



A LOOK AT THE MOST COMMON REASONS AN ATHLETE DOESN'T EARN AN ACCEPTABLE BASELINE TEST RESULT

By Dr. David Darby, Neurologist, Axon Sports Medical Consultant

Changes in cognitive performance can be quite subtle after concussion. Detecting these as sensitively as possible depends upon an Athlete giving their best effort at Baseline testing. There are many reasons why an Athlete may not obtain an “acceptable” Baseline result and the counseling that is appropriate may vary depending upon the reason. This article outlines the most common reasons, their underlying causes and the counseling tips that might be most appropriate for the testing supervisors.

GENERAL RECOMMENDATIONS

Environment: For all initial unacceptable results, review the testing environment. Optimal concentration is only possible if the Athlete tests in a distraction-free environment, and they are rested, relaxed and comfortable. So, for any first Baseline test result with a “try again” message, it’s worth considering whether there were distractions or reasons why the Athlete was uncomfortable, and then attempt to remedy these for their next attempt. For example, if the Athlete was tested in a group setting (such as a computer lab), then consider whether they were influenced by other Athletes, and whether testing them alone in a quiet room or using noise-cancelling headphones would be better. Also remember Athletes should have slept well, turned off cell phones and been to the restroom if appropriate.

Do a Practice test: Knowing what the test includes without the stress of a recorded score can reduce testing anxiety, facilitate familiarization with the tasks and help optimize Athletes’ performance. Even though Athletes may be told to complete a Practice test (available without charge on the Axon Sports home page), it is possible they did not do one prior to their first scored test. Suggesting a two- to three-minute time out to complete a Practice test can help them perform better both overall and for specific tasks.

Keep them motivated: All cognitive testing depends upon the cooperation of the Athlete. The more motivated they are to do well, the more likely they will concentrate and put forth a best effort. There are clearly different strategies for different ages and types of personalities of Athletes including:

- a general rule that Athletes will not be allowed to train, spar or play competitively until they have an acceptable Baseline test result, and
- for older Athletes, post reaction time results on notice boards for team members to promote friendly competition between them. (who’s faster?)

Education about sandbagging: Some Athletes clearly consider doing poorly at Baseline testing with the idea that in the event of a concussion they will be cleared to play sooner. This can be countered by counseling up front:

- accurate Baseline testing can often clear an Athlete of persistent cognitive impairment earlier than if there is inaccurate or no cognitive testing;
- the aim of cognitive testing is to protect their future brain health, so why would they want to put themselves at risk;
- the test contains methods for detecting deliberately poor performance, and
- if they don’t get an acceptable Baseline test result, they will have to do the test again!

What if all these measures have been considered and the Athlete still hasn’t passed the Baseline? To put this into perspective, our research shows that about 14 percent of Athletes do not get an acceptable Baseline test result on their first attempt. This varies depending upon the test setting (higher with less strict supervision), gender (higher with some groups of males), and numerous other factors. However, it drops markedly down to about 1.6 percent on the second attempt, and only 0.6 percent on the third attempt. An advantage of the Axon Sports CCAT is the immediate feedback the Athlete will see after completing the test. A dialog will show a red “X” for an unacceptable attempt and a green “checkmark” for an acceptable Baseline test performance. This way, the Athlete knows right away that they will need to re-test and can decide to do the test immediately if they wish.

In all these scenarios there are common patterns. We suggest a review of speed and accuracy results to identify strategy errors. Here are some examples.

COMMON STRATEGY ERRORS

Accuracy is too low

Accuracy for the Processing Speed and Attention tasks is usually near 100 percent (called a “ceiling effect”). Therefore, if an Athlete makes even a few mistakes their accuracy will fall, and will be flagged as too low. The most common mistakes made are “anticipations,” in which an Athlete responds before the card has turned over. The test itself gives feedback that these are errors by an error sound and a spoken “Go slower” instruction, and in addition, another trial is scheduled at the end of the task to try to get a correct non-anticipatory response to replace this error. Most Athletes understand the error feedback and avoid anticipating, but some will persist, raising the possibility of attention or impulse control disorders. The following report is an example.



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Baseline Test Report

This is not a Medical Diagnosis. After Injury reports should be interpreted only by a qualified Medical Provider and are intended solely to give the Provider additional information about an athlete's cognitive function.



Athlete Information

Name: _____
 Birth Year: _____
 Age: 20
 Gender: Female
 Dominant Hand: Right
 Test Date: 1 Oct 2010
 Test Time: 12:10 PM
 Test Duration: 660 seconds
 Expiration Date*: 30 Sep 2011
 Test ID: 2292

*While acceptable Baseline test results will be compared to After Injury tests, new Baseline tests are strongly recommended every year.

Integrity Checks

Processing Accuracy > 90% (87%) **x**
 Attention Accuracy > 80% (88%) **✓**
 Learning Accuracy > 53% (81%) **✓**
 W. Memory Accuracy > 53% (94%) **✓**
 Processing Speed < Attention Speed **✓**
 Processing Speed < W. Memory Speed **✓**

Note: This is not a Medical Diagnosis. After Injury reports should be interpreted only by a qualified Medical Provider and are intended solely to give the Provider additional information about an athlete's cognitive function. "Acceptable" means only that a Baseline score on a particular test is statistically within normal ranges. It does not guarantee that the Computerized Cognitive Assessment Tool (CCAT) results are an accurate measure of a particular athlete's cognitive function. Many factors can influence the quality and validity of CCAT results, including low motivation, distractions during test taking, emotional distress, lack of sleep, etc. A Baseline test should be repeated if it is suspected that such factors may have impaired the testing process.

Test Results

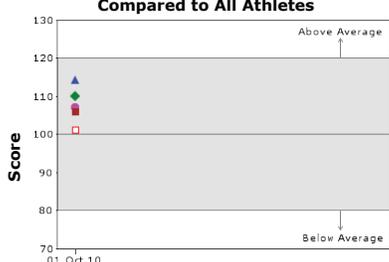
| Task | Score | Acceptable |
|--------------------------------|------------|------------|
| Processing Speed | 107 | x |
| Speed ¹ | 270 ms | |
| Accuracy ² | 87.0% | |
| Hits ³ | 40 | |
| Misses ⁴ | 6 | |
| Anticipations ⁵ | 6 | |
| Attention | 114 | ✓ |
| Speed ¹ | 355 ms | |
| Accuracy ² | 88.2% | |
| Hits ³ | 30 | |
| Misses ⁴ | 4 | |
| Anticipations ⁵ | 0 | |
| Learning | 111 | ✓ |
| Speed ¹ | 769 ms | |
| Accuracy ² | 80.7% | |
| Hits ³ | 71 | |
| Misses ⁴ | 17 | |
| Anticipations ⁵ | 0 | |
| Working Memory Speed | 107 | ✓ |
| Speed ¹ | 569 ms | |
| Working Memory Accuracy | 102 | ✓ |
| Accuracy ² | 93.5% | |
| Hits ³ | 29 | |
| Misses ⁴ | 2 | |
| Anticipations ⁵ | 0 | |

1. A higher value indicates a slower response
 2. A higher value indicates a better performance
 3. A higher value indicates a better response
 4. A higher value indicates a poorer performance
 5. Threshold is 1.65 standard deviations computed from age-based within-subject standard deviation
Note: Cognitive test results are standardized around a mean of 100 with a standard deviation of 10. All data is compared to age-matched normative baseline.

Explanation

The accuracy of responses need to be better. Please try again.

Compared to All Athletes



Warning: Taking this test will not prevent head injury. For more information on test reports and their meaning, visit axonsports.com. **Traumatic brain injury and concussion are very serious medical conditions. If it is suspected that an athlete may have sustained such an injury, they should immediately seek the care of a doctor. Only a doctor can safely make a decision on whether an athlete has sustained a traumatic brain injury or concussion or whether an athlete is ready to return to sports or school.** This report's sole purpose is to give doctors additional information about an athlete's cognitive function. Test data and results are to be interpreted by doctors and are never a substitute for their expert medical judgment. This report does not provide a medical diagnosis and return to play decisions must consider all clinical signs and symptoms, history of concussion, and the results of any other investigations undertaken (eg, MRI or CT scans). Many factors can influence the quality and validity of CCAT test results, including low motivation, distractions during test taking, emotional distress, lack of sleep, etc. A Baseline or After Injury test should be repeated if it is suspected that such factors may have impaired the testing process.

Questions? If you have questions regarding this test, please feel free to contact us customerservice@axonsports.com. You can also call us at 1.877.399.2966 between 8 am and 8 pm CST. Please be advised that our customer service representatives are not authorized nor able to provide medical counsel or advice of any kind. Such issues should be discussed with a doctor.

Note that the integrity checks section show an “X” beside the Processing Speed accuracy criterion which should be greater than 90 percent, but her score is less than this at 87 percent. The middle column shows she made six anticipations. In this example, it's also noteworthy that she did not anticipate in the later tasks. This suggests she might not have been familiar with the tasks before doing this test, since she has had trouble only on the first (and easiest) task. Counseling to be a little less impulsive led to fewer anticipations and an acceptable Baseline test result.

For Processing Speed, Attention and Working Memory tasks, an Athlete's speed is compared to age-based normative data, and this is depicted in the top graph “compared to all Athletes” with slower speeds than average falling below 100. For Learning, speed is not shown on the normative graph but is usually slower than all other tasks.

Accuracy is low and speed is too fast

Some Athletes may show a low accuracy and a very fast mean reaction time. This is associated with responses that bear little regard for the onscreen card behavior. In the following example, the Athlete has failed integrity checks for Learning because of near chance level accuracy. In addition, she was probably just hitting the keys without thinking about whether she had seen the card before. This is likely because her speed is much faster than we usually see with the Learning task (here 484ms, whereas it is normally about 800-900ms). She has done well, however, on the other tasks. This Athlete either does not understand the Learning task or has given up on it.

| | |
|--|--|
| <p>Birth Year:</p> <p>Age: 17</p> <p>Gender: Female</p> <p>Dominant Hand: Right</p> <p>Test Date: 31 Aug 2010</p> <p>Test Time: 08:21 PM</p> <p>Test Duration: 536 sec</p> <p>Expiration Date*: 30 Aug</p> <p>Test ID: 1566</p> <p><small>*While acceptable Baseline test results will be compared to previous tests, new Baseline tests are strongly recommended every year.</small></p> <p>Integrity Checks</p> <p>Processing Accuracy > 90% (97%)</p> <p>Attention Accuracy > 80% (86%)</p> <p>Learning Accuracy > 53% (53%)</p> <p>W. Memory Accuracy > 53% (81%)</p> <p>Processing Speed < Attention Speed</p> <p>Processing Speed < W. Memory Speed</p> <p>Note: This is not a Medical Diagnosis. After Injury reports should be interpreted only by a qualified Medical Provider and are intended solely to give the Provider additional information about an athlete's cognitive function. "Acceptable" means only that a Baseline score on a particular test is statistically within normal ranges. It does not guarantee that the Computerized</p> | <p>Processing Speed 99</p> <p>Speed¹ 338 ms</p> <p>Accuracy² 97.3%</p> <p>Hits³ 36</p> <p>Misses⁴ 1</p> <p>Anticipations⁴ 1</p> <hr/> <p>Attention 107</p> <p>Speed¹ 428 ms</p> <p>Accuracy² 85.7%</p> <p>Hits³ 30</p> <p>Misses⁴ 5</p> <p>Anticipations⁴ 0</p> <hr/> <p>Learning 88</p> <p>Speed¹ 484 ms</p> <p>Accuracy² 52.6%</p> <p>Hits³ 50</p> <p>Misses⁴ 45</p> <p>Anticipations⁴ 4</p> <hr/> <p>Working Memory Speed 107</p> <p>Speed¹ 572 ms</p> <p>Working Memory Accuracy 90</p> <p>Accuracy² 80.6%</p> <p>Hits³ 25</p> <p>Misses⁴ 6</p> <p>Anticipations⁴ 0</p> |
|--|--|

Very fast response speed

In this case, specific counseling about the Learning task and how to do well on it was associated with an improvement in Learning accuracy to 76 percent and mean reaction time to 871ms (a much more normal performance overall). Also, remember only a few cards repeat themselves during the Learning task and always within seven to 10 cards, so the task, though still hard, is not as hard as it might first appear (particularly toward the end!).

Very slow speed

Very slow responses are also not likely to be optimal performances. The following is an example where all the speed measures are exceptionally slow and the Athlete has traded speed for accuracy. This Athlete's report was flagged as not acceptable and they repeated the test after counseling that both speed and accuracy are important. He then scored more normal speed values (e.g. Processing Speed about 250ms).

| Athlete Information | | Test Results | |
|---------------------|-------------|-----------------------------|--------------|
| Name: | | Task | Score |
| Birth Year: | | Processing Speed | 89 |
| Age: | 17 | Speed ¹ | 447 ms |
| Gender: | Female | Accuracy ² | 97.3% |
| Dominant Hand: | Right | Hits ³ | 36 |
| Test Date: | 31 Aug 2010 | Misses ⁴ | 1 |
| Test Time: | 08:21 PM | Anticipations ⁴ | 1 |
| Test Duration: | 536 seconds | Attention | 81 |
| Expiration Date*: | 30 Aug 2011 | Speed ¹ | 897 ms |
| Test ID: | 1566 | Accuracy ² | 100% |
| | | Hits ³ | 30 |
| | | Misses ⁴ | 0 |
| | | Anticipations ⁴ | 0 |
| | | Learning | 124 |
| | | Speed ¹ | 2558 ms |
| | | Accuracy ² | 92.0% |
| | | Hits ³ | 50 |
| | | Misses ⁴ | 45 |
| | | Anticipations ⁴ | 4 |
| | | Working Memory Speed | 107 |
| | | Speed ¹ | 572 ms |

*While acceptable Baseline test results will be compared to previous tests, new Baseline tests are strongly recommended every year.

Integrity Checks

- Processing Accuracy > 90% (97%)
- Attention Accuracy > 80% (86%)
- Learning Accuracy > 53% (53%)
- W. Memory Accuracy > 53% (81%)
- Processing Speed < Attention Speed

Very slow speed scores

Speed or accuracy is 2 standard deviations below age-based norms

Very slow or inaccurate responses (or both) will be flagged as not acceptable. Research studies have shown that deliberate simulation of poor performance will usually be characterized by extreme slowing or inaccuracy (often much more than is seen with actual concussion!). Usually repeating the Baseline test after the above recommendations and education about sandbagging will be sufficient to improve the Athlete's performance. If not, then the Athlete may have some specific cause which is discussed in the next section.

Repeated unacceptable Baseline tests

Repeated unacceptable Baseline test results are quite rare with only about 1 in 200 Athletes overall not passing on their third attempt. Such Athletes will usually get unacceptable results because of variability in speed and/or accuracy in comparison to the normative data (i.e. they don't pass the simpler integrity checks of the Axon Sports CCAT). Medical evaluation is appropriate at this time to ensure there is no medical or neurological cause. Clearly any cause is best determined prior to participation in contact sports particularly if amenable to treatment. If there is a benign or static cause, then the Baseline results can still be used for future comparisons though the automated test reporting rules will continue to flag any After Injury results as failure to return to Baseline (since there is no documented acceptable Baseline).