**Supplemental Material**

**Major Study Analyses Excluding (*n* = 3) Subjects Who Failed the MSVT at Baseline**

Tables S1 and S2 present the two major set of findings from the main body of the manuscript (those reported in Tables 3 and 5), but this time excluding the three subjects who failed the MSVT at pre-season baseline examinations. The concussed *versus* control group effect sizes (Cohen’s d) across measures and time points were highly similar when excluding these subjects (Table S1 below) as compared to what was reported using the entire sample (Table 3), with the mean difference in effect sizes between the two analyses = 0.00. Similarly, the sensitivity values reported in Table S2 below closely mirror those reported from the full study sample (Table 5). For example, excluding these subjects resulted in a mean increase in sensitivity (across 1+ and 2+ criteria and all time points) for ANAM, Axon, and ImPACT (all concussed athletes) of 0.0, 0.9, and 0.03, respectively, while the corresponding false positive rates increased by a mean of 0.03, 4.5, and 0.1, respectively.

**Table S1**

*Concussed vs. Control Group Effect Sizes (Cohen’s d), Excluding Subjects with Failed Baseline MSVT*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | BL | 24-hr | Day 8 | Day 15 | Day 45 |
| SCAT3 Symptom Severity | -.07 | **-1.52** | **-.40** | -.13 | .23 |
| **ANAM** |  |  |  |  |  |
| Composite | -.18 | **-.84** | -.33 | -.30 | -.21 |
| SRT | -.04 | **-.58** | -.18 | -.12 | -.10 |
| CDS | -.06 | **-.61** | -.26 | -.17 | -.19 |
| PRO | -.32 | **-.68** | -.35 | -.26 | .03 |
| MTH | -.19 | -.19 | -.02 | -.22 | -.09 |
| M2S | -.32 | **-.89** | **-.47** | **-.40** | -.36 |
| CDD | .06 | **-.66** | -.10 | -.16 | -.36 |
| SR2 | .08 | **-.64** | -.27 | -.15 | -.02 |
| GNG | -.13 | -.30 | -.22 | .03 | .18 |
| *Mean* | *-.12* | *-.60* | *-.25* | *-.19* | *-.13* |
| **Axon** |  |  |  |  |  |
| PS Speed | -.07 | **-.53** | -.12 | -.11 | -.03 |
| AT Speed | -.09 | **-.72** | **-.41** | -.22 | -.08 |
| LN Acc. | -.22 | **-.51** | **-.39** | -.12 | -.28 |
| WM Speed | -.07 | **-.51** | -.25 | .01 | .00 |
| *Mean* | *-.11* | *-.57* | *-.29* | *-.11* | *-.10* |
| **ImPACT** |  |  |  |  |  |
| VERM | .02 | **-.76** | **-.40** | -.18 | -.18 |
| VISM | -.21 | **-.76** | -.17 | -.21 | -.26 |
| VMS | -.27 | **-.80** | -.31 | -.29 | -.21 |
| RT | .08 | **-.70** | -.24 | -.23 | -.18 |
| *Mean* | *-.10* | *-.76* | *-.28* | *-.23* | *-.21* |

*Note*. Bolded where *p* < .05 after adjustment for multiple comparisons. Comparisons are all scaled such that negative values reflect worse performance in the concussed group. BL = baseline; SRT = Simple reaction time; CDS = code substitution-learning; PRO = procedural reaction time; MTH = mathematical processing; M2S = matching to sample; CDD = code substitution-delayed; SR2 = simple reaction time 2; GNG = go no-go; PS= processing speed; AT = attention; LN acc. = learning accuracy; WM = working memory; VERM = verbal memory composite; VISM = visual memory composite; VMS = visual motor speed composite; RT = reaction time composite.

**Table S2**

*Percentage of Concussed (All), Asymptomatic Concussed (Sx-), and Non-Injured Controls With 1 or More (1+) and 2 or More (2+) Significant Declines According to Reliable Change Index (RCI) Criteria*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24 hr | | |  | Day 8 | | |  | Day 15 | | |  | Day 45 | | |
|  | Concussed | | Control |  | Concussed | | Control |  | Concussed | | Control |  | Concussed | | Control |
|  | All | Sx- | (false +) |  | All | Sx- | (false +) |  | All | Sx- | (false +) |  | All | Sx- | (false +) |
| **ANAM** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1+ decline | 47.6 | 42.9 | 25.5 |  | 31.0 | 28.6 | 29.9 |  | 35.4 | 30.8 | 27.9 |  | 25.7 | 26.1 | 25.3 |
| 2+ decline | 31.0 | 0.0 | 6.4 |  | 10.7 | 7.1 | 14.0 |  | 7.6 | 6.2 | 11.5 |  | 11.4 | 11.6 | 8.0 |
| **Axon** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1+ decline | 63.9 | 42.9 | 27.5 |  | 38.0 | 30.6 | 31.4 |  | 26.9 | 22.0 | 26.5 |  | 26.8 | 27.3 | 25.0 |
| 2+ decline | 38.9 | 0.0 | 8.8 |  | 15.5 | 8.3 | 7.0 |  | 9.0 | 8.0 | 10.8 |  | 14.3 | 14.5 | 8.3 |
| **ImPACT** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1+ decline | 68.6 | 58.3 | 29.3 |  | 49.4 | 40 | 43.4 |  | 47 | 45.5 | 40.8 |  | 39.0 | 38.2 | 40.0 |
| 2+ decline | 34.9 | 16.7 | 4.1 |  | 8.4 | 5.0 | 6.6 |  | 10.8 | 9.1 | 10.8 |  | 6.5 | 6.6 | 4.8 |

*Note*. Symptom-free (Sx-) *n*s at 24-hr were small (7 for ANAM, 8 for Axon, and 13 for ImPACT). Symptomatic *n*s were small at day 45 (2 for ANAM; 1 for Axon/ImPACT). The number of neurocognitive RCIs available for each CNT was 7 for ANAM, 5 for Axon, and 4 for ImPACT. ImPACT uses 80% confidence intervals around RCIs, whereas ANAM and Axon use 90% CIs.

**Effect of Test Order on CNT Findings**

**Test-retest reliability.** Below are the stability coefficients for the baseline vs. first follow-up time points (*M* = 198 day test-retest interval) presented separately by tests administered as the 1st or 2nd CNT during the testing sessions. There was not a consistent advantage for tests administered first or second in terms of stability over time. The median difference in reliability for each subtest for Order 1 – Order 2 was .05 (for both Pearson *r*s and ICCs). Nine of 17 indices showed higher Pearson reliability coefficients (10 of 17 for ICCs) for Order 1 vs. 2.

**Table S3**

*Test-Retest Reliability by Order of CNT Administration*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Order 1 | Order 2 | Order 1 | Order 2 |
|  | Pearson *r* | Pearson *r* | ICC | ICC |
| **ANAM** |  |  |  |  |
| Composite | .62 | .74 | .61 | .72 |
| SRT | .18 | .44 | .18 | .43 |
| CDS | .67 | .78 | .66 | .75 |
| PRT | .46 | .61 | .44 | .57 |
| MTH | .75 | .70 | .74 | .68 |
| M2S | .55 | .63 | .56 | .63 |
| CDD | .62 | .64 | .57 | .55 |
| SR2 | .42 | .49 | .42 | .49 |
| GNG | .13 | .44 | .13 | .42 |
| **Axon** |  |  |  |  |
| PS Speed | .70 | .24 | .67 | .13 |
| AT Speed | .69 | .42 | .68 | .42 |
| LN Acc. | .62 | .41 | .49 | .30 |
| WM Speed | .78 | .73 | .78 | .73 |
| **ImPACT** |  |  |  |  |
| VERM | .63 | .41 | .62 | .31 |
| VISM | .51 | .46 | .51 | .46 |
| VMS | .83 | .54 | .81 | .53 |
| RT | .70 | .44 | .70 | .44 |

**Effects of order on CNT performance and Concussed vs. Control group differences.** To examine the effect of test order on CNT performance as well as interactions between Group and Order, we performed a series of ANOVAs (separately by each CNT measure/composite score) with Group, Order, and Group x Order as predictors. Baseline performance primarily provided an opportunity to examine overall Order effects, while the 24-hr time point was selected given that any interactions between Order and Group should be maximal when concussed athletes were more acutely injured. The Table below summarizes the findings of these analyses. Across all measures at Baseline, 2 of 17 CNT indices had significantly different performance (unadjusted *p-*values) between Order 1 and 2 in opposite directions: ANAM SR2 performance was better for Order 1 than 2, and ImPACT VMS was better for Order 2 than 1. Across time points, no Group x Order interactions were present. Similarly, group effect sizes were not systematically different by order: the median difference between Order 1 and 2 in the Concussed vs. Control group difference (Cohen’s *d*) was .11 at 24 hr (favoring Order 1), with 10 of 17 CNT producing bigger Concussed vs. Control group differences for CNTs administered 1st, and 7 indices producing bigger group effect sizes when administered 2nd.

**Table S4**

*Unadjusted p-values from Concussion Group x CNT Order ANOVAs at Baseline and 24-hr Post-Injury*

|  |  |  |  |
| --- | --- | --- | --- |
|  | Group | Order | Group x Order |
|  | *p* | *p* | *p* |
| **ANAM** |  |  |  |
| Composite BL | .136 | .061 | .639 |
| Composite 24-hr | **< .001** | .690 | .652 |
| SRT BL | .645 | .264 | .297 |
| SRT 24-hr | **< .001** | .917 | .426 |
| CDS BL | .657 | .738 | .925 |
| CDS 24-hr | **< .001** | .434 | .718 |
| PRO BL | **.014** | .152 | .902 |
| PRO 24-hr | **< .001** | .640 | .757 |
| MTH BL | .129 | .242 | .455 |
| MTH 24-hr | .144 | .785 | .347 |
| M2S BL | **.014** | .149 | .872 |
| M2S 24-hr | **< .001** | .495 | .235 |
| CDD BL | .778 | .536 | .540 |
| CDD 24-hr | **< .001** | .959 | .882 |
| SR2 BL | .905 | **.018** | .885 |
| SR2 24-hr | **< .001** | .830 | .521 |
| GNG BL | .486 | .377 | .645 |
| GNG 24-hr | **.039** | .500 | .670 |
| **AXON** |  |  |  |
| PS Speed BL | .743 | .524 | .904 |
| PS Speed 24-hr | **.001** | .228 | .179 |
| AT Speed BL | .619 | .186 | .431 |
| AT Speed 24-hr | **< .001** | .266 | .978 |
| LN Acc. BL | .184 | .978 | .573 |
| LN Acc. 24-hr | **.001** | .425 | .221 |
| WM Speed BL | .602 | .670 | .490 |
| WM Speed 24-hr | **.001** | .707 | .474 |
| **IMPACT** |  |  |  |
| VERM BL | .914 | .666 | .038 |
| VERM 24-hr | **< .001** | .539 | .965 |
| VISM BL | .099 | .050 | .304 |
| VISM 24-hr | **< .001** | .524 | .396 |
| VMS BL | .037 | **.017** | .905 |
| VMS 24-hr | **< .001** | .053 | .925 |
| RT BL | .599 | .392 | .993 |
| RT 24-hr | **< .001** | .606 | .973 |

**Table S5**

*Group Comparisons for ANAM by Subscale and Time*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Concussed *N* = 104 |  | Control *N* = 113 |  |  | Group x Time | Group |
|  | *M* | *SD* | *M* | *SD* |  | *p* | *p* |
| **Composite** | |  |  |  |  | < .001 |  |
| BL | .31 | 1.02 | .48 | 1.02 |  |  | .350 |
| 24-hr | -.46 | 1.59 | .67 | 1.10 |  |  | **< .001** |
| Day 8 | .44 | 1.44 | .88 | 1.19 |  |  | .067 |
| Day 15 | .43 | 1.17 | .80 | 1.26 |  |  | .095 |
| Day 45 | .64 | 1.15 | .90 | 1.27 |  |  | .291 |
| **SRT** |  |  |  |  |  | < .001 |  |
| BL | 242.32 | 29.22 | 243.45 | 28.47 |  |  | .864 |
| 24-hr | 220.82 | 50.33 | 244.52 | 30.10 |  |  | **< .001** |
| Day 8 | 248.37 | 37.40 | 254.60 | 32.05 |  |  | .317 |
| Day 15 | 248.01 | 32.42 | 252.32 | 37.97 |  |  | .532 |
| Day 45 | 243.45 | 32.62 | 246.68 | 29.39 |  |  | .634 |
| **CDS** |  |  |  |  |  | .004 |  |
| BL | 59.26 | 11.08 | 59.91 | 12.01 |  |  | .776 |
| 24-hr | 54.63 | 11.38 | 61.42 | 10.85 |  |  | **< .001** |
| Day 8 | 60.38 | 11.89 | 63.41 | 11.04 |  |  | .143 |
| Day 15 | 61.97 | 10.54 | 63.97 | 13.46 |  |  | .350 |
| Day 45 | 64.60 | 10.84 | 66.75 | 11.85 |  |  | .339 |
| **PRO** |  |  |  |  |  | < .001 |  |
| BL | 100.17 | 14.91 | 104.58 | 12.63 |  |  | .077 |
| 24-hr | 97.22 | 21.65 | 109.27 | 12.97 |  |  | **< .001** |
| Day 8 | 102.89 | 19.13 | 109.06 | 16.50 |  |  | .051 |
| Day 15 | 103.76 | 16.12 | 107.66 | 14.32 |  |  | .169 |
| Day 45 | 107.72 | 15.39 | 107.23 | 18.53 |  |  | .914 |
| **MTH** |  |  |  |  |  | .342 |  |
| BL | 21.48 | 5.47 | 22.53 | 5.56 |  |  | .311 |
| 24-hr | 20.21 | 6.26 | 21.48 | 6.80 |  |  | .287 |
| Day 8 | 24.88 | 7.76 | 25.05 | 6.87 |  |  | .921 |
| Day 15 | 23.68 | 7.44 | 25.18 | 6.07 |  |  | .241 |
| Day 45 | 24.99 | 7.25 | 25.62 | 7.39 |  |  | .698 |
| **M2S** |  |  |  |  |  | .001 |  |
| BL | 37.82 | 11.36 | 41.69 | 12.50 |  |  | .077 |
| 24-hr | 31.28 | 11.17 | 41.97 | 12.75 |  |  | **< .001** |
| Day 8 | 35.79 | 12.92 | 42.21 | 14.09 |  |  | **.004** |
| Day 15 | 34.23 | 10.98 | 39.17 | 13.51 |  |  | **.023** |
| Day 45 | 36.67 | 11.85 | 41.83 | 16.18 |  |  | .067 |
| **CDD** |  |  |  |  |  | < .001 |  |
| BL | 55.15 | 14.82 | 54.38 | 12.71 |  |  | .776 |
| 24-hr | 51.31 | 15.59 | 61.17 | 14.27 |  |  | **< .001** |
| Day 8 | 52.21 | 14.65 | 53.60 | 13.49 |  |  | .610 |
| Day 15 | 53.74 | 14.01 | 56.22 | 15.89 |  |  | .350 |
| Day 45 | 57.66 | 14.29 | 62.74 | 13.66 |  |  | .067 |
| **SR2** |  |  |  |  |  | < .001 |  |
| BL | 240.34 | 35.04 | 237.82 | 30.78 |  |  | .705 |
| 24-hr | 212.98 | 54.31 | 241.80 | 33.67 |  |  | **< .001** |
| Day 8 | 236.75 | 47.21 | 248.19 | 37.23 |  |  | .136 |
| Day 15 | 237.83 | 41.84 | 243.79 | 38.14 |  |  | .412 |
| Day 45 | 234.99 | 36.99 | 235.64 | 35.75 |  |  | .940 |
| **GNG** |  |  |  |  |  | .073 |  |
| BL | 3.40 | 1.43 | 3.58 | 1.46 |  |  | .527 |
| 24-hr | 3.63 | 1.44 | 4.06 | 1.39 |  |  | .081 |
| Day 8 | 4.01 | 1.55 | 4.35 | 1.52 |  |  | .235 |
| Day 15 | 3.94 | 1.52 | 3.88 | 1.60 |  |  | .877 |
| Day 45 | 3.84 | 1.47 | 3.57 | 1.43 |  |  | .350 |

*Note*. Bolded where *p* < .05 after adjustment for multiple comparisons. All scores (except GNG, which reflect d-prime) represent throughput scores (a combination of reaction time and accuracy where higher scores reflect better performance). BL = baseline; SRT = Simple reaction time; CDS = code substitution-learning; PRO = procedural reaction time; MTH = mathematical processing; M2S = matching to sample; CDD = code substitution-delayed; SR2 = simple reaction time 2; GNG = go no-go.

**Table S6**

*Group Comparisons for Axon by Subscale and Time*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Concussed *N* = 93 |  | Control *N* = 91 |  |  | Group x Time | Group |
|  | *M* | *SD* | *M* | *SD* |  | *p* | *p* |
| **PS Speed** |  |  |  |  |  | .001 |  |
| BL | 106.87 | 6.25 | 107.25 | 5.47 |  |  | .776 |
| 24-hr | 98.49 | 12.35 | 104.29 | 9.36 |  |  | **.003** |
| Day 8 | 103.70 | 10.03 | 104.78 | 6.76 |  |  | .551 |
| Day 15 | 104.73 | 7.57 | 105.52 | 6.54 |  |  | .610 |
| Day 45 | 104.76 | 6.37 | 104.92 | 6.55 |  |  | .949 |
| **AT Speed** |  |  |  |  |  | < .001 |  |
| BL | 107.87 | 5.02 | 108.38 | 5.86 |  |  | .690 |
| 24-hr | 102.04 | 10.00 | 108.18 | 6.51 |  |  | **< .001** |
| Day 8 | 105.50 | 8.43 | 108.38 | 5.21 |  |  | **.033** |
| Day 15 | 106.97 | 5.61 | 108.24 | 5.89 |  |  | .287 |
| Day 45 | 106.66 | 5.88 | 107.15 | 6.20 |  |  | .711 |
| **LN Acc.** |  |  |  |  |  | .202 |  |
| BL | 98.86 | 7.08 | 100.35 | 6.54 |  |  | .291 |
| 24-hr | 99.60 | 10.74 | 104.81 | 9.46 |  |  | **.004** |
| Day 8 | 104.19 | 12.60 | 108.55 | 9.18 |  |  | **.041** |
| Day 15 | 105.74 | 12.06 | 107.18 | 11.14 |  |  | .556 |
| Day 45 | 107.73 | 9.65 | 110.60 | 11.21 |  |  | .194 |
| **WM Speed** |  |  |  |  |  | < .001 |  |
| BL | 105.35 | 5.79 | 105.77 | 6.74 |  |  | .776 |
| 24-hr | 102.30 | 7.92 | 105.98 | 6.55 |  |  | **.004** |
| Day 8 | 105.51 | 7.22 | 107.18 | 6.44 |  |  | .229 |
| Day 15 | 107.53 | 5.97 | 107.49 | 6.27 |  |  | .967 |
| Day 45 | 106.96 | 6.31 | 106.98 | 6.39 |  |  | .963 |

*Note*. Bolded where *p* < .05 after adjustment for multiple comparisons. Descriptive statistics reflect Axon standard scores (*M* = 100; *SD* = 10). BL = baseline; PS= processing speed; AT = attention; LN Acc. = learning accuracy; WM = working memory.

**Table S7**

*Group Comparisons for ImPACT by Composite Score and Time*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Concussed  *N* = 112 |  | Control *N* = 126 |  |  | Group x Time | Group |
|  | *M* | *SD* | *M* | *SD* |  | *p* | *P* |
| **VERM** |  |  |  |  |  | < .001 |  |
| BL | 85.77 | 10.01 | 85.56 | 10.04 |  |  | .921 |
| 24-hr | 79.90 | 14.24 | 88.98 | 9.29 |  |  | **< .001** |
| Day 8 | 85.93 | 10.53 | 89.84 | 8.97 |  |  | **.013** |
| Day 15 | 87.07 | 10.75 | 88.94 | 10.33 |  |  | .311 |
| Day 45 | 87.30 | 10.86 | 89.11 | 9.77 |  |  | .330 |
| **VISM** |  |  |  |  |  | < .001 |  |
| BL | 76.83 | 12.80 | 79.54 | 12.76 |  |  | .256 |
| 24-hr | 70.79 | 14.52 | 80.61 | 11.13 |  |  | **< .001** |
| Day 8 | 75.04 | 13.19 | 77.23 | 12.29 |  |  | .317 |
| Day 15 | 74.58 | 13.94 | 77.39 | 13.17 |  |  | .241 |
| Day 45 | 74.33 | 13.95 | 77.86 | 13.05 |  |  | .157 |
| **VMS** |  |  |  |  |  | < .001 |  |
| BL | 38.95 | 7.22 | 40.76 | 6.14 |  |  | .136 |
| 24-hr | 36.60 | 7.90 | 42.03 | 5.69 |  |  | **< .001** |
| Day 8 | 40.09 | 7.19 | 42.07 | 5.66 |  |  | .067 |
| Day 15 | 41.29 | 6.70 | 43.16 | 6.24 |  |  | .089 |
| Day 45 | 41.48 | 6.22 | 42.78 | 6.24 |  |  | .264 |
| **RT** |  |  |  |  |  | < .001 |  |
| BL | .56 | .07 | .56 | .06 |  |  | .698 |
| 24-hr | .63 | .13 | .56 | .07 |  |  | **< .001** |
| Day 8 | .57 | .08 | .55 | .06 |  |  | .173 |
| Day 15 | .56 | .07 | .55 | .06 |  |  | .192 |
| Day 45 | .55 | .06 | .54 | .06 |  |  | .324 |

*Note*. Bolded where *p* < .05 after adjustment for multiple comparisons. BL = baseline; VERM = verbal memory composite; VISM = visual memory composite; VMS = visual motor speed composite; RT = reaction time composite.

**Table S8**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24 hr | | |  | Day 8 | | |  | Day 15 | | |  | Day 45 | | |
|  | Concussed | | Control |  | Concussed | | Control |  | Concussed | | Control |  | Concussed | | Control |
|  | All | Sx- | All |  | All | Sx- | All |  | All | Sx- | All |  | All | Sx- | All |
| **ANAM** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SRT | 20.2 | 0.0 | 9.8 |  | 4.8 | 3.6 | 6.4 |  | 6.3 | 4.6 | 9.6 |  | 10.0 | 10.1 | 4.6 |
| CDS | 14.3 | 0.0 | 0.9 |  | 7.1 | 5.4 | 5.5 |  | 3.8 | 3.1 | 5.8 |  | 0.0 | 0.0 | 2.3 |
| PRO | 20.2 | 14.3 | 2.7 |  | 7.1 | 7.1 | 5.5 |  | 5.1 | 4.6 | 5.8 |  | 5.7 | 5.8 | 6.9 |
| MTH | 6.0 | 14.3 | 2.7 |  | 2.4 | 3.6 | 1.8 |  | 1.3 | 1.5 | 0.0 |  | 0.0 | 0.0 | 0.0 |
| M2S | 20.2 | 14.3 | 8.0 |  | 10.7 | 8.9 | 10.1 |  | 10.1 | 9.2 | 12.5 |  | 7.1 | 7.2 | 10.3 |
| CDD | 21.4 | 0.0 | 0.9 |  | 13.1 | 12.5 | 12.8 |  | 11.4 | 7.7 | 9.6 |  | 7.1 | 7.2 | 3.4 |
| SR2 | 23.8 | 0.0 | 7.2 |  | 8.3 | 3.6 | 8.3 |  | 7.6 | 7.7 | 3.8 |  | 10.0 | 10.1 | 6.9 |
| **Axon** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PS Speed | 48.6 | 28.6 | 18.9 |  | 23.6 | 13.5 | 20.9 |  | 17.6 | 13.7 | 16.9 |  | 19.3 | 19.6 | 19.4 |
| AT Speed | 30.1 | 0.0 | 3.3 |  | 9.7 | 8.1 | 7.0 |  | 5.9 | 3.9 | 2.4 |  | 14.0 | 14.3 | 4.2 |
| LN Acc. | 6.8 | 12.5 | 2.2 |  | 13.9 | 16.2 | 1.2 |  | 5.9 | 5.9 | 4.8 |  | 1.8 | 1.8 | 2.8 |
| WM Speed | 26.0 | 12.5 | 3.3 |  | 8.3 | 2.7 | 7.0 |  | 4.4 | 5.9 | 6.0 |  | 5.3 | 5.4 | 4.2 |
| **ImPACT** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| VERM | 37.9 | 7.7 | 8.0 |  | 17.9 | 18.0 | 11.3 |  | 15.5 | 14.1 | 15.0 |  | 16.7 | 15.6 | 11.4 |
| VISM | 25.3 | 23.1 | 8.0 |  | 17.9 | 13.1 | 20.2 |  | 21.4 | 19.2 | 23.3 |  | 15.4 | 15.6 | 19.0 |
| VMS | 24.4 | 0.0 | 4.8 |  | 7.2 | 3.3 | 6.5 |  | 8.4 | 9.1 | 4.2 |  | 3.9 | 3.9 | 4.8 |
| RT | 39.5 | 38.5 | 13.6 |  | 18.1 | 15.0 | 13.7 |  | 16.9 | 15.6 | 10.8 |  | 10.4 | 10.5 | 10.5 |

*Percentage of* *Concussed (All), Asymptomatic Concussed (Sx-), and Non-Injured Controls with Significant Declines (From Baseline) on Reliable Change Index (RCI)*

*Criteria for Each Subtest of ANAM, Axon, and ImPACT*

*Note*. Symptom-free (Sx-) *n*s at 24-hr were small (7 for ANAM, 8 for Axon, and 13 for ImPACT). Symptomatic *n*s were small at day 45 (2 for ANAM; 1 for Axon/ImPACT). SRT = Simple reaction time; CDS = code substitution-learning; PRO = procedural reaction time; MTH = mathematical processing; M2S = matching to sample; CDD = code substitution-delayed; SR2 = simple reaction time 2; GNG = go no-go; PS= processing speed; AT = attention; LN acc. = learning accuracy; WM = working memory; VERM = verbal memory composite; VISM = visual memory composite; VMS = visual motor speed composite; RT = reaction time composite.