



ImPACT Raw Data & Composite Scores

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Disclosure Statements

- The statements and opinions contained in this program are solely those of the presenter.
- Treatment options and tools presented are some of many that are available.
- All individuals in control of content disclosed no relevant financial relationships.
- Other CE disclosures can be found in your course information document.

Course Description

Master the raw data on the ImPACT clinical report, learn how to calculate the composite scores, and review the reliable change indices for each score. An overview of post injury testing guidelines will also be discussed.

Course Objectives: At the end of the course, the attendee should be able to:

- Restate best practices for post-injury testing
- Summarize how the ImPACT composite scores are calculated
- State the reliable change index for each composite score

Speaker Biography



Scott Burkhart, PsyD

Pediatric Sports Neuropsychologist
Children's Health Andrews Institute
Plano, TX

- Received BS and Doctorate of Psychology (2010) from George Fox University
- Held a clinical psychology and neuropsychology internship at Tewksbury Hospital
- Completed a two-year concussion fellowship at the University of Pittsburgh Medical Center Sports Concussion Program
- Served as the Clinical Director at the Tallahassee Orthopedic Clinic Concussion Center before joining Children's Health
- Specializes in the diagnosis, treatment, and management of concussion

What You Need for this Course:

1. Perfect Score Cheat Sheet
2. Sample Clinical Report
3. A Calculator

What is ImPACT?

- Clinically valid, reliable, useful
- A tool



ImPACT is Not:

- A stand-alone assessment
- Effective if the clinician is untrained
- A substitute for thorough medical evaluation





Post Injury Testing

Post Injury Testing Guidelines

- Environment
- Supervision
- Administered through Customer Center
- Serially 1 through 4



When to Give Post Injury 1

Concussion Management Protocol



Guiding Accommodations / Management



- Return to learn
- Return to play



Post Injury Scores > Baseline

- More conservative management
- Academic history





Reviewing the Clinical Report

Page 1

Demographics

Sample Report – P. 1



ImPACT Clinical Report

Webinar Sample

Name:	Passport ID:
Organization:	Age: 16
Date of birth:	Height: 69 inches
Gender: Male	Weight: 135
Handedness: Right	
Native Country/Region: US	Second Language: Spanish
Native Language: English	
Years of education completed excluding kindergarden:	Repeated one or more years of school: No
10	Diagnosed learning disability: No
Received speech therapy:	Problems with ADD/hyperactivity: Yes
No	
Attended special education classes:	
No	
Current sport: Wrestling	
Primary position/event/class: 130 lbs	
Current level of participation: High School	
Years of experience at this level: 0	
CONCUSSION HISTORY	
Number of times diagnosed with a concussion (excluding current injury): 0	Treatment for headaches by physician: No
	Treatment for migraine headaches by physician: No
	Treatment for epilepsy/seizures: No
	Treatment for substance or alcohol abuse: No
	Treatment for psychiatric condition (depression, anxiety): No
	Diagnosed with ADD/ADHD: Yes
	Diagnosed with dyslexia: No
	Diagnosed with autism: No
	History of meningitis: No
Total games missed as a result of all concussions combined: 0	Strenuous exercise in the last 3 hours: No

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Raw Scores

Sample Clinical Report - P. 3



ImPACT Clinical Report

Webinar Sample

WORD MEMORY

Hits (Immediate)	12	10	11		
Correct distractors (immed.)	12	12	12		
Learning percent correct	100%	92%	96%		
Hits (delay)	11	6	11		
Correct distractors (delay)	12	12	12		
Delayed memory % correct	96%	75%	96%		
Total percent correct	98%	83.5%	96%		

DESIGN MEMORY

Hits (Immediate)	11	10	12		
Correct distractors (immed.)	11	10	9		
Learning percent correct	92%	83%	88%		
Hits (delay)	11	10	11		
Correct distractors (delay)	11	9	12		
Delayed memory % correct	92%	79%	96%		
Total percent correct	92%	81%	92%		

X'S AND O'S

Total correct (memory)	11	8	11		
Total correct (interference)	122	117	124		
Average correct RT (interference)	0.48	0.51	0.45		
Total Incorrect (interference)	1	2	2		
Average incorrect RT (interference)	0.45	0.38	0.45		

SYMBOL MATCH

Total correct (visible)	26	27	27		
Average correct RT (visible)	1.25	1.5	1.26		
Total correct (hidden)	8	6	8		
Average correct RT (hidden)	1.88	1.89	1.6		

COLOR MATCH

Total correct (visible)	9	9	9		
Average correct RT (visible)	0.79	0.75	0.51		
Total commissions	0	0	0		
Average commissions RT	0	0	0		

THREE LETTERS

Total sequence correct	5	4	4		
Total letters correct	15	12	13		
% of total letters correct	100%	80%	86.67%		
Average time to first click	1.85	2.53	1.7		
Average counted	14.8	12.4	21		
Average counted correctly	14.6	12.4	21		

PAGE 3

Word Memory

- Instructions
- Scoring
- Distractor
- Immediate vs Delay

Lake

Was this one of the words displayed?

Yes

No

Word Memory

Hits (Immediate)	12	10	11
Correct distractors (immed.)	12	12	12
Learning percent correct	100%	92%	96%
Hits (delay)	11	6	11
Correct distractors (delay)	12	12	12
Delayed memory pct. correct	96%	75%	96%
Total percent correct	98%	83.5%	96%

Design Memory

- Instructions
- Scoring
- Main task
- Distractor
- Immediate vs Delay

Was this one of the designs displayed?



Yes

No

Design Memory

Hits (Immediate)	11	10	12
Correct distractors (immed.)	11	10	9
Learning percent correct	92%	83%	88%
Hits (delay)	11	10	11
Correct distractors (delay)	11	9	12
Delayed memory pct. correct	92%	79%	96%
Total percent correct	92%	81%	92%

X's & O's

- Instructions
- Scoring
- Memory vs Interference
- Reaction time

After the X's and O's are displayed, you will be asked to do a REACTION TIME or SPEED TEST. Below are the directions for the SPEED TEST. Remember, this is a sample. Do the following for each shape that you see:



Press this key on your keyboard as quickly as you can when you see:



Press this key on your keyboard as quickly as you can when you see:



PLEASE RESPOND AS FAST AS YOU CAN!

Click the Continue button to start the sample.

Continue

X's and O's

Total correct (memory)	11	8	11
Total correct (interference)	122	117	124
Avg. correct RT (interference)	0.48	0.51	0.45
Total incorrect (interference)	1	2	2
Avg. incorrect RT (interfer.)	0.45	0.38	0.45

Symbol Match

- Instructions
- Scoring
- Visible vs Hidden

Click on the number that corresponds to the following

D

↗	△	☰	D	+	∞	◊	○	□
1	2	3	4	5	6	7	8	9

Remember which number goes with each shape.

Symbol Match

Total correct (visible)	26	27	27
Avg. correct RT (visible)	1.25	1.5	1.26
Total correct (hidden)	8	6	8
Avg. correct RT (hidden)	1.88	1.89	1.6

Color Match

- Instructions
- Scoring
- Main task
- Distractor
- Color Blindness

Color Match

On the next screen, you will see the words RED, GREEN, and BLUE presented one at a time. Click the word inside the box when it is shown in the same color in which it is written. Do not click the word when it is shown in a different color.

For example:

Click as fast as you can when you see one of these:

RED GREEN BLUE

Do not click when you see these:

RED GREEN BLUE

We will start with a sample of the test to familiarize you with the process.

Click the button below when you are ready to begin the sample.

Continue

Color Match

Total correct	9	9	9
Avg. correct RT	0.79	0.75	0.51
Total commissions	0	0	0
Avg. commissions RT	0	0	0

Three Letters

- Instructions
- Scoring
- Average Counted vs Average Counted Correctly

16
8
11
14
23

19
6
7
1
21

5
20
12
22
24

25
17
9
2
13

15
18
10
3
4

Click each of these buttons in BACKWORD ORDER.

Start with 25 and count down to 1
AS FAST AS YOU CAN

If you make a mistake, use the 'Go Back' button to clear the buttons you have already clicked, one at a time.

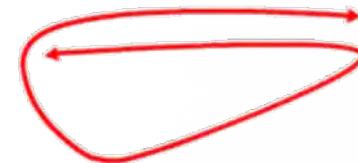
Three Letters

Total sequence correct	5	4	4
Total letters correct	15	12	13
Pct. of total letters correct	100%	80%	86.67%
Avg. time to first click	1.85	2.53	1.7
Avg. counted	14.8	12.4	21
Avg. counted correctly	14.6	12.4	21

End of Test

- Word Memory (delay)
- Design Memory (delay)
- Optional second set of symptoms

Was this one of the designs displayed?



Lake

Was this one of the words displayed?

Yes

No

Yes

No

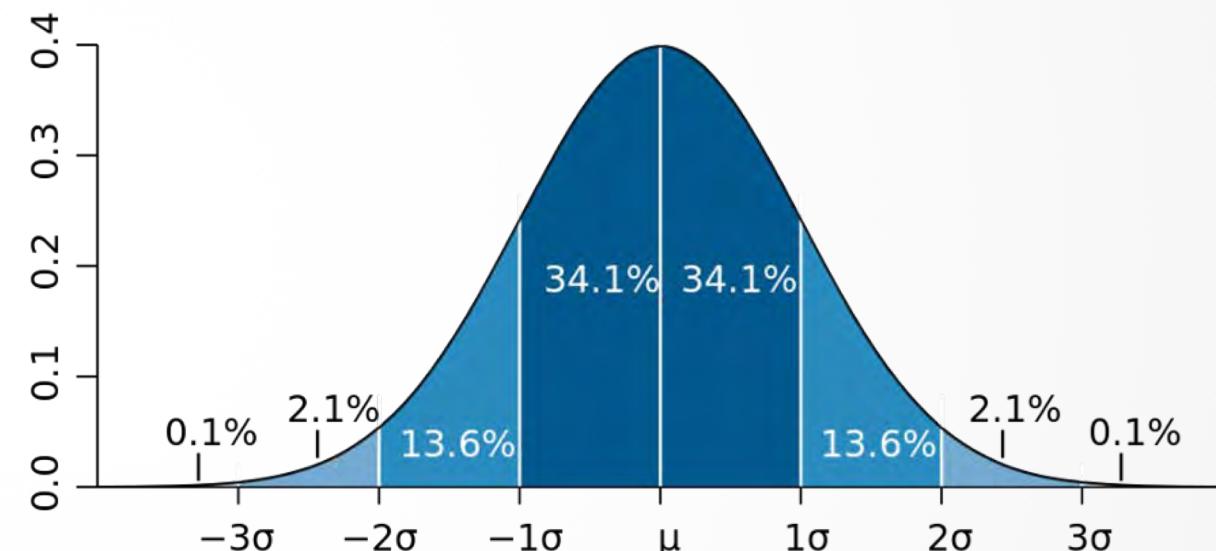
Composite Scores

Composite Scores

Memory composite (verbal)	96	88%	77	24%	90	70%
Memory composite (visual)	92	94%	74	44%	92	94%
Visual motor speed composite	37.15	41%	33.23	20%	47	83%
Reaction time composite	0.56	59%	0.59	44%	0.46	97%
Impulse control composite	1		2		2	
Total Symptom Score	3		22		0	

Percentile Ranges

Very Superior/Superior	92 nd - 99 th
High Average	76 th - 91 st
Average	25 th - 75 th
Low Average	9 th - 24 th
Borderline Impaired	2 nd - 8 th
Impaired	<1 st - 2 nd



If No Baseline

- Academic history
- Learning disability
- Symptoms and cognitive data



If No Baseline

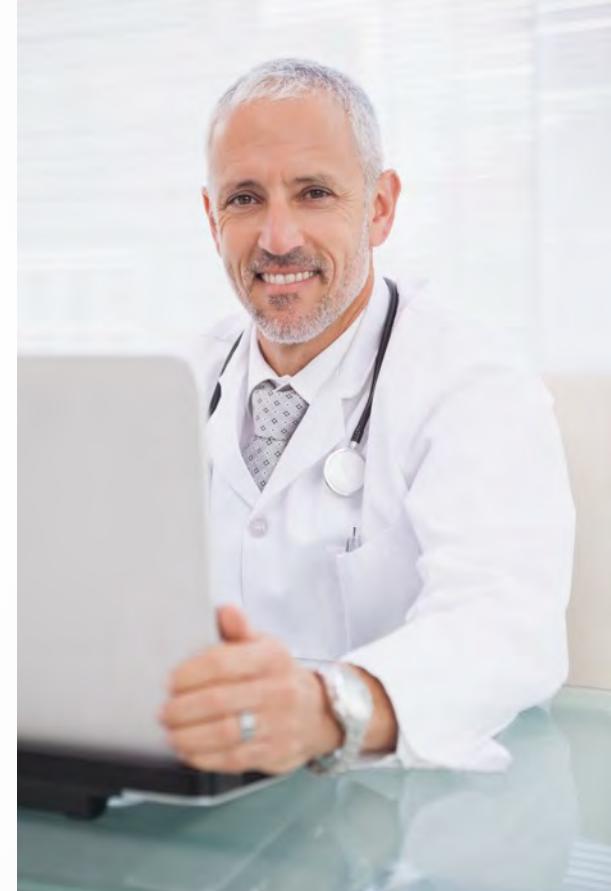
A/B student; high SAT	65 th - 75 th percentile or higher
B/C student; average SAT	35 th -45 th percentile or higher
D/F student; low SAT, LD	20 th percentile or higher

Optimal Raw Scores (Average to Above Average Students):

Verbal Memory Composite	90
Visual Memory Composite	80
Visual Motor Speed Composite	40.0
Reaction Time Composite	0.55
Impulse Control Composite	8-9

Reliable Change Index (RCI) Scores

- Statistically calculated
- Standard error of measurement



Reliable Change Index Scores

Meaningful Comparisons

Iverson et al, TCN 2005

ImPACT Domain	Mean	RCI 90% Confidence
<i>ImPACT Verbal Memory Score</i>		
Time 1	88.6	8.75
Time 2	88.8	
<i>ImPACT Visual Memory Score</i>		
Time 1	78.7	13.5
Time 2	77.5	
<i>ImPACT Processing Speed Score</i>		
Time 1	40.54	4.98
Time 2	42.24	
<i>ImPACT Reaction Time Score</i>		
Time 1	.543	.06
Time 2	.536	
<i>ImPACT Symptom Score</i>		
Time 1	5.23	9.6
Time 2	5.79	

Calculating Verbal Memory

Word Memory

Hits (Immediate)	12
Correct distractors (immed.)	12
Learning percent correct	100%
Hits (delay)	11
Correct distractors (delay)	12
Delayed memory pct. correct	96%
Total percent correct	98%

Symbol Match

Total correct (visible)	26
Avg. correct RT (visible)	1.25
Total correct (hidden)	8
Avg. correct RT (hidden)	1.88

Three Letters

Total sequence correct	5
Total letters correct	15
Pct. of total letters correct	100%
Avg. time to first click	1.85
Avg. counted	14.8
Avg. counted correctly	14.6

Word Memory	Total Percent Correct	98
Symbol Match	Total Correct	$8/9 = 0.88 *100$ 88.9
Three Letters	Pct. of Total Letters Correct	+ 100
	Subtotal	286.9
	Subtotal Divided by 3	95.6

Verbal Memory Composite Results

RCI of 8.75

Composite Scores

Memory composite (verbal)	96	88%	77	24%	90	70%
Memory composite (visual)	92	94%	74	44%	92	94%
Visual motor speed composite	37.15	41%	33.23	20%	47	83%
Reaction time composite	0.56	59%	0.59	44%	0.46	97%
Impulse control composite	1		2		2	
Total Symptom Score	3		22		0	

Calculating Visual Memory

Design Memory

Hits (Immediate)	11
Correct distractors (immed.)	11
Learning percent correct	92%
Hits (delay)	11
Correct distractors (delay)	11
Delayed memory pct. correct	92%
Total percent correct	92%

X's and O's

Total correct (memory)	11
Total correct (interference)	122
Avg. correct RT (interference)	0.48
Total incorrect (interference)	1
Avg. incorrect RT (interfer.)	0.45

Design Memory	Total Percent Correct	92%
X's & O's	Total Correct Memory	11/12 = 0.92*100
	Subtotal	92
	Subtotal Divided by 2	184

Visual Memory Composite Results

RCI of 13.55

Composite Scores

Memory composite (verbal)	96	88%	77	24%	90	70%
Memory composite (visual)	92	94%	74	44%	92	94%
Visual motor speed composite	37.15	41%	33.23	20%	47	83%
Reaction time composite	0.56	59%	0.59	44%	0.46	97%
Impulse control composite	1		2		2	
Total Symptom Score	3		22		0	

Calculating Visual Motor Speed

X's and O's

Total correct (memory)	11
Total correct (interference)	122
Avg. correct RT (interference)	0.48
Total incorrect (interference)	1
Avg. incorrect RT (interfer.)	0.45

Three Letters

Total sequence correct	5
Total letters correct	15
Pct. of total letters correct	100%
Avg. time to first click	1.85
Avg. counted	14.8
Avg. counted correctly	14.6

X's and O's	Total Correct (Interference)	122 / 4	30.5
Three Letters	Avg. Counted Correctly	14.6 * 3	+ 43.8
			Subtotal

Subtotal Divided by 2 **37.15**

Visual Motor Speed Composite Results



RCI of 4.98

Composite Scores

Memory composite (verbal)	96	88%	77	24%	90	70%
Memory composite (visual)	92	94%	74	44%	92	94%
Visual motor speed composite	37.15	41%	33.23	20%	47	83%
Reaction time composite	0.56	59%	0.59	44%	0.46	97%
Impulse control composite	1		2		2	
Total Symptom Score	3		22		0	

Calculating Reaction Time

X's and O's

Total correct (memory)	11
Total correct (interference)	122
Avg. correct RT (interference)	0.48
Total incorrect (interference)	1
Avg. incorrect RT (interfer.)	0.45

Symbol Match

Total correct (visible)	26
Avg. correct RT (visible)	1.25
Total correct (hidden)	8
Avg. correct RT (hidden)	1.88

Color Match

Total correct	9
Avg. correct RT	0.79
Total commissions	0
Avg. commissions RT	0

X's and O's	Avg correct RT (interference)	0.48
Symbol Match	Ave correct RT (visible)	1.25 / 3 0.42
Color Match	Avg. correct RT	+ 0.79
	Subtotal	1.69
	Subtotal Divided by 3	0.56

Reaction Time Composite Results

RCI of 0.06

Composite Scores

Memory composite (verbal)	96	88%	77	24%	90	70%
Memory composite (visual)	92	94%	74	44%	92	94%
Visual motor speed composite	37.15	41%	33.23	20%	47	83%
Reaction time composite	0.56	59%	0.59	44%	0.46	97%
Impulse control composite	1		2		2	
Total Symptom Score	3		22		0	

Calculating Impulse Control

X's and O's

Total correct (memory)	11
Total correct (interference)	122
Avg. correct RT (interference)	0.48
Total incorrect (interference)	1
Avg. incorrect RT (interfer.)	0.45

X's and O's

Color Match	Total Incorrect (Interference)	1
	Total Commissions	+ 0
	Total	1

Color Match

Total correct	9
Avg. correct RT	0.79
Total commissions	0
Avg. commissions RT	0

- Not a clinical scale like preceding scores
- **Functions as invalidity check at baseline if >30**

Impulse Control Composite Results

No RCI

Composite Scores

Memory composite (verbal)	96	88%	77	24%	90	70%
Memory composite (visual)	92	94%	74	44%	92	94%
Visual motor speed composite	37.15	41%	33.23	20%	47	83%
Reaction time composite	0.56	59%	0.59	44%	0.46	97%
Impulse control composite	1		2		2	
Total Symptom Score	3		22		0	

Cognitive Efficiency Index

- Not a composite score or clinical scale
- Symbol Match ONLY
- Speed vs. Accuracy

Cognitive Efficiency Index: **0.52** **0.33** **0.52**

The Cognitive Efficiency Index measures the interaction between accuracy (percentage correct) and speed (reaction time) in seconds on the Symbol Match test. This score was not developed to make return to play decisions but can be helpful in determining the extent to which the athlete tried to work very fast on symbol match (decreasing accuracy) or attempted to improve their accuracy by taking a more deliberate and slow approach (jeopardizing speed). Low scores (0 to .20) may in some cases suggest a very poor performance on this subtest.

Scores in **bold RED** type exceed the Reliable Change Index (RCI) when compared to the baseline score. However, scores that do not exceed to RCI index may still be clinically significant. Percentile scores if available are listed in small type.

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- Symptom Score
- RCI of 9.18



ImPACT Clinical Report

Webinar Sample

SYMPTOMS SCORE

Headache	0	1	2	0	0		
Nausea	0	1	0	0	0		
Vomiting	0	0	0	0	0		
Balance Problems	0	1	0	0	0		
Dizziness	0	2	1	0	0		
Fatigue	0	4	0	0	0		
Trouble falling asleep	3	0	N/A	0	N/A		
Sleeping more than usual	0	0	N/A	0	N/A		
Sleeping less than usual	0	0	N/A	0	N/A		
Drowsiness	0	0	2	0	0		
Sensitivity to light	0	0	0	0	0		
Sensitivity to noise	0	2	0	0	0		
Irritability	0	0	0	0	0		
Sadness	0	0	0	0	0		
Nervousness	0	0	0	0	0		
Feeling more emotional	0	0	0	0	0		
Numbness or tingling	0	1	0	0	0		
Feeling slowed down	0	3	1	0	0		
Feeling mentally foggy	0	3	2	0	0		
Difficulty concentrating	0	4	2	0	0		
Difficulty remembering	0	0	2	0	0		
Visual problems	0	0	0	0	0		
Total Symptom Score	3	22	12	0	0		

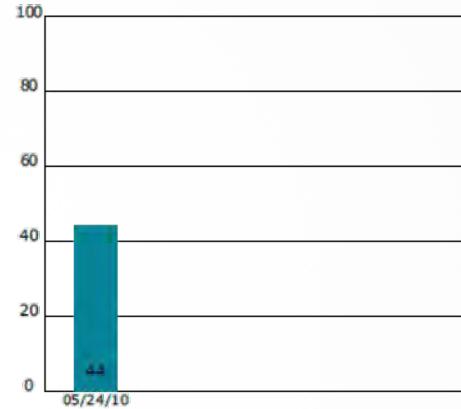
First column displays symptoms immediately before test

The ImPACT Symptom Increase Score

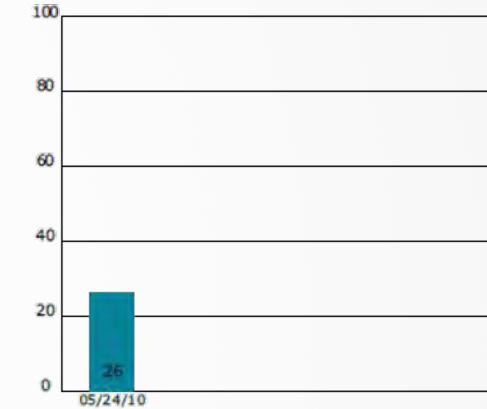
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Bar Graphs of Composite Scores & Symptom Scores to Compare

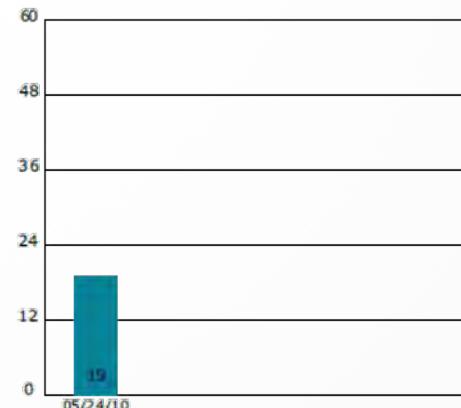
Memory Composite (Verbal)



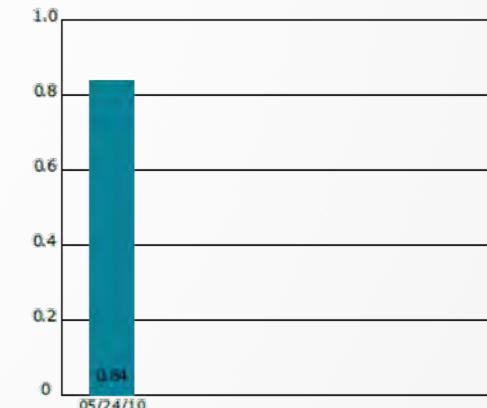
Memory Composite (Visual)



Visual Motor Composite



Reaction Time Composite



Potential Error – X's and O's

X's and O's

Total correct (memory)	12
Total correct (interference)	6
Avg. correct RT (interference)	0.5
Total incorrect (interference)	102
Avg. incorrect RT (interfer.)	0.62

Mixing Up P & Q on Keyboard

Composite Scores

Memory composite (verbal)	96	88%
Memory composite (visual)	92	94%
Visual motor speed composite	21.75	<1%
Reaction time composite	0.56	59%
Impulse control composite	1	
Total Symptom Score	3	

Potential Error – Color Match

Color Match

Total correct	9
Avg. correct RT	0.28
Total commissions	18
Avg. commissions RT	0.37

0.01 – 0.40 Color Match Average Correct Reaction Time

Composite Scores

Memory composite (verbal)	96	88%
Memory composite (visual)	92	94%
Visual motor speed composite	21.75	<1%
Reaction time composite	0.37	100%
Impulse control composite	1	
Total Symptom Score	3	

Potential Error – Three Letters

**Counting Forward
From 1-25 Instead of
Backward**

Three Letters

Total sequence correct	4	5	4
Total letters correct	13	15	13
Pct. of total letters correct	86.67%	100%	86.67
Avg. time to first click	1.42	1.51	1.53
Avg. counted	15.2	13.6	17.6
Avg. counted correctly	0.2	0	0

Composite Scores

Memory composite (verbal)	77	29%	84	29%	87	66%
Memory composite (visual)	74	49%	82	49%	81	69%
Visual motor speed composite	13.43	<1%	14.5	<1%	14.5	<1%
Reaction time composite	0.63	36%	0.54	36%	0.49	95%
Impulse control composite	5		4		11	
Total Symptom Score	9		8		2	

Resources

- ConcussionManagement.com
- cdc.gov/concussion

Question

How do we account for a color blind athlete?

Question

If the last post injury is the new baseline, will that be reflected in the report if they have another concussion?

Question

Is there any research that says we should not test post-exercise? Should testing either pre or post injury occur before any type of workout for the day?

Question

How do we account for an athlete with an IEP and severe learning disabilities and difficulty taking the test?

Question

An athlete's baseline test showed a composite score in the "<1 percentile" but was not flagged as an invalid test. How is that possible?

Question

To what extent do you review baseline tests and how often do you have to do it?

Question

Do you have suggestions for getting the fewest invalid baseline tests from our athletes that we test in a group setting?

Question

What happens if an athlete's composite scores fall within the Reliable Change Indices (RCI), but are below the baseline score?

Question

When would you start physical exertion / return to play progression?

Question

Which is more important to you as a clinician: the individual test results or the composite scores?

What if individual results look OK, but composites poor?

Question

When we be referring an athlete for more comprehensive neuropsychological evaluation?

Question

How do you manage a concussion when the post-injury scores are lower than baseline scores?

Question

What do I do if an athlete repeatedly tests as invalid on their baseline?

Question

How often do you wait between subsequent post-injury tests?



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