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# Reliability and Test Differences for the Impact: Implications for Concussion Testing Programs

Christopher Koch & Sean Robertson

## Abstract

This study was conducted to determine the long-term reliability of ImPACT scores among young athletes. Youth sport participants ( $n=294$ ) who completed ImPACT tests one year apart were included in the study. Ages ranged from nine to 14 with a mean of 11.42 ( $SD = .96$ ). The majority ( $n = 215$ ) were males. Test-retest reliabilities for verbal memory, visual memory, response time, and impulse control were statistically significant but weak, ranging between .33 and .49. The index score had poor test-retest reliabilities ( $r = .26$ ). Visual-motor test-retest reliability was also significant but moderate ( $r=.68$ ). Scores for the verbal memory subtest and the index score did not change over time. However, there was significant improvement for the visual memory ( $t(293) = 2.24, p < .03, d = .13$ ), visual-motor ( $t(293) = 9.23, p < .001, d = .54$ ), response time ( $t(293) = 3.78, p < .001, d = .22$ ), and impulse ( $t(293) = 3.27, p < .001, d = .19$ ) subtests. These results indicate that the long-term test-retest reliability of the ImPACT is inadequate and that several subtests change over time. Therefore, it is recommended that baseline ImPACT scores are obtained on an annual basis.

## Introduction

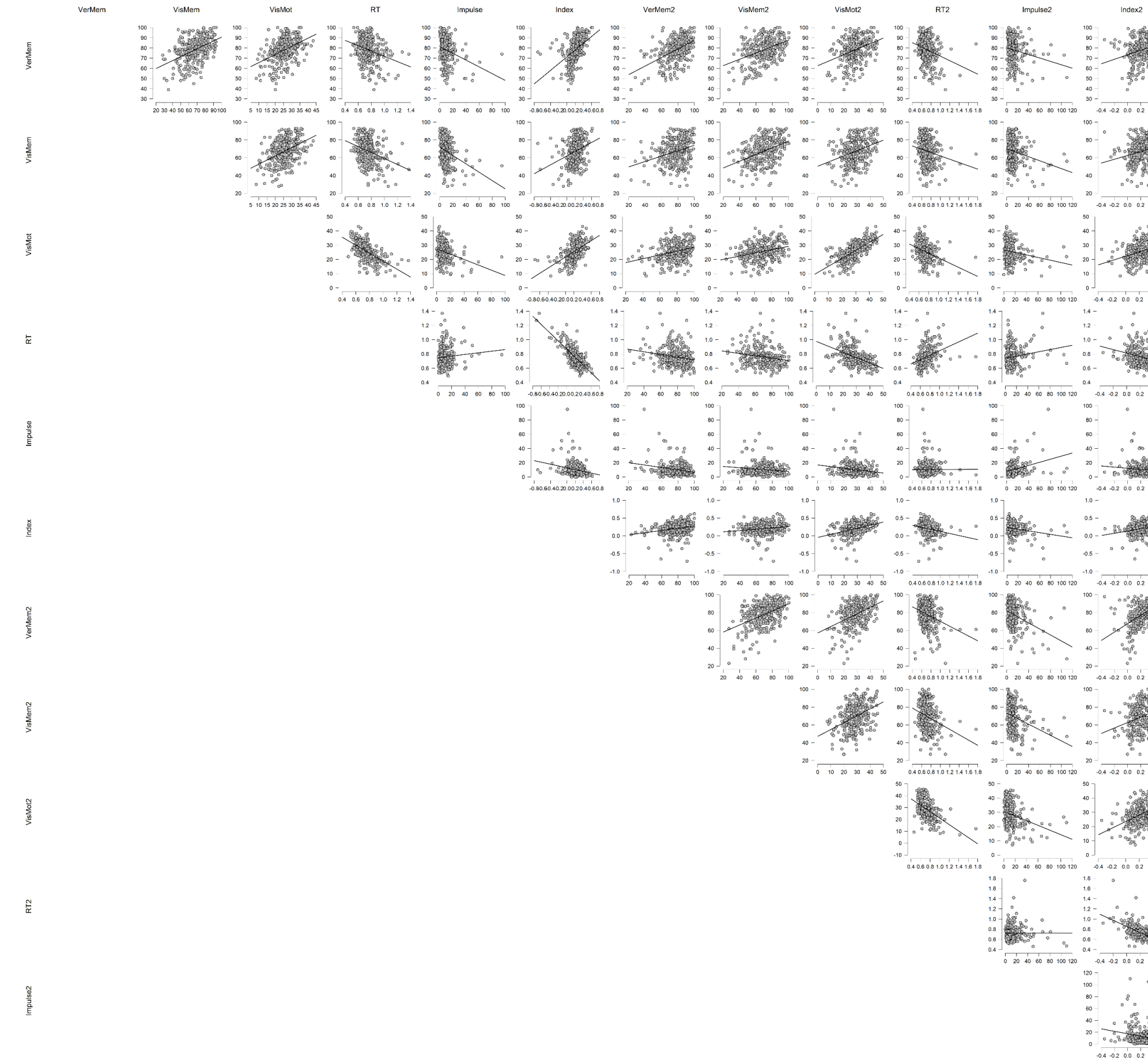
Growing concern about sports-related concussions has prompted state legislatures to create laws dealing with concussion education and return-to-play criteria. It is now also common for youth football leagues to require baseline concussion testing for participation. The ImPACT is a widely used neuropsychological assessment for diagnosing concussion and determining return-to-play readiness. Since the ImPACT can be administered in groups using computers, it is an efficient tool for baseline testing teams. The CDC recommends annual baseline tests (i.e., behavioral-based symptom checklists) and neuropsychological baseline tests every two years. Comparing scores across time requires reliable measures. There is some evidence to suggest that the ImPACT has adequate long-term test-retest reliability with high school (Brett, Smyk, Solomon, Baughman, & Schatz, 2016) and college students (Nakayama, Covassin, Schatz, Nogle, & Kovan, 2014; Schatz, 2010). However, the ImPACT was constructed to be administered to individuals 10 years old and older. This study was conducted to determine the long-term reliability of ImPACT scores among younger athletes.

## Method

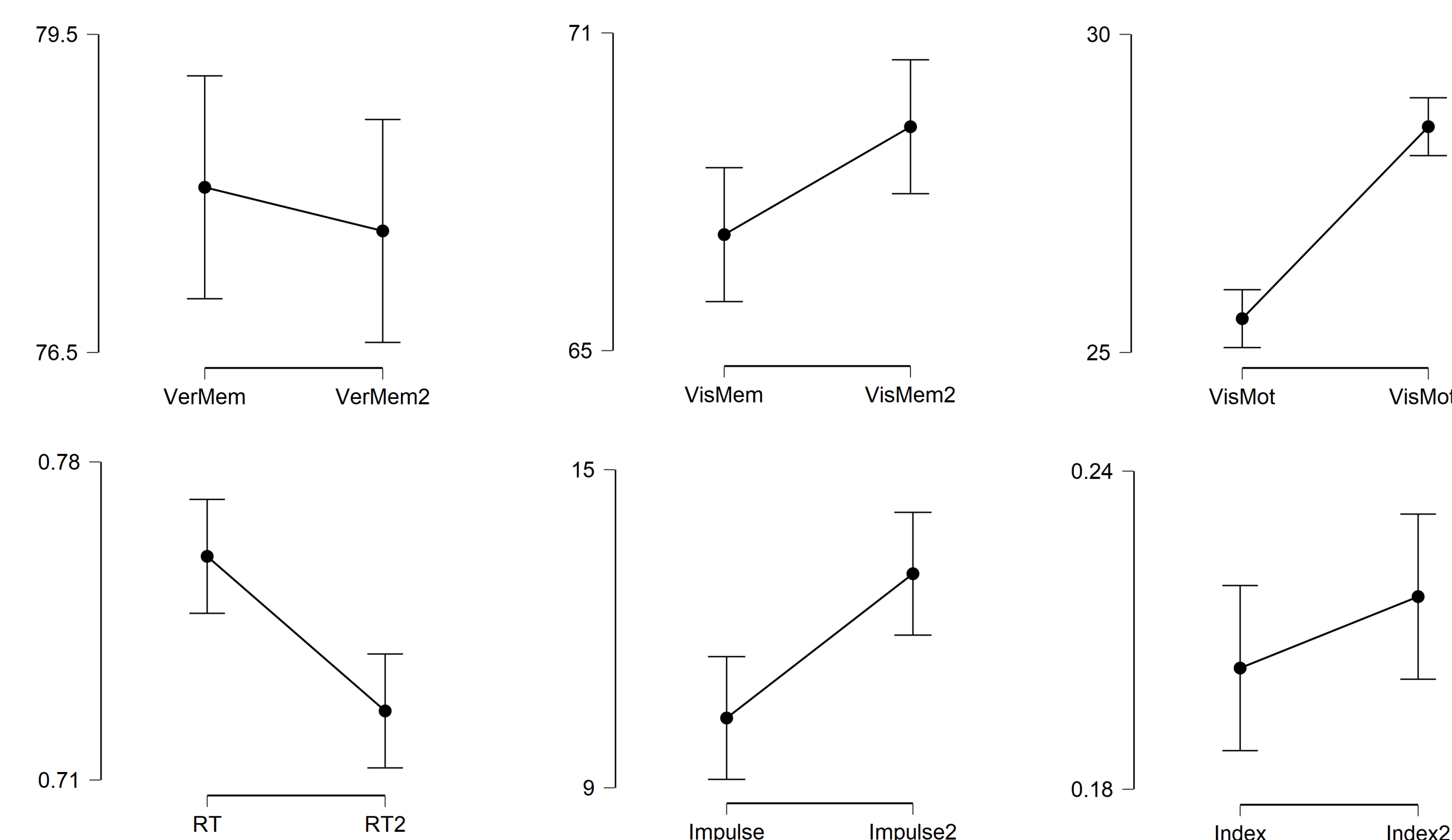
Youth sport participants ( $n=294$ ) who completed ImPACT tests one year apart were included in the study. Ages ranged from nine to 14 with a mean of 11.42 ( $SD = .96$ ). The majority ( $n = 215$ ) were males. All tests were administered via computer in a group setting consistent with normal testing procedures.

## Results

Test-retest reliabilities for verbal memory, visual memory, response time, and impulse control were statistically significant but weak, ranging between .33 and .49. The index score had poor test-retest reliabilities ( $r = .26$ ). Visual-motor test-retest reliability was also significant but moderate ( $r=.68$ ).



Scores for the verbal memory subtest and the index score did not change over time. However, there was significant improvement for the visual memory ( $t(293) = 2.24, p < .03, d = .13$ ), visual-motor ( $t(293) = 9.23, p < .001, d = .54$ ), response time ( $t(293) = 3.78, p < .001, d = .22$ ), and impulse ( $t(293) = 3.27, p < .001, d = .19$ ) subtests.



## Discussion

This study was conducted to determine the long-term reliability of ImPACT scores among younger athletes. Results from the study indicate that the long-term test-retest reliability of the ImPACT is inadequate with younger participants and that several subtests change over time. This finding is similar to Resch et al., 2013 who also found variable reliability of ImPACT scores. The combination of poor test-retest reliability and significant changes in scores from one administration to another make comparing scores from one season to the next problematic. This issue, however, may not be specific to the ImPACT since scores on the WISC-IV, for example, have also been found to have questionable long-term reliability (Watkins & Smith, 2013).

Therefore, the current findings suggest that the CDC recommendation, that neurological concussion baseline tests be administered every two years, may not be appropriate for younger athletes. There are at least three implications for the current findings; namely, the tests are inadequate, the testing recommendation is adequate, as suggested above, or other statistics need to be applied for proper interpretation of test scores. It is possible that the rapid developmental changes of younger athletes lead to lower long-term test reliabilities. To avoid the long-term issue, more frequent short-term testing may be required (e.g., at the beginning of each sport season). More frequent testing would also require the need for parallel test versions and increase the threat of practice effects. It may also be possible to account for known differences on the test by utilizing reliable changed indices to better inform clinical decisions (Littleton, Register-Mihalik, & Guskiewicz, 2015).

## References

- Brett, B. L., Smyk, N., Solomon, G., Baughman, B. C., & Schatz, P. (2016). Long-term Stability and Reliability of Baseline Cognitive Assessments in High School Athletes Using ImPACT at 1-, 2-, and 3-year Test-Retest Intervals. *Archives of Clinical Neuropsychology, 31*(8), 904–914. <https://doi.org/10.1093/arclin/acw055>
- Littleton, A. C., Register-Mihalik, J. K., & Guskiewicz, K. M. (2015). Test-Retest Reliability of a Computerized Concussion Test. *Sports Health: A Multidisciplinary Approach, 7*(5), 443–447. <https://doi.org/10.1177/1941738115586997>
- Nakayama, Y., Covassin, T., Schatz, P., Nogle, S., & Kovan, J. (2014). Examination of the Test-Retest Reliability of a Computerized Neurocognitive Test Battery. *The American Journal of Sports Medicine, 42*(8), 2000–2005. <https://doi.org/10.1177/0363546514535901>
- Resch, J., Driscoll, A., McCaffrey, N., Brown, C., Ferrara, M. S., Macciocchi, S., ... Walpert, K. (2013). ImPACT Test-Retest Reliability: Reliably Unreliable? *Journal of Athletic Training, 48*(4), 506–511. <https://doi.org/10.4085/1062-6050-48.3.09>
- Schatz, P. (2010). Long-Term Test-Retest Reliability of Baseline Cognitive Assessments Using ImPACT. *The American Journal of Sports Medicine, 38*(1), 47–53. <https://doi.org/10.1177/0363546509343805>
- Watkins, M. W., & Smith, L. G. (2013). Long-term stability of the Wechsler Intelligence Scale for Children—Fourth Edition. *Psychological Assessment, 25*(2), 477–483. <https://doi.org/10.1037/a0031653>

