

# MYBRAINTEST



## Computerized Concussion Testing

Best Practices for Sports Teams and School Athletic Departments  
A Guide for Coaches, Athletic Trainers, Physicians, and Parents

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## About This Guide

A number of high profile cases involving long term risks of concussions in professional sports such as the National Football League and National Hockey League, along with countless local media stories highlighting the negative effects of concussions in high school and collegiate sports have spurred sports concussion legislation at the state level.

State legislation will typically require mandatory concussion management policies that school administrators and athletic departments are responsible for implementing, including:

- Education of coaches, parents, athletes on concussion signs and symptoms
- Removal from play of any athlete suspected of having sustained a concussion
- Require written authorization from a medical professional before the athlete can return to practice/game

Many schools are opting for computerized cognitive testing for all players as part of a concussion management process.

This guide is intended to provide a useful framework for schools and athletic departments to consider:

- Implementing pre-season baseline cognitive testing
- Post injury testing options
- Return to play guidelines

A product guide to computerized concussion testing systems, with sample baseline reports, is included at the end of this guide. Concussion testing products included are:

- Axon Sports
- Concussion Vital Signs
- HeadMinder CRI
- ImPACT Applications

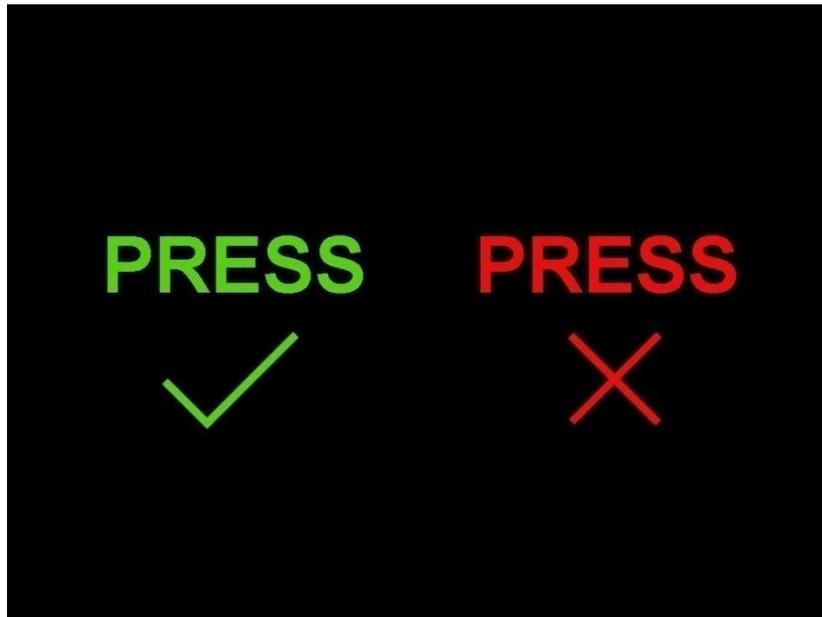
## Computerized Cognitive Testing Overview

Computerized cognitive testing is an outgrowth of efforts in neuroscience, psychology, and cognitive research labs in the 70s and 80s to computerize well known paper and pencil cognitive tests. The basic research lab environment created a cottage industry of sorts, with hundreds of computerized tests for memory/recall, attention/vigilance, reaction time, verbal learning, and executive function being created independently from one another. These efforts have also resulted in a number of new, computer-only cognitive tests.

There are also some fairly recent additions to computerized cognitive testing systems for concussions that offer the capability for widespread general use, through standard packaged cognitive test batteries with a common scoring and reporting format. Most of these concussion testing batteries rely on the following basic cognitive tests (test names and descriptions will vary based on vendor implementation and commercial packages):

### **Go/No-Go Response Inhibition Test**

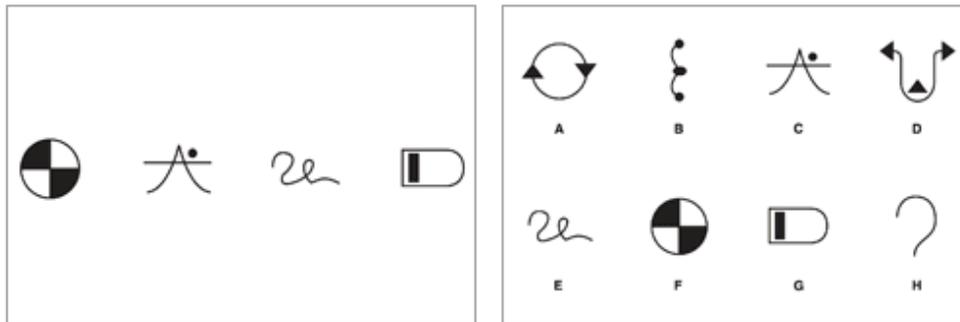
- measures attention and executive function



*Go/No-Go* reaction tasks require that the subject press a button when one stimulus type appears and withhold a response when another stimulus type appears. For example, the subject may have to press the button when a green box appears and not respond when a red box appears.

## Verbal and Pattern Recognition/Delayed Recall Test

- measures learning retention and memory



Delayed recall tests require the subject to learn a series of words or symbols at the beginning of the cognitive battery. The subject is then tested on memory recall for the words or symbols later in the battery.

## Stroop Interference Test

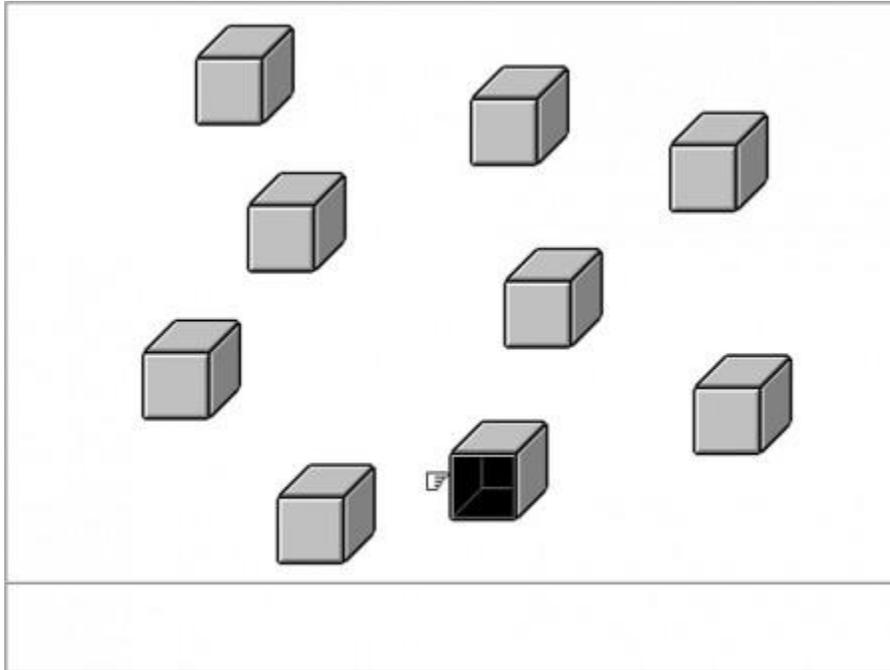
- measures attention and executive function

**PURPLE YELLOW RED**  
**BLACK RED GREEN**  
**RED YELLOW ORANGE**  
**BLUE PURPLE BLACK**  
**RED GREEN ORANGE**

The Stroop test is another kind of response inhibition test. The task takes advantage of our ability to read words more quickly and automatically than we can name colors. If a word is printed or displayed in a color different from the color it actually names; for example, if the word "green" is written in blue ink we will say the word "green" more readily than we can name the color in which it is displayed, which in this case is "blue."

## Spatial Working Memory Test

- measures attention and executive function



Based on variations of the Corsi Block Test, subjects must remember the order of blocks that light up, and then repeat the sequence in forward or reverse order.

### Automatic Recording-Scoring on Computerized Concussion Tests

One of the primary benefits of computerized concussion testing batteries is the standardized recording and scoring of test results with software that is included in the testing systems. Concussion testing batteries measure accuracy, reaction time, and processing speed on the tests, using algorithms to produce detailed baseline and re-test scores.

Automatic recording and scoring on concussion testing batteries is far more efficient than the pencil and paper approach, and also tends to be more reliable, especially compared to self-reporting symptoms.<sup>(1)</sup>

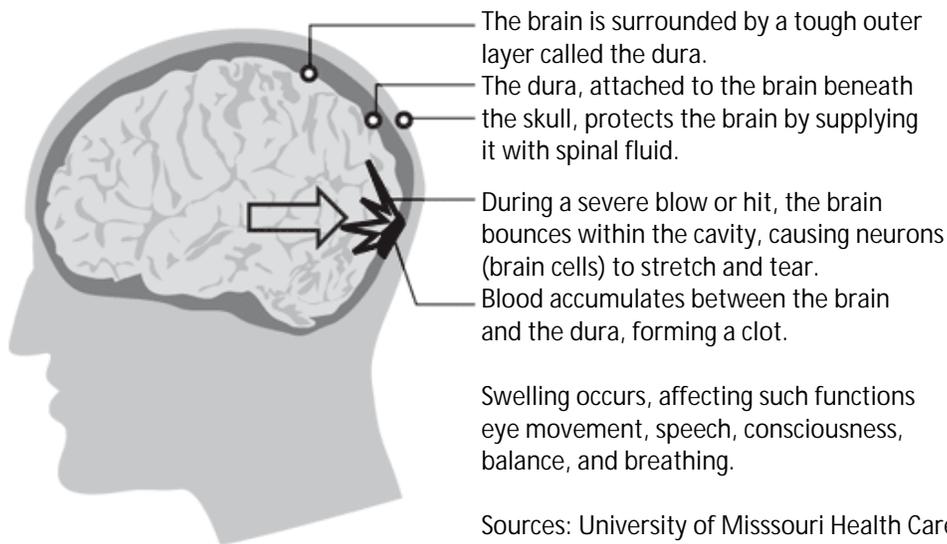
Special attention should be paid to collecting **valid baseline cognitive test scores**, covered in detail beginning on page 15.

## Concussion Signs and Symptoms

A concussion is a type of traumatic brain injury that is caused by a blow to the head, a fall, or another injury that physically shakes or quickly rotates the brain inside the skull. Although there may be cuts or bruises on the head or face, there may be no other visible signs of a brain injury.

### Injury on Impact

A concussion may result when the head strikes an object or is struck by an object. Concussions may produce unconsciousness or bleeding in or around the brain.



Sources: University of Missouri Health Care  
National Institutes of Health (NIH)

### Pay Attention to these Signs and Symptoms

Signs Observed by Coaching Staff	Symptoms Reported by Athlete
Appears dazed or stunned	Headache or “pressure” in head
Confused about assignment/position	Balance problems or dizziness
Forgets sports plays	Double or blurry vision
Is unsure of game, score, or opponent	Sensitivity to light
Moves clumsily	Sensitivity to noise
Answers questions slowly	Feeling sluggish, foggy, or groggy
Loses consciousness (even briefly)	Concentration or memory problems
Shows behavior/personality changes	Confusion
Can’t recall events prior or after hit	Does not “feel right”
<b>Source: CDC</b>	

## Why Monitor and Test for Concussions?

The obvious answer is to protect the health of student athletes. In addition, there are two important legal and science research areas that help promote the idea of testing and monitoring sports concussions:

### State Legislation Mandates for School Sports Concussion Policies

Over 30 states will have enacted laws regarding school sports concussion policies by the end of 2011, with many other states planning to pass sports concussion legislation in 2012. School administrators and athletic departments are responsible for implementing the intent of these laws, which typically include:

- Education of coaches, parents, athletes on concussion signs and symptoms
- Removal from play of any athlete suspected of having sustained a concussion
- Require written authorization from a medical professional before the athlete can return to practice/game

### Emerging Research on Concussion Recovery Time & Process

Recent research on concussions and traumatic brain injury (TBI) point to new and important data to consider:

A study published in the Journal of Head Trauma Rehabilitation analyzed results from almost 400 high school and collegiate football players during the 2008-2009 playing season in Milwaukee, WI. A total of 28 players sustained concussions during the playing season, and were monitored using Quantitative EEG (QEEG) recording, balance & body control systems, and cognitive testing.<sup>(2)</sup>

The QEEG results showed that ***abnormal readings in the concussed players continued long after more traditional clinical tests (balance testing and cognitive testing) for concussions came back “clean”***. These results point to more evidence that there is a “recovery window” in the brain as it heals from a concussion that might be significantly longer than most athletic trainers and physicians have traditionally assumed.

Given the above research example, along with many other studies,<sup>(3,4,5,6)</sup> proactive baseline testing and monitoring for sports concussions should be considered by all school athletic programs.

# Evaluating and Choosing a Computerized Concussion Testing System

There are a number of computerized concussion testing systems available for sports teams and school athletic departments to consider, when implementing a baseline cognitive testing process as part of an overall concussion detection and management policy.

MyBrainTest suggests that the following five key questions be addressed when evaluating computerized concussion testing (CCT) systems. (See available CCT systems beginning on the next page.)

## Evaluation Guide and Checklist

Computerized Concussion Testing (CCT) Systems
<b>Question 1:</b> Is the CCT system backed by published, peer reviewed research data? (PubMed, <a href="http://www.pubmed.gov">www.pubmed.gov</a> , is an unbiased repository)
<b>Question 2:</b> Has the CCT system been tested with a large number of target-age subjects (mid- teens to mid-20s at a minimum)? The test results from this age group are important to establishing reliable test norms. (The CCT vendor should be able to provide detailed normative test range information.)
<b>Question 3:</b> Does the CCT system include a standardized software algorithm for scoring cognitive test results? The CCT vendor should be able to provide detailed information on cognitive test score components, and how an overall (global) test score index is computed.
<b>Question 4:</b> Does the CCT system have a documented process for detecting invalid baseline and post injury cognitive test results? Invalid tests may result from deliberate low effort (sandbagging), distractions during the test battery, or a multitude of other causes.
<b>Question 5:</b> Does the CCT system include clear, simple instructions for the test subject, and a standard test instruction script for administrators? A common, standardized approach to administering cognitive tests will result in more reliable baseline scores.

# MYBRAINTEST

MyBrainTest is a research and advisory service for the cognitive health assessment and testing market, and the larger neurodiagnostic industry. There are at least 1.4 million cases of concussions and traumatic brain injuries each year in the US, with children and young adults comprising a large percentage. National standards for concussion/TBI detection, assessment, and rehabilitation need to be developed.

## **Computerized Concussion Testing**

### **Best Practices for Sports Teams and School Athletic Departments**

*A Guide for Coaches, Athletic Trainers, Physicians, and Parents*

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For more information on the report:

<http://www.mybraintest.org/product-reports/>

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