

What is the Impact Test?

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.

Measures player symptoms

Computer administered

Can be administered on a lap-top for easy access and administration

Assists physicians and athletic trainers in making difficult return-to-play decisions

Permits individual and group administration

Provides reliable baseline test information

Results can be E-mailed or Faxed for fast consultation by a Neuropsychologist

Produces comprehensive report of test results

Automatically stores data from repeat testing

Measures attention, memory, processing speed and reaction time

Reaction time measured to 1/100th of second

ImPACT© 2.0 is a user-friendly, Windows-based computer program that can be administered by a team coach, athletic trainer or physician with minimal training. Reaction time is reliably measured to one hundredth of a second across individual test modules (10 modules total) and allows for an assessment of processing speed as the player fatigues. The test battery consists of a near infinite number of alternate forms by randomly varying the stimulus array for each administration. This feature was built in to the program to minimize the "practice effects" that have limited the usefulness of more traditional neurocognitive tests. ImPACT takes approximately 20 minutes to complete. The program measures multiple aspects of cognitive functioning in athletes, including:

I. Demographic and Background Information

II. Symptoms

III. Neurocognitive Testing

Module 1 (Word Discrimination)

Module 2 (Design Memory)

Module 3 (X's and O's)

Module 4x (Visual Attention Span)

ImPACT 1.0 only-This module has been removed for version 2.0.

Module 4 (Symbol Matching)

Module 5 (Color Match)

Module 6 (Three letters)

IV. Injury Description

V. Graphic Display of Data

Test Module Descriptions

ImPACT is a user-friendly, Windows-based computer program that can be administered by a team coach, athletic trainer or physician with minimal training. Reaction time is reliably measured to one hundredth of a second across individual test modules (10 modules total) and allows for an assessment of processing speed as the player fatigues. The test battery consists of a near infinite number of alternate forms by randomly varying the stimulus array with each administration. This feature was built in to the program to minimize the "practice effects" that have limited the usefulness of more traditional neurocognitive tests. ImPACT takes approximately 20 minutes to complete. This computer program measures multiple aspects of cognitive functioning in athletes, including:

- Attention span- Working memory- Sustained and selective attention time
- Response variability- Non-verbal Problem Solving- Reaction time

I. Demographic and Background Information

ImPACT requires the subject to input basic demographic and descriptive information through a series of easy to follow instructional screens. The subject inputs this information via the keyboard and utilizes an external mouse to navigate/select responses on the screen. Many of the questions in this section can be answered through the use of windows "pull down" screens. This section asks the subject to answer questions regarding height, weight, sport, position, concussion history, history of learning disabilities and other important descriptive information. The subject is asked to input a 9 digit ID number, which is typically the social security number. This provides unique identification of each subject within the user's database. Once the demographic information recorded at the time of the first evaluation, subsequent evaluations do not require entry of this information as the computer automatically pulls up the original record.

II. Symptoms

This section of ImPACT requires the subject to rate the current severity of 20 concussive symptoms, via a 7-point Likert scale. This is accomplished via the use of the external mouse that is utilized to complete other sections of ImPACT. Individual scores are provided as well as a graphic representation of the symptom total score.

III. Neurocognitive Testing

Module 1 (Word Discrimination)

This module evaluates attentional processes/verbal recognition memory and utilizes a word discrimination paradigm. Twelve target words are presented for 750 milliseconds on the computer screen. This word list is presented twice to facilitate learning of the list. At the end of the second presentation of the list, the subject is tested for recall via the presentation of the 24-word list that is comprised of 12 target words and 12 non-target words that have been chosen from the same semantic category as the target word. For example, 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 on the screen. 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)

This module evaluates attentional processes and visual recognition memory and utilizes a design discrimination paradigm. Twelve target designs are presented for 750 milliseconds on the computer screen. This sequence is presented twice to facilitate learning. At the end of the second presentation of the list, the subject is tested for recognition via the presentation of 24-designs comprised of 12 target designs and 12 non-target designs (target designs that have been rotated in space). Similar to the word recognition task, the subject responds by mouse-clicking the "yes" or "no" buttons on the screen. 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. Design memory is a new experimental task for ImPACT 2.0. New normative data regarding this test is currently available on our web site.

Module 3 (X's and O's)

This module measures visual working memory as well as visual processing speed and consists of a visual memory paradigm with a distractor task. The subject is allowed to practice the distractor task prior to presentation of the memory task. The distractor is a choice reaction time test during which 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. For each of the trials of the memory task, a screen is displayed for 1.5 second that has a computer generated random assortment of X's and O's. For each of the trials, three of the X's or O's are illuminated in YELLOW on the screen. The subject is asked to remember the location of the illuminated objects. The X's and O's that are illuminated are randomized by the computer for each trail and for each administration of the test. 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)

This module 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)

This module represents a choice reaction time task and also 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.

Module 6 (Three letters)

This module measures working memory and visual-motor response speed. First, the subject is allowed to practice a distractor task, which 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." Once the subject has completed this initial practice task, he/she is presented with three consonant letters that are displayed on the screen. Immediately following display of the three letters, the numbered grid re-appears and the subject is instructed to click the numbered buttons in backward order as quickly as possible. 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. This module 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.

IV. 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.

V. Graphic Display of Data

In addition to the individual scores for each module described above, ImPACT 2.0 also yields summary composite scores for Verbal Memory, Visual Memory, Reaction Time, Processing Speed and Impulse Control. ImPACT 1.0 yields the following composite scores: Memory, Reaction Time, Processing Speed, and Impulse Control.

Following is a summary of the composition of the ImPACT 2.0 composite scores.

Verbal Memory Composite ...is comprised of the average of the following scores: 1) Total memory percent correct; 2) Symbol Match-Total correct hidden symbols and; 3) Three-letters total percent of total letters correct.

Reaction Time Composite ...is comprised of the average of the following scores: 1) X's and O's-Avg. correct RT (interference); 2) Symbol Match-Avg correct RT/3 and; 3) Color Match-Avg. correct RT.

Processing Speed Composite ...is comprised of the average of following scores: 1) X's and O's-total correct (interference)/4; 2) Three-letters-Avg. counted correctly*3.

Total Symptom Composite Score...is also displayed graphically. This score represents the total for all 22-symptom descriptors.

Visual Memory Composite...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 are available. This score in its current form is comprised of the average of the Design memory —total percent correct score and the X's and O's-total correct-memory score.

This series of graphs allows direct comparison of test performance in these core areas across multiple testing sessions. The composite scores were constructed to provide summary information regarding different broad cognitive domains. Thus far, studies have indicated that all composite scores accuracies discriminate concussed from non-concussed control subjects.

ImPACT 2.0 has been designed to integrate data from previous versions into the new report format. This allows 1.0 user's to keep baseline testing data that was acquired using earlier versions of the software. ImPACT 2.0 software can therefore be installed in the same folder as ImPACT 1.0 and automatically "read" the previous data. In other words, when ImPACT 2.0 is installed on a computer that contains ImPACT 1.0 data, the newer program transfers the ImPACT 1.0 data into the new composite score format.