



## **The Best Approach To Concussion Management**

### **WHO WE ARE:**

ImPACT team members have dedicated the past 15 years to the scientific study of sports-related concussion and the clinical application of this knowledge throughout professional and amateur sports. ImPACT team members are widely acknowledged as world leaders in the field of concussion management and are committed to ongoing development of increasingly advanced concussion management tools.

### **WHAT WE DO:**

ImPACT is a sophisticated research-based software tool developed to help sports-medicine clinicians evaluate recovery following concussion. The ImPACT program evaluates and documents multiple aspects of neurocognitive functioning including memory, brain processing speed, reaction time and post-concussive symptoms. In addition, the ImPACT program provides a user-friendly injury documentation system that facilitates the tracking of the injury from the field through the recovery process.



The Best Approach To Concussion Management

Concussion is a **common injury** and is often a **difficult condition to diagnose and treat**. Most often, return to play decisions were made without the benefit of neuropsychological testing and were based on observation and player report of symptoms. **The ImPACT software package provides the sports medicine clinician with information that can help to take the guesswork out of concussion management and return-to-play decisions.**

Using a battery of tests of memory, reaction time & processing speed, ImPACT provides specific information regarding the severity of injury and a standard for evaluating recovery from injury.

The ImPACT software package consists a Self-Report Symptom Questionnaire (22 symptoms commonly associated with concussion), a Concussion-History Form that precedes the neuropsychological measures, and seven cognitive tests of cognitive functioning:

- *Attention Span*
- *Sustained Attention*
- *Non-verbal Problem Solving*
- *Visual Memory & Verbal Memory*
- *Working Memory*
- *Selective Attention*
- *Reaction Time*
- *Response Variability*



Welcome to ImPACT



**ImPACT**<sup>®</sup>

**Immediate Post-concussion Assessment and Cognitive Testing**

-  Start a new test
-  Print reports
-  Submit your data

▶ First Name
▶ Last Name
▶ Organization
▶ Height
▶ Weight
▶ Gender
▶ Handedness
▶ Country
▶ Native language
▶ Second language
- Years speaking
- Years in North America
▶ Years of education completed
▶ Check any of the following that apply
- Received speech therapy
- Attended special education classes
- Repeated one or more years of school
- Diagnosed ADD or Hyperactive
- Diagnosed learning disability
▶ Current sport
- Current position/event/class
- Current Level
▶ Years experience

**Identification**

Language/Lengua:

Enter the subject's identification number and date of birth below. If available, use the social security or social insurance number as the identification number. Otherwise, assign a unique identification number to the subject.

SSN/Identification #:

Date of Birth:  (MM/DD/YYYY)

**Language**

Native country/region:

Native language (or language group):

Second language (or language group):

Years speaking:

Years in North America:

Other Medical History

Indicate whether you have experienced the following:

Yes  No Treatment for headaches by physician

Yes  No Treatment for migraine headaches by physician

Yes  No Treatment for epilepsy/seizures

Yes  No History of brain surgery

Yes  No History of meningitis

Yes  No Treatment for substance/alcohol abuse

Yes  No Treatment for psychiatric condition (depression, anxiety)

Cancel << Previous Next >> Finish

Current Conditions

Date of last concussion:  (MM/DD/YYYY)  
(approximate if uncertain)

Hours of sleep last night:

Current medications:

Cancel << Previous Next >> Finish

■ Number of times diagnosed with a concussion

■ Total number of concussions that resulted in loss of consciousness

■ Total number of concussions that resulted in confusion

■ Total number of concussions that resulted in difficulty with memory for events occurring immediately after injury

■ Total number of concussions that resulted in difficulty with memory for events occurring immediately before injury

■ Total games were missed as a direct result of all concussions combined.

■ List the 5 most recent concussions

■ Indicate whether you have experienced the following

■ Treatment for headaches by physician

■ Treatments for migraine headaches

■ Treatment for epilepsy/seizures

■ History of brain surgery

■ History of meningitis

■ Treatment for substance/alcohol abuse

■ Treatment for psychiatric condition (depression, anxiety, etc.)



CURRENT SYMPTOMS
✓ Headache
✓ Nausea
✓ Vomiting
✓ Balance Problems
✓ Dizziness
✓ Fatigue
✓ Trouble falling asleep
✓ Sleeping more than usual
✓ Sleeping less than usual
✓ Drowsiness
✓ Sensitivity to light
✓ Sensitivity to noise
✓ Irritability
✓ Sadness
✓ Nervousness
✓ Feeling more emotional
✓ Numbness or tingling
✓ Feeling slowed down
✓ Feeling mentally foggy
✓ Difficulty concentrating
✓ Difficulty remembering
✓ Visual problems (blurry or double vision)

Current Health - Symptoms

Click the box or button below that indicates the degree to which you are **currently** experiencing the following symptom:

Headache

Not experiencing this symptom

1 2 3 4 5 6

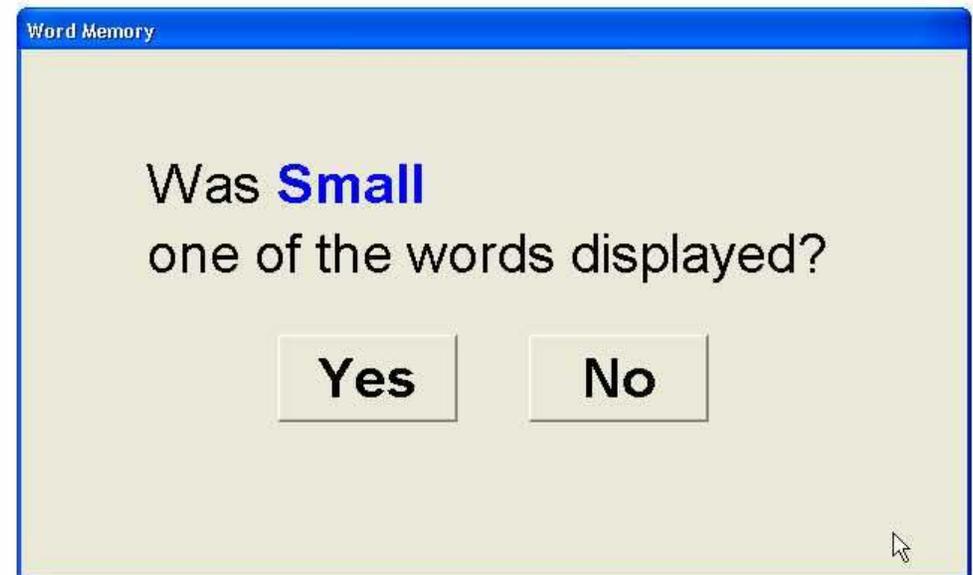
Minor Severe

Cancel << Previous Next >> Finish

## Module 1 (Word Discrimination)

- Evaluates attentional processes/verbal recognition memory
- Utilizes a word discrimination paradigm.
- Twelve target words are presented for 750 milliseconds (twice to facilitate learning of the list)
- The subject is then tested for recall via the presentation of the 24-word list that is:
  - ✓ comprised of 12 target words and 12 non-target words
  - ✓ Words chosen from the same semantic category as the target word.
  - ✓ EX: the word “ice” is a target word, while the word “snow” represents the non-target word.
  - ✓ The subject responds by mouse-clicking the “yes” or “no” buttons
  - ✓ Individual scores are provided both for correct “yes” and “no” responses -In addition, a total percent correct score is provided.
- There are five different forms of the word list.

**Delay Condition:** *Following the administration of all other test modules (approximately 20 minutes), the subject is again tested for recall via the same method described above. The same scores that are described above are provided for the delay condition.*



## Module 2 (Design Memory)

- Evaluates attentional processes and visual recognition memory
- Utilizes a design discrimination paradigm.
- Twelve target designs are presented for 750 milliseconds (twice to facilitate learning)
- The subject is then tested for recall via the presentation of the 24-designs

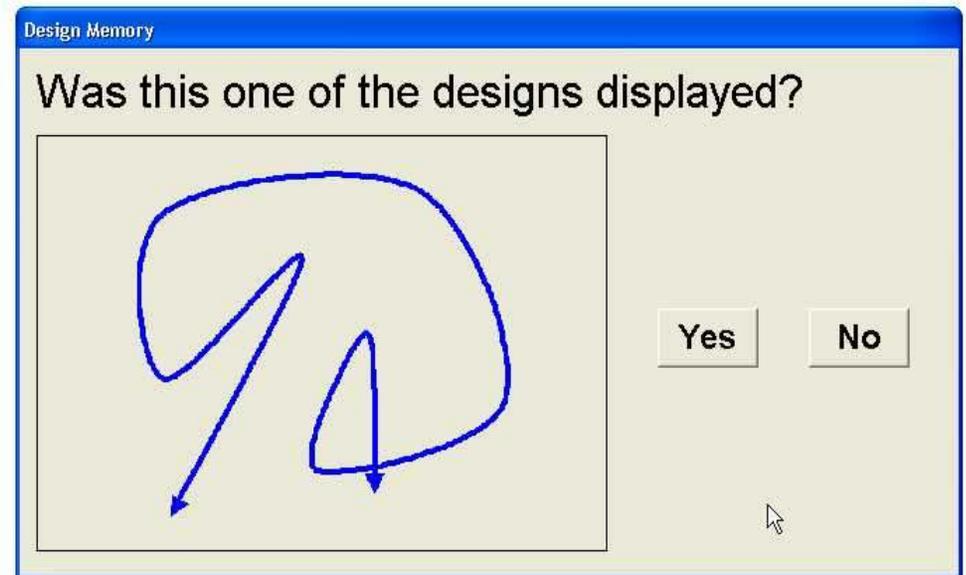
✓ comprised of 12 target designs and 12 non-target designs

✓ EX: target designs that have been rotated in space

✓ The subject responds by mouse-clicking the “yes” or “no” buttons

✓ Individual scores are provided both for correct “yes” and “no” responses

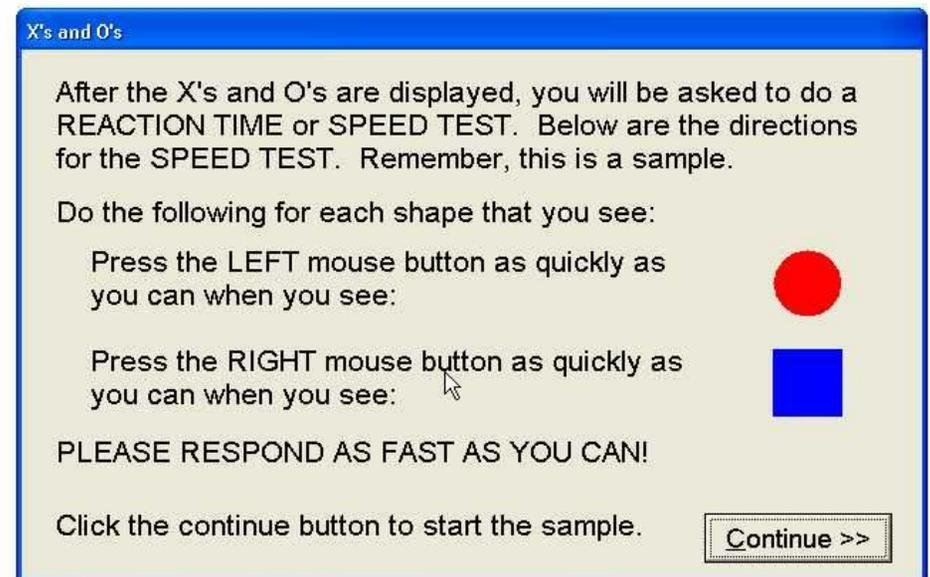
✓ In addition, a total percent correct score is provided



- There are five different forms of this task

## Module 3 (X's and O's)

- Measures visual working memory, visual processing speed, and visual memory paradigm
  - Incorporates a distractor task.
  - The subject can practice the distractor task prior to presentation of the memory task
  - The distractor is a choice reaction time test: the subject is asked to click the left mouse button if a blue square is presented and the right mouse button if a red circle is presented.
  - Once the subject has completed this task, the memory task is presented.
- ✓ Memory task: a random assortment of X's and O's is displayed for 1.5 seconds
  - ✓ For each trial: three of the X's or O's are illuminated in YELLOW (the subject has to remember the location of the illuminated objects).
  - ✓ Immediately after the presentation of the 3 X's or O's, the distractor task re-appears on the screen.
  - ✓ Following the distractor task, the memory screen (X's and O's) re-appears and the subject is asked to click on the previously illuminated X's and O's.
  - ✓ Scores are provided for correct identification of the X's and O's (memory), reaction time for the distractor task, and number of errors on the distractor task.

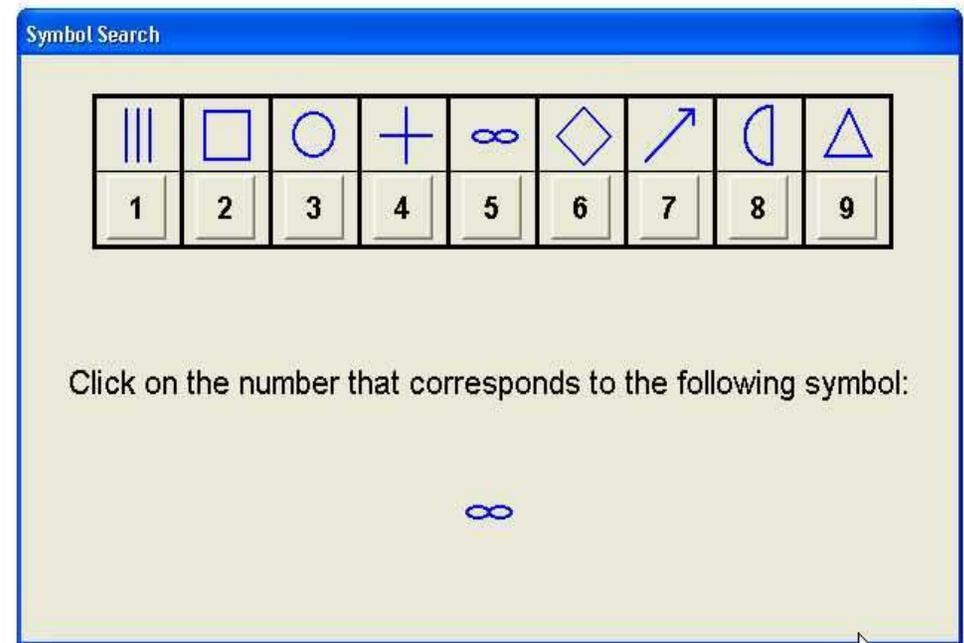


- For each administration of ImPACT, the subject completes 4 trials.

## Module 4 (Symbol Matching)

- Evaluates **visual processing speed, learning and memory**
- Initially, the subject is presented with a screen that displays 9 common symbols (triangle, square, arrow, etc).
- Directly under each symbol is a number button from 1 to 9
- .Below this grid, a symbol is presented.

- ✓ The subject is required to click the matching number as quickly as possible and to remember the symbol/number pairings
- ✓ Correct performance is reinforced through the illumination of a correctly clicked number in GREEN. Incorrect performance illuminates the number button in RED.
- ✓ Following the completion of 27 trials, the symbols disappear from the top grid.
- ✓ The symbols again appear below the grid and the subject is asked to recall the correct symbol/number pairing by clicking the appropriate number button.



- This module provides an average **reaction time score** and a score for the **memory condition**.

## Module 5 (Color Match)

- Represents a choice **reaction time** task and measures **impulse control/response inhibition**
  - First, the subject is required to respond by clicking a red, blue or green button as they are presented on the screen. This procedure is completed to assure that subsequent trials would not be affected by color blindness
  - Next, a word is displayed on the screen in the same colored ink as the word (e.g. **RED**), or in a different colored ink (**GREEN** or **BLUE**)
- ✓ The subject is instructed to click in the box as quickly as possible only if the word is presented in the matching ink.
- In addition to providing a **reaction time** score, this task also provides an **error score**.

Color-Word Match

This is a test of SPEED or REACTION TIME.

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 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: RED or GREEN or BLUE

Do not click when you see: RED or GREEN or BLUE

Click this button when you are ready to begin: Continue >>

### Module 6 (Three letters)

- Measures **working memory** and **visual-motor response speed**
- First, the subject is allowed to practice a distractor task
- ✓ Consists of 25 numbered buttons (5 x 5 grid).
- ✓ The subject is instructed to click as quickly as possible on the numbered buttons in backward order starting with “25.” (has an initial practice task)
- ✓ Then they are presented with three consonant letters displayed on the screen.
- ✓ Immediately following display of the 3 letters, the numbered grid re-appears and the subject is instructed to click the numbered buttons in backward order, again
- ✓ After a period of 18 seconds, the numbered grid disappears and the subject is asked to recall the three letters by typing them from the keyboard.
- ✓ Both the number placement on the grid and letters displayed are randomized for each trial.
- Yields a **memory score** (total number of correctly identified letters) and a score for the average number of correctly clicked numbers per trial from the distractor test.
- Five trials of this task are presented for each administration of the test.

Three Letters (Pass 1 of 5)

Click each of these buttons in BACKWARD ORDER.

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

3	19	14	22	17
23	13	8	4	5
16	20	2	7	10
21	11	18	12	9
1	15	25	24	6

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

<< Go back

## *Injury Description*

- Following the first evaluation of the athlete following a concussion, the professional who is conducting the evaluation is asked to describe the characteristics of the injury and treatment undertaken, if any.
- The mouse is used to identify appropriate descriptors of the injury (e.g. duration of loss of consciousness, retrograde amnesia, on-field symptoms) as well as a description of evaluation and treatment, if any (e.g. CT, MRI, emergency room visit, etc.).
- This section also tracks other potentially important information such as whether or not a dental protection device (mouth guard) was utilized.

## Composite Summary of Results

In addition to the individual scores for each module described, ImPACT 2.0 also yields summary composite scores for Verbal Memory, Visual Memory, Reaction Time, Processing Speed and Impulse Control.

## Numeric Display of all Composites over Time

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### **ImPACT® Clinical Report**

*ImPACT Applications*

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Exam Type:	Baseline	Post-concussion	Post-concussion	Post-concussion
Date Tested:	09/04/02	01/28/03	02/03/03	02/05/03
Last Concussion:		01/27/03	01/27/03	01/27/03

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#### Composite Scores

Memory composite (Verbal)	96 %	66 %	84 %	90 %
Memory composite (Visual)*	78 %	65 %	61 %	84 %
Visual motor speed composite	32.85	16.05	15.25	32.55
Reaction time composite	0.50	0.63	0.53	0.53
Impulse control composite	7	120	15	9

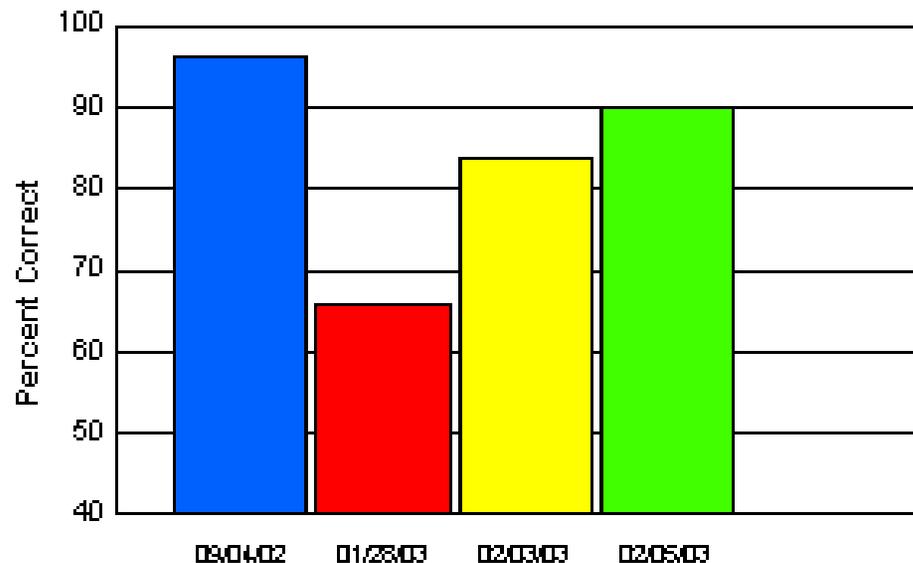
## Verbal Memory Composite

Is comprised of the average of the following scores:

- 1) Total percent correct score from Module 1 (Word Discrimination)
- 2) Total correct hidden symbols from Module 4 (Symbol Matching)
- 3) Percent of total letters correct from Module 6 (3 Letters)

## Graphic Display of Verbal Memory Composite over time

**Memory Composite (Verbal)**



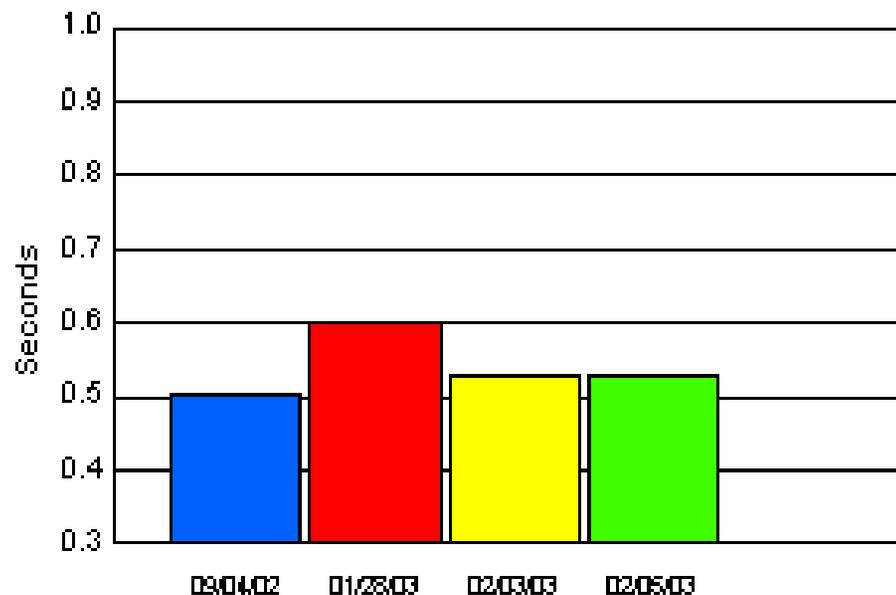
## Reaction Time Composite

Is comprised of the average of the following scores:

- 1) Average Correct RT of interference stage of module 3 (X's & O's)
- 2) Average Correct RT /3 of module 4 (Symbol Match)
- 3) Average Correct RT of module 5 (Color Match)

## Graphic Display of Reaction Time Composite over time

**Reaction Time Composite**



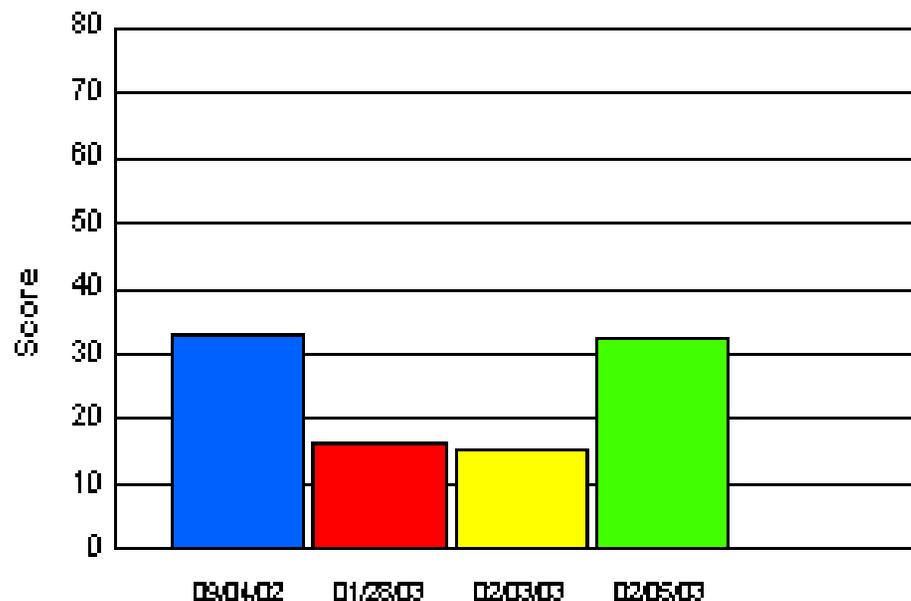
## Processing/Visual Motor Speed Composite

Is comprised of the average of following scores:

- 1) Total number correct /4 during interference of module 3 (X's & O's)
- 2) Average counted correctly x3 from countdown phase of module 6 (3 Letters)

## Graphic Display of Processing/Visual Motor Speed Composite over time

**Visual Motor Speed Composite**



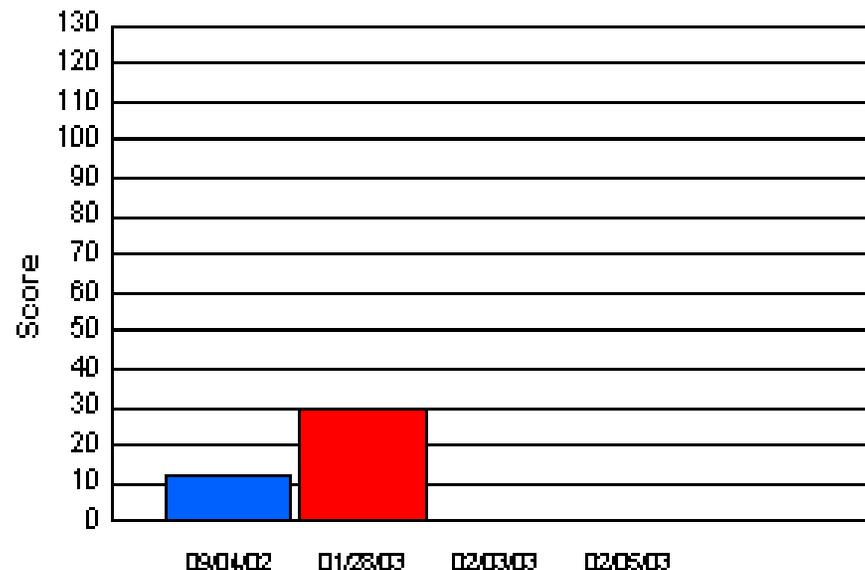
CURRENT SYMPTOMS
✓ Headache
✓ Nausea
✓ Vomiting
✓ Balance Problems
✓ Dizziness
✓ Fatigue
✓ Trouble falling asleep
✓ Sleeping more than usual
✓ Sleeping less than usual
✓ Drowsiness
✓ Sensitivity to light
✓ Sensitivity to noise
✓ Irritability
✓ Sadness
✓ Nervousness
✓ Feeling more emotional
✓ Numbness or tingling
✓ Feeling slowed down
✓ Feeling mentally foggy
✓ Difficulty concentrating
✓ Difficulty remembering
✓ Visual problems (blurry or double vision)

### Total Symptom Composite

Is also displayed graphically. This score represents the total for all 22-symptom descriptors.

### Graphic Display of Total Symptom Composite over time

Symptom Score



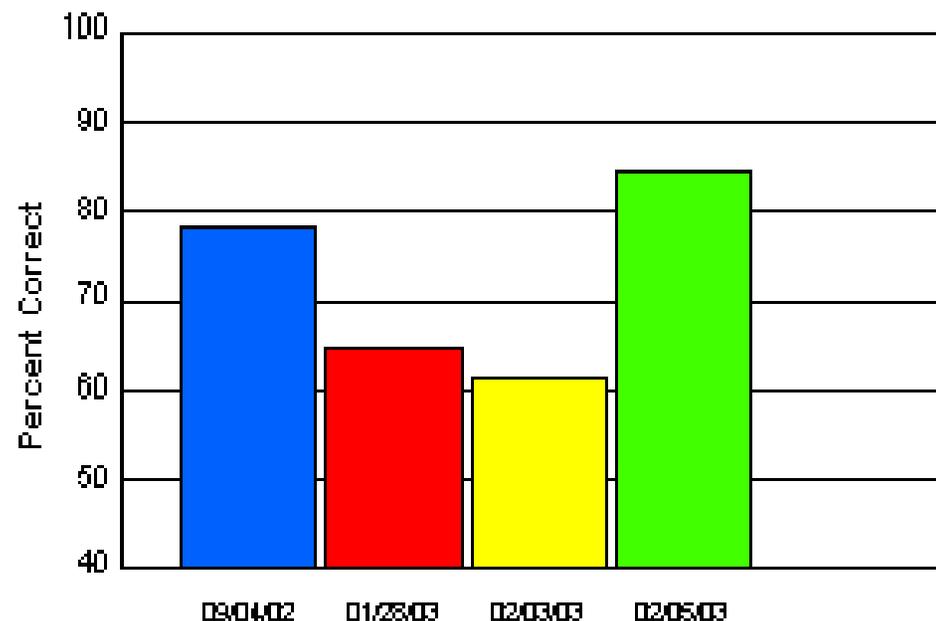
## Visual Memory Composite

This score represents a new composite score for ImPACT 2.0, which is currently undergoing field-testing. **Clinical decisions should not be based on this composite score until data is available.** This score in its current form is comprised of the average of:

- 1) Total percent correct score from module 2 (Design Memory)
- 2) Total correct-memory score from module 3 (X's & O's)

## Graphic Display of Visual Memory Composite over time

Memory Composite (Visual)



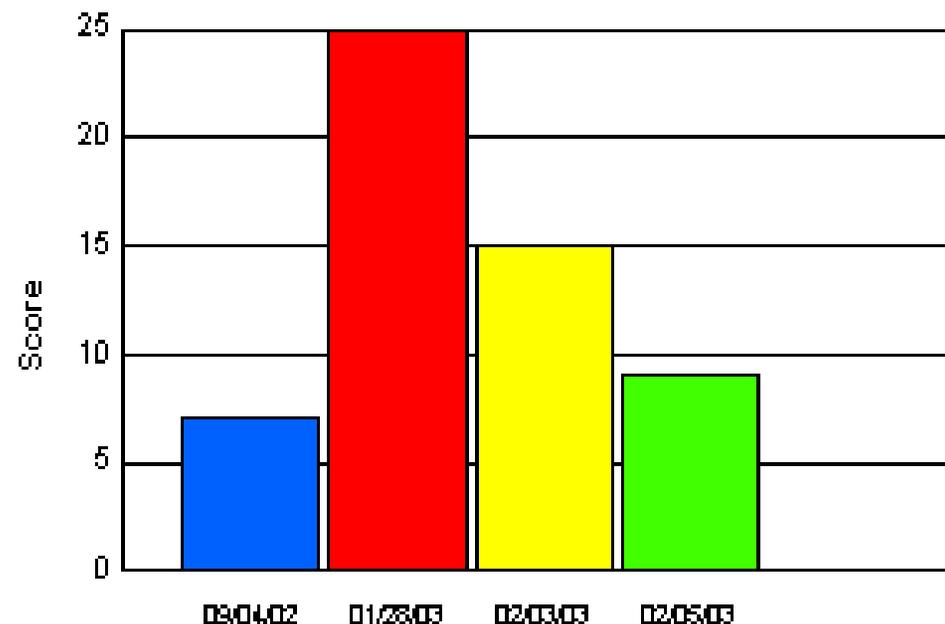
## Impulse Control Composite

This score indicates the sum of errors committed during different phases of the test and while it clinical decisions should not be based on this composite, its inclusion may help in the interpretation of other composites. This score is obtained by adding:

- 1) Total errors on the interference phase of module 3 (X's & O's)
- 2) Total commissions from module 5 (Color Match)

## Graphic Display of Impulse Control Composite over time

**Impulse Control Composite**





**The Best Approach To Concussion Management**

**Developed following years of university-based research:**

- Valid and Reliable
- Sensitive to Subtle Changes in Brain Function
- Easy to Administer
- Baseline and Post-Injury Testing
- Comprehensive Clinical Report
- Utilized Throughout Professional and Amateur Sports:
  - ✓ 24 NFL Teams
  - ✓ IRL, CHAMP CAR & Formula One
  - ✓ USA Women's Olympic Hockey
  - ✓ USA Women's Hockey
  - ✓ 1000 + High Schools
  - ✓ 250 + Sports Medicine Centers
  - ✓ Professional Hockey
  - ✓ Professional Baseball
  - ✓ International Rugby
  - ✓ Swedish World Cup Soccer
  - ✓ 300 + Universities
  - ✓ 150 + Neuropsychology Clinics



## The Best Approach To Concussion Management

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