	Date & time of assessment:		
Symptom number (of 22)			
Symptom severity score (of 132)			
Orientation (of 5)			
Immediate memory	of 15 of 30	of 15 of 30	of 15 of 30
Concentration (of 5)			
Neuro exam	Normal Abnormal	Normal Abnormal	Normal Abnormal
Balance errors (of 30)			
Delayed Recall	of 5 of 10	of 5 of 10	of 5 of 10

Date and time of injury: _____

If the athlete is known to you prior to their injury, are they different from their usual self?
☐ Yes ☐ No ☐ Unsure ☐ Not Applicable
(If different, describe why in the clinical notes section)

Concussion Diagnosed?
☐ Yes ☐ No ☐ Unsure ☐ Not Applicable

If re-testing, has the athlete improved?
☐ Yes ☐ No ☐ Unsure ☐ Not Applicable

I am a physician or licensed healthcare professional and I have personally administered or supervised the administration of this SCAT5.

Signature: _____

Name: _____

Title: _____

Registration number (if applicable): _____

Date: _____

Balance Error Scoring System

- Assessing static postural stability

- Six 20 sec trials

- Eyes Closed

- Firm flat surface and foam pad

BESS

Score Card

Balance Error Scoring System (BESS)
(Guskiewicz)

Balance Error Scoring System – Types of Errors

1. Hands lifted off iliac crest
2. Opening eyes
3. Step, stumble, or fall
4. Moving hip into > 30 degrees abduction
5. Lifting forefoot or heel
6. Remaining out of test position >5 sec

The BESS is calculated by adding one error point for each error during the 6 20-second tests.

SCORE CARD: (# errors)	FIRM Surface	FOAM Surface
Double Leg Stance (feet together)		
Single Leg Stance (non-dominant foot)		
Tandem Stance (non-dom foot in back)		
Total Scores:		
BESS TOTAL:		

Which **foot** was tested: ☐ Left ☐ Right
(i.e. which is the **non-dominant** foot)

BESS
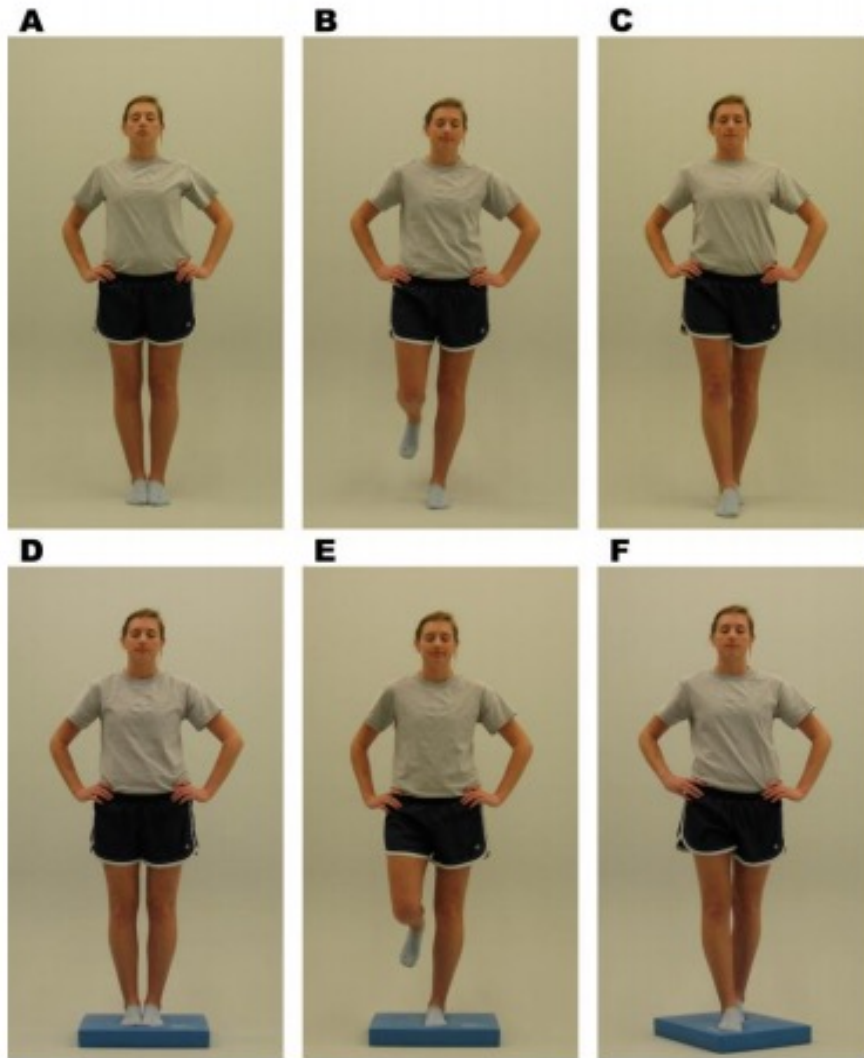
Balance Measurements

- C3 Logix
- Neurocom
- Cobalt
- Force Plates
- Smart Phones

Vestibular Ocular-Motor Screening (VOMS)

- Assessing vestibular and ocular motor impairments while performing:
  - Smooth pursuits
  - Horizontal and Vertical Saccades
  - Convergence
  - Horizontal vestibular ocular reflex
  - Visual motion sensitivity

Mucha et al.

VOMS cont...

Vestibular/Ocular-Motor Screening (VOMS) for Concussion

Vestibular/Ocular Motor Test:	Not Tested	Headache 0-10	Dizziness 0-10	Nausea 0-10	Fogginess 0-10	Comments
BASELINE SYMPTOMS:	N/A					
Smooth Pursuits						
Saccades – Horizontal						
Saccades – Vertical						
Convergence (Near Point)						(Near Point in cm): Measure 1: _____ Measure 2:_____ Measure 3:_____
VOR – Horizontal						
VOR – Vertical						
Visual Motion Sensitivity Test						

Mucha et al.

VOMS...

Figure 1. Smooth pursuits.

Mucha et al.

VOMS...

Figure 2. Horizontal saccades.

Figure 3. Vertical saccades.

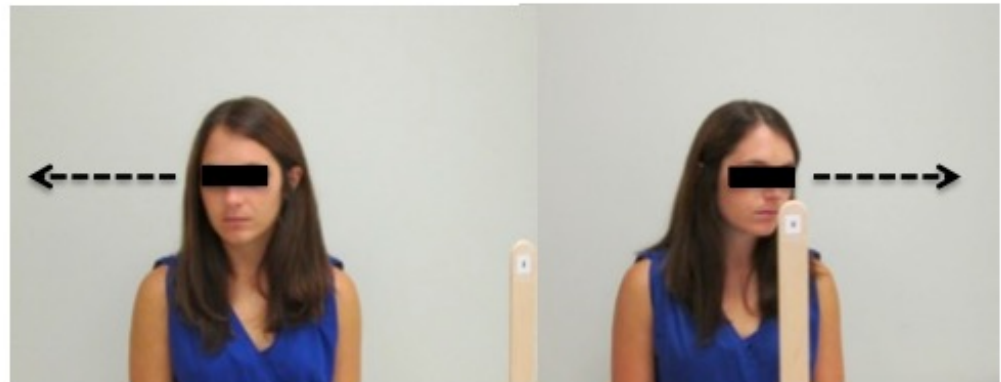Figure 4. Convergence

Figure 5. Horizontal VOR.

Mucha et al.

VOMS...

Figure 7. VMS.

Mucha et al.

Current Treatment Recommendations

- Zurich 2016 - Concussion in Sport Group Consensus Statement
  - Immediate treatment:
    - If sports related – immediate removal from the sporting event
    - Concussion evaluation – including neurological assessment
    - Monitor or instruct someone to monitor patient for worsening symptoms
  - Follow up treatment:
    - Serial concussion assessments until asymptomatic
    - Physical activity is limited to below the symptom threshold
    - Computerized and/or formal neuropsychological evaluation
    - Oculomotor and cervicovestibular evaluation and rehabilitation

Return to Play

Table 4.	Return-to-Play Progression
Stage[a]	Physical Activity
1	No activity
2	Light exercise: <70% age-predicted maximal heart rate
3	Sport-specific activities without the threat of contact from others
4	Noncontact training involving others, resistance training
5	Unrestricted training
6	Return to play

[a] Stages should be separated by at least 24 hours.[7]

Broglia, Cantu, Gioia, et. al. 2014. J Ath Trn

Return to Learn

Stage 1- Cognitive Rest (Brain Rest)

Short term cognitive rest allows the brain to heal more quickly.

Avoid:

- Classroom attendance
- Formation
- Briefings
- Homework
- "Screen time" (phone, computer, video game use)
- Reading
- Loud noise and bright lights
- Attending meals in Mitchell Hall

Goal: Being asymptomatic at rest, then progress to the next stage.

Stage 2- Trial of Cognitive Activity (return to homework)

- Attempt cognitive activity such as homework or reading for 20-30 minutes, gradually increase time increments
- Allow for approximately 15 minutes of rest in between each activity
- If the cadet develops symptoms after participating in activities, they should rest until symptoms subside
- The cadet should <u>not</u> participate in military formations, briefings, marching, meals, and running strips

Goal: Completing approximately an hour of cognitive activity without significant concussion symptoms. Then can progress to the next stage.

USAFA

Return to Learn

Stage 3- Return to Class (with maximum modifications)

- Return to a partial day of classes
- Avoid specific classes or activities that lead to the onset of symptoms, particularly challenging classes, labs, and excessive computer use
- The cadet should not participate in physical education classes
- The cadet should communicate to their academic advisor, professors, and instructors when they are experiencing symptoms and ask to leave class or modify classes in order to minimize concussion symptoms
- The cadet should not take quizzes or GRs, as a quiz or GR taken while concussed will not accurately represent their ability and knowledge
- The cadet can begin to make up work (e.g., reading assignments) missed when they were not in class
- The cadet should not participate in military formations, briefings, marching, meals, and running strips

Goal: Complete a partial day of classes without concussion symptoms, then progress to the next stage.

USAFA

Return to Learn

Stage 4- Return to Class (with minimum modifications)
- The cadet returns to a full day of classes but should take breaks when necessary
- The cadet can begin to take quizzes and GRs, although he/she should be provided an opportunity to take an adapted form in order to prevent triggering symptoms (e.g., oral exam instead of written, paper instead of computer, increased time allowance on timed assessments etc.)
- Single class excusals for a particular class that provokes symptoms may be necessary
- Self-paced participation in military formations, briefings, marching, and meals
- No running strips

Goal: Attend classes without concussion symptoms, then progress to the next stage.

Stage 5- Full Class Attendance (no modifications)
- The cadet returns to classes as usual, fully participating and taking all quizzes and GRs in the original format
- The cadet will continue to work with professors and instructors in order to ensure that any missed work is excused or made up and he/she is caught up to the syllabus
- The expectation is that the cadet is attending all formations and briefings
- Full participation in military formations, briefings, marching, and meals
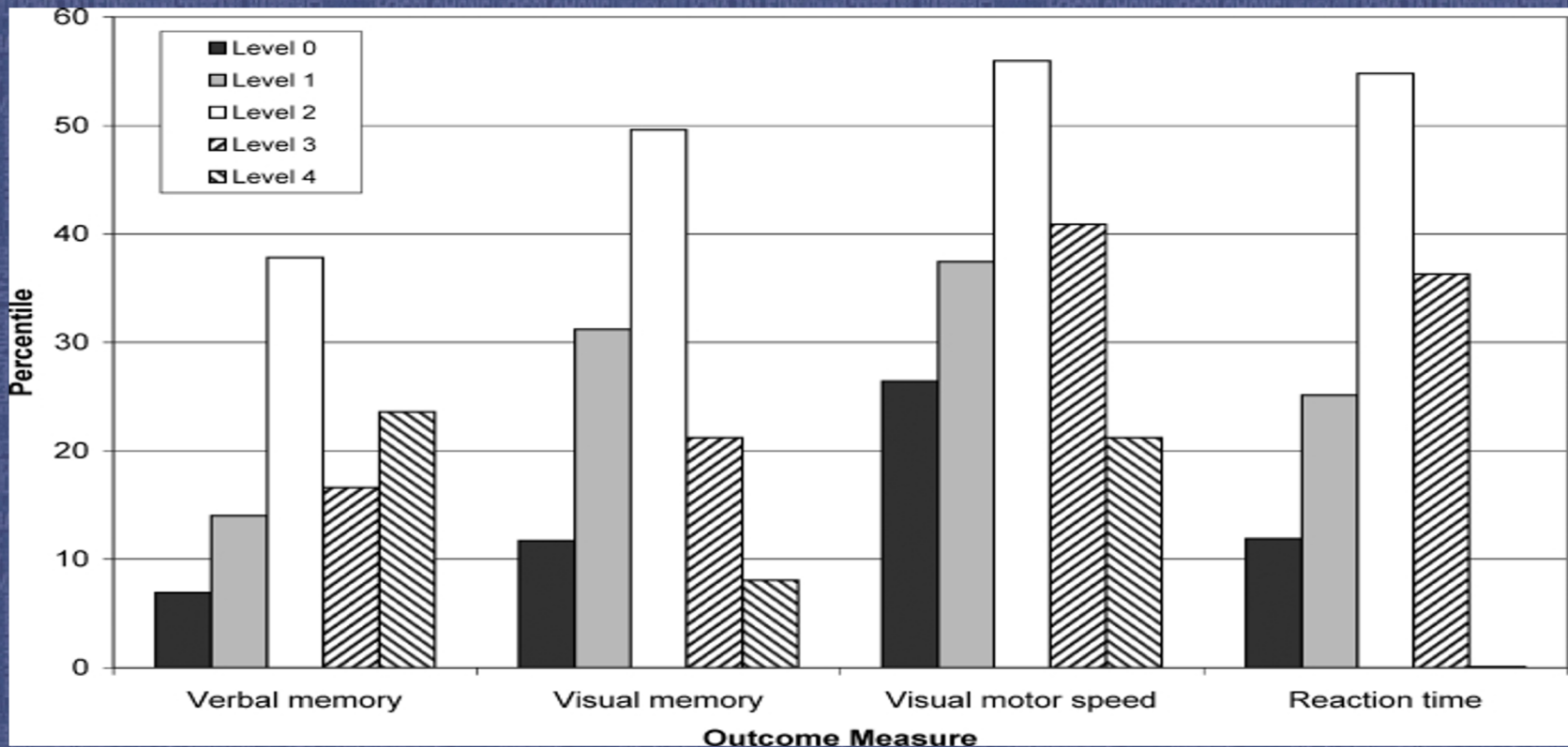- No running strips

USAFA

Treatment Options

- ## Active Rehabilitation
    - After acute phase of injury (24-48 hrs)
    - Must be mindful of the symptom threshold

British Journal of Sports Medicine (2017):Rest and treatment/rehabilitation following sport-related concussion: a systematic review - Schneider KJ, Leddy JJ, Guskiewicz KM, et al.

Active Rehabilitation

Effects of exertion on recovery. Athletes participating in school activity and light activity at home (e.g., slow jogging, mowing the lawn) performed better than athletes experiencing other levels of exertion. Percentiles of time-adjusted mean scores were derived from the multivariate analysis. "Level" refers to the activity intensity scale in which 0 indicates no school or exercise activity and 4 indicates school activity and full sport participation.

Majerske, et. al., 2008
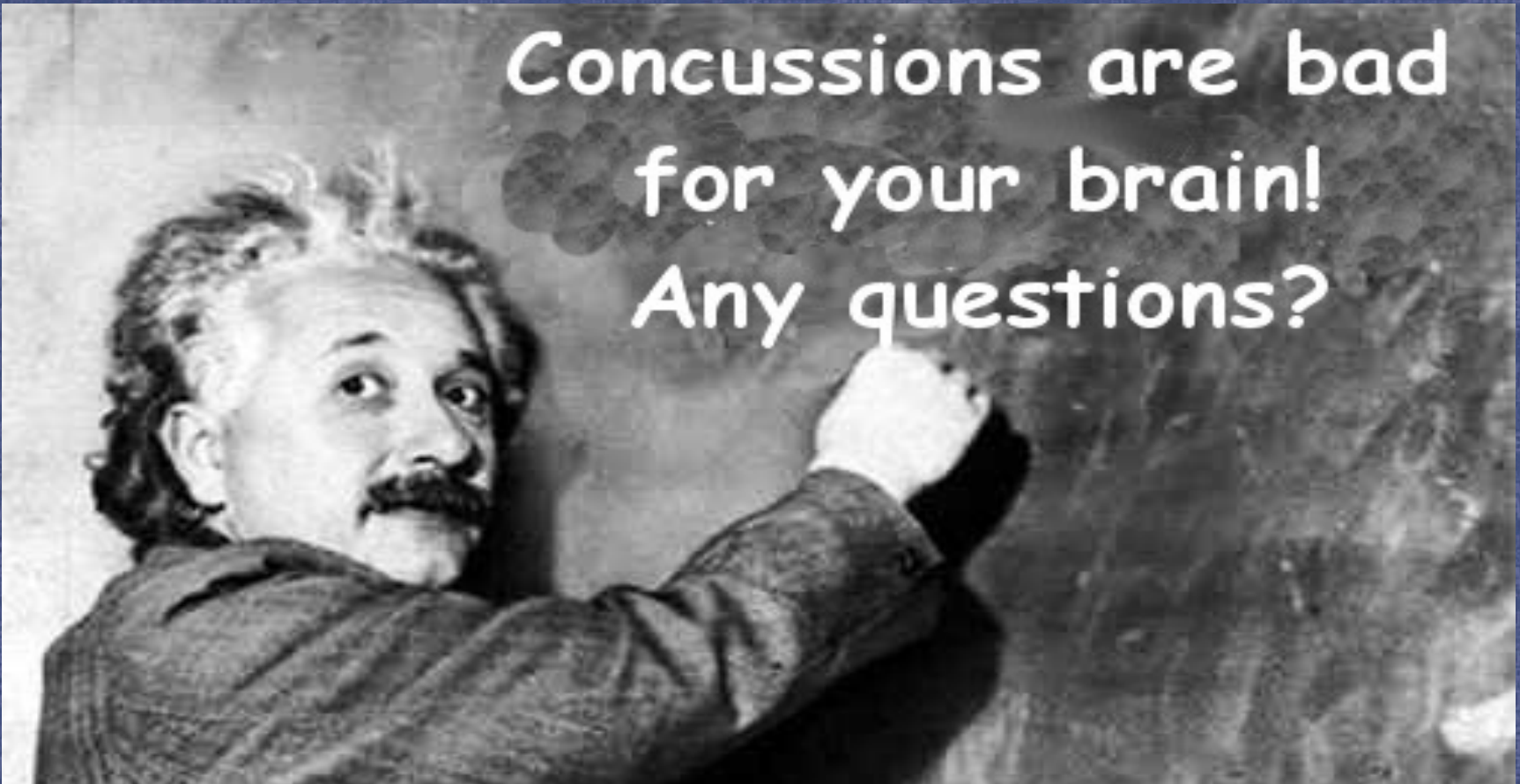
Take Home Points

Take Home Points

- Comprehensive holistic assessment to determine full extent of symptoms and deficits

- Serial follow up to monitor patients progress through the recovery process

- Concussions are not all the same!
  - Differentiating between different trajectories should lead to more specific treatment options and more efficient care

- Complexity: Multi-disciplinary approach is the most effective approach to treatment

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Questions?