**Appendix**

All materials in the Appendix used with permission of Mayo Foundation of Medical Education and Research. An excel file that automates T-scores calculations is available by request through the Mayo Clinic Study of Aging website at the following link: <link TBD while manuscript is in the publication queue>.

**Table A1.** AVLT measures.

|  |  |
| --- | --- |
| AVLT measure | Formula / description |
| Primary |  |
|  Trials 1-5 total | trial 1 recall + trial 2 recall + trial 3 recall + trial 4 recall + trial 5 recall |
|  30-min recall | 30-minute recall total correct (delayed recall) |
|  Sum of trials  | trials 1-5 total + trial 6 + 30-minute recall |
|  Recognition % correct  | {[(recognition hits + (15 – recognition FP errors)] / 30} x 100 |
| Secondary |  |
|  Trial 1 | trial 1 recall total correct |
|  Trial 2 | trial 2 recall total correct |
|  Trial 3 | trial 3 recall total correct |
|  Trial 4 | trial 4 recall total correct |
|  Trial 5 | trial 5 recall total correct |
|  Trials 1-3 total a | trial 1 recall + trial 2 recall + trial 3 recall |
|  List B | list B recall total correct |
|  Trial 6 | trial 6 recall total correct (short delayed recall) |
|  Short-term % retention  | 100 x (trial 6 / trial 5)  |
|  Long-term % retention  | 100 x (30 minute delay / trial 5)  |
|  Total intrusions  | intrusions summed across trial 1 + trial 2 + trial 3 + trial 4 + trial 5 + list B + trial 6 + 30-min recall |
|  Memory efficiency score  | {[(30 min delay / 15) / (trials 1-5 total / 75)] + [(recognition hits / 15) – (recognition FP errors / 15)]} |

Abbreviation: AVLT, Auditory Verbal Learning Test. %, percentage. FP = false positive.

a We recommend using the 5 trial version of the AVLT. If an abbreviated version of the AVLT with only 3 learning trials is administered, note that normative data cannot be applied to any other AVLT measures beyond Trial 3.

**Table A2.** Table for converting raw scores to unadjusted scaled scores for primary variables. **a**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SS | Trials 1-5 Total | 30-Min Recall | Sum of Trials | Recognition PC |
| 0 | 0-14 | - | 0-17 | 0-23 |
| 1 | 15-17 | - | 18-21 | 27-47 |
| 2 | 18-20 | - | 22-24 | 50-57 |
| 3 | 21-23 | 0 | 25-27 | 60-63 |
| 4 | 24-25 | 1 | 28-31 | 67 |
| 5 | 26-27 | 2 | 32-35 | 70-73 |
| 6 | 28-30 | 3 | 36-39 | 77 |
| 7 | 31-33 | 4 | 40-44 | 80 |
| 8 | 34-36 | 5-6 | 45-49 | 83-87 |
| 9 | 37-40 | 7 | 50-55 | 90 |
| 10 | 41-43 | 8 | 56-61 | - |
| 11 | 44-47 | 9 | 62-66 | 93 |
| 12 | 48-50 | 10-11 | 67-72 | 97 |
| 13 | 51-54 | 12 | 73-78 | - |
| 14 | 55-57 | 13 | 79-83 | - |
| 15 | 58-61 | 14 | 84-88 | 100 |
| 16 | 62-63 | - | 89-92 | - |
| 17 | 64-65 | 15 | 93-95 | - |
| 18 | 66-67 | - | 96-96 | - |
| 19 | 68 | - | 97-97 | - |
| 20 | 69-75 | - | 98-105 | - |

**a** Scaled scores are provided only as a step in determining the demographically-corrected T-scores using the equations below. These scaled scores are not adjusted for any demographic variables and should not be used for clinical practice. Use of the fully-adjusted T-scores is recommended.

*Note*. 30-Min Recall = 30-Minute Delayed Recall; PC = Percentage Correct; Sum of Trials = Trials 1-5 total + trial 6 + 30-min recall.

**Table A3.** Table for converting raw scores to unadjusted scaled scores for secondary variables. **a**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SS | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Trial 5 | Trials 1-3 Total | List B | Trial 6 | STPR | LTPR | Memory Efficiency Score |
| 0 | 0 | 0-1 | 0-1 | 0-2 | 0-2 | 0-7 | - | - | - | - | -1.0 - -0.10 |
| 1 | - | 2 | 2 | 3 | 3 | 8 | - | - | - | - | -0.09 - 0.03 |
| 2 | 1 | - | 3 | 4 | 4 | 9 | 0 | 0 | 0 | - | 0.04 - 0.27 |
| 3 | 2 | 3 | 4 | - | 5 | 10-11 | - | - | 7-13 | 0 | 0.28 - 0.46 |
| 4 | - | 4 | - | 5 | - | 12 | 1 | 1-2 | 14-33 | 7-18 | 0.47 - 0.71 |
| 5 | - | - | 5 | 6 | 6 | 13 | - | 3 | 36-44 | 20-33 | 0.72 - 0.94 |
| 6 | 3 | 5 | 6 | - | 7 | 14-15 | 2 | 4 | 45-55 | 36-45 | 0.95 - 1.19 |
| 7 | - | - | - | 7 | 8 | 16-17 | 3 | 5 | 56-62 | 46-56 | 1.20 - 1.38 |
| 8 | 4 | 6 | 7 | 8 | 9 | 18 | - | 6 | 64-70 | 57-64 | 1.39 - 1.56 |
| 9 | - | 7 | 8 | 9 | 10 | 19-20 | 4 | 7 | 71-77 | 67-71 | 1.57 - 1.71 |
| 10 | 5 | - | 9 | 10 | 11 | 21-22 | - | 8 | 78-82 | 73-79 | 1.72 - 1.85 |
| 11 | - | 8 | 10 | 11 | 12 | 23-24 | 5 | 9-10 | 83-89 | 80-86 | 1.86 - 1.97 |
| 12 | 6 | 9 | 11 | 12 | 13 | 25-26 | - | 11 | 90-92 | 87-92 | 1.98 - 2.07 |
| 13 | - | 10 | 12 | 13 | - | 27-28 | 6 | 12 | 93 | 93 | 2.08 - 2.15 |
| 14 | 7 | - | - | - | 14 | 29-30 | 7 | 13 | 100 | - | 2.16 - 2.22 |
| 15 | 8 | 11 | 13 | 14 | - | 31-32 | - | 14 | - | 100 | 2.23 - 2.29 |
| 16 | 9 | 12 | 14 | - | 15 | 33-34 | 8 | 15 | - | - | 2.30 - 2.35 |
| 17 | - | 13 | - | 15 | - | 35-36 | 9 | - | - | - | 2.36 - 2.43 |
| 18 | 10 | 14 | 15 | - | - | 37 | 10 | - | - | - | 2.44 - 2.50 |
| 19 | 11 | - | - | - | - | 38 | 11 | - | - | - | 2.51 - 2.60 |
| 20 | 12-15 | 15 | - | - | - | 39-45 | 12-15 | - | - | - | 2.61 - 76.0 |

**a** Scaled scores are provided only as a step in determining the demographically-corrected T-scores using the equations below. These scaled scores are not adjusted for any demographic variables and should not be used for clinical practice. Use of the fully-adjusted T-scores is recommended.

*Note*. STPR = Short-Term Percentage Retention; LTPR = Long-Term Percentage Retention

***T* Score Formulas**

Age, sex, and education-adjusted T scores for a subject’s raw score(s) can be calculated with the formulas below.

**SS = scaled score**: determined from look-up tables above.

**Sex**: 0 = Female, 1 = male

**Education** level determination rules were as follows:

* If < 12 years, each full year of school completed is counted
* Vocational/Trade school years completed are counted
* GED=12 years
* High School Diploma=12 years
* College without degree: years completed are counted (13-15 years)
* 4 or more years of college, with no degree=15 years
* Bachelor's Degree=16 years
* Bachelor's Degree plus some graduate school=17 years
* Master's Degree=18 years
* Master's Degree plus some doctoral level courses=19 years
* Attorneys and Priests=19 years
* Doctoral degree=20 years

*Note*. Caution is suggested when interpreting performance in individuals with 8-11 years of education. Application of the fully demographically corrected normative formulas for individuals with age or education levels outside of the observed ranges is not recommended.

**Equations for fully-adjusted T-Scores:**

**Primary variables**

Trials 1-5 Total T-Score =rounde(50+((((AVLTSum5SS -(10.2048820335+(Age\* 0.0696731708)+(Male\*-2.0691847063)+(EDUC\* 0.2076286782)+(Age\*\*2 \*-0.0014410120)))/1)+0.0000000637336)/0.23569807));

30-Min Recall T-Score =rounde(50+((((AVDSS -(12.4118437425+(Age\*-0.0016432817)+(Male\*-1.8612455591)+(EDUC\* 0.1380628944)+(Age\*\*2 \*-0.0007027918)))/1)+0.0000001024411)/0.25299505));

Sum of Trials T-Score =rounde(50+((((AVLTsum5p6DSS-(10.8349191766+(Age\* 0.0514562686)+(Male\*-2.0670904968)+(EDUC\* 0.1915793153)+(Age\*\*2 \*-0.0012694294)))/1)-0.0000001038205)/0.23673872));

Recognition Percentage Correct T-Score =rounde(50+((((AVRecPCSS -(10.7915054797+(Age\* 0.0163995950)+(Male\*-1.8832719513)+(EDUC\* 0.1180746912)+(Age\*\*2 \*-0.0005488200)))/1)+0.0000001925238)/0.29155771));

**Secondary variables**

Trial 1 T-Score =rounde(50+((((AV1SS -(10.5554207904+(Age\* 0.0361599800)+(Age\*\*2 \*-0.0009181852)+(Male\*-1.2432854518)+(EDUC\*0.1518778446)))/1)-0.0000001305326)/0.26867547));

Trial 2 T-Score =rounde(50+((((AV2SS -(10.2054872384+(Age\* 0.0513655747)+(Age\*\*2 \*-0.0011932848)+(Male\*-1.7651639080)+(EDUC\*0.1919280336)))/1)-0.0000000448036)/0.25613384));

Trial 3 T-Score =rounde(50+((((AV3SS -(10.6083066798+(Age\* 0.0436932539)+(Age\*\*2 \*-0.0011424483)+(Male\*-1.7605746863)+(EDUC\*0.1870822095)))/1)-0.0000001720072)/0.24470110));

Trial 4 T-Score =rounde(50+((((AV4SS -(10.3271703981+(Age\* 0.0637213583)+(Age\*\*2 \*-0.0013266346)+(Male\*-1.9598250972)+(EDUC\*0.1859304791)))/1)-0.0000002083300)/0.24650622));

Trial 5 T-Score =rounde(50+((((AV5SS -( 9.9952872306+(Age\* 0.0622550674)+(Age\*\*2 \*-0.0012837374)+(Male\*-1.9754640301)+(EDUC\*0.1870905944)))/1)-0.0000000482041)/0.24516225));

Trials 1-3 Total T-Score =rounde(50+((((AVLTSum3SS -(10.4083623066+(Age\* 0.0537576200)+(Age\*\*2 \*-0.0012667176)+(Male\*-1.8439550539)+(EDUC\*0.1987705165)))/1)-0.0000000560410)/0.23872421));

List B T-Score =rounde(50+((((AVBSS -( 8.9167820377+(Age\* 0.0780069203)+(Age\*\*2 \*-0.0013677187)+(Male\*-1.1375184278)+(EDUC\*0.1914262059)))/(2.3996448266+(Age\*\*2 \*-0.0000533322)))+0.00000967380900)/0.12287159));

Trial 6 T-Score =rounde(50+((((AV6SS -(11.7981182251+(Age\* 0.0154689603)+(Age\*\*2 \*-0.0008517340)+(Male\*-1.6396477808)+(EDUC\*0.1436500033)))/1)+0.0000000285607)/0.25404381));

Short-Term Percentage Retention T-Score =rounde(50+((((AVSTPRSS -(12.3521586103+(Age\*-0.0320618335)+(Age\*\*2 \*-0.0001238422)+(Male\*-0.7356439106)+(EDUC\*0.0493228458)))/(1.7628871897+(Age\*\*2 \* 0.0001168168)))+0.00000072036751)/0.12110756));

Long-Term Percentage Retention T-Score =rounde(50+((((AVLTPRSS -(13.3565938006+(Age\*-0.0448177870)+(Age\*\*2 \*-0.0000815093)+(Male\*-1.3287251835)+(EDUC\*0.0567713694)))/(2.0060197485+(Age\*\*2 \* 0.0000707217)))+0.00000042085768)/0.12427314));

Memory Efficiency Score T-Score =rounde(50+((((AVMemEffScSS -(11.6072102613+(Age\* 0.0018532956)+(Age\*\*2 \*-0.0004164258)+(Male\*-1.6379708166)+(EDUC\*0.0747602251)))/(1.8870824513+(Age\*\*2 \* 0.0000241449)))-0.00000100593800)/0.14018809));

**Alternative T-score formulas for primary variables**

**Equations for age- and sex-adjusted T-Scores:**

Trials 1-5 Total T-Score =rounde(50+((((AVLTSum5SS -(13.3975677899+(Age\* 0.0739281419)+(Age\*\*2 \*-0.0015449437)+(Male\*-1.9300702911)))/1)-0.000000215137900)/0.24136506));

30-Min Recall T-Score =rounde(50+((((AVDSS -(14.5348232863+(Age\* 0.0011860656)+(Age\*\*2 \*-0.0007719013)+(Male\*-1.7687412914)))/1)-0.000000142809100)/0.25534659));

Sum of Trials T-Score =rounde(50+((((AVLTsum5p6DSS-(13.7813144042+(Age\* 0.0553751285)+(Age\*\*2 \*-0.0013653039)+(Male\*-1.9391251867)))/1)+0.000000188774220)/0.24155121));

Recognition Percentage Correct T-Score =rounde(50+((((AVRecPCSS -(12.6060146804+(Age\* 0.0188551657)+(Age\*\*2 \*-0.0006082048)+(Male\*-1.8039811735)))/1)+0.000000150739090)/0.29305345));

**Equations for age-adjusted T-Scores:**

Trials 1-5 Total T-Score =rounde(50+((((AVLTSum5SS -(12.7156031925+(Age\* 0.0621605724)+(Age\*\*2 \*-0.0014370025)))/1)-0.000000053633100)/0.25992588));

30-Min Recall T-Score =rounde(50+((((AVDSS -(13.9098621394+(Age\*-0.0095978869)+(Age\*\*2 \*-0.0006729826)))/1)+0.000000048148911)/0.27021437));

Sum of Trials T-Score =rounde(50+((((AVLTsum5p6DSS-(13.0971814680+(Age\* 0.0435109130)+(Age\*\*2 \*-0.0012564840)))/1)-0.000003235023000)/0.26026677));

Recognition Percentage Correct T-Score =rounde(50+((((AVRecPCSS -(11.9632533397+(Age\* 0.0080540559)+(Age\*\*2 \*-0.0005089992)))/1)+0.000000096505809)/0.30660879));

Table A4. Total number of intrusions across all trials (trials 1-5, list B, trial 6, and 30 minute recall). The second column includes the observed cumulative percent. The third column provides ranges for suggested bins for clinical decision-making.

|  |  |  |
| --- | --- | --- |
| **Intrusions** | **Observed Cumulative Percent** | **Cumulative Percentile Range** |
| 0 | 100 | ≤ 14 |
| 1 | 68.4 |
| 2 | 45.3 |
| 3 | 30.2 |
| 4 | 20.5 |
| 5 | 14.0 |
| 6 | 9.7 | 2-10 |
| 7 | 6.8 |
| 8 | 4.6 |
| 9 | 3.3 |
| 10 | 2.4 |
| 11 | 1.6 | < 2 |
| 12 | 1.2 |
| 13+ | 0.9 |