# Supplementary Material

**Supplemental Table 1.** Patient characteristics by diagnostic group.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | SCD | MCI | Ad dementia | FTD | VD | DLB | PPA | Other dementia |
| N | 1,369 | 756 | 856 | 203 | 83 | 149 | 58 | 125 |
| Age in years | 59.7 ± 9.1 | 66.3 ± 7.5 | 66.8 ± 7.9 | 63.1 ± 7.8 | 69.1 ± 6.8 | 68.6 ± 6.4 | 66.6 ± 7.2 | 65.8 ± 7.9 |
| Female, n (%) | 592 (40.6) | 275 (36.4) | 381 (44.5) | 80 (39.4) | 27 (32.5) | 24 (16.1) | 26 (44.8) | 57 (45.6) |
| Education years, M (IQR) | 13 (10–13) | 10 (9–13) | 10 (9–13) | 10 (9–13) | 10 (9–13) | 10 (9–13) | 11.5 (9.25–13) | 10 (9–13) |
| Aβ status, n abnormal/n available (%) | 219/957 (22.9) | 348/625 (55.7) | 648/712 (91.0) | 28/160 (17.5) | 22/53 (41.5) | 67/118 (56.8) | 22/47 (46.8) | 36/97 (37.1) |
| MTA, average left/right, M (IQR) | 0 (0–0.5) | 1 (0–1.5) | 1.5 (0.5–2) | 1.5 (1–2) | 1.5 (1–2) | 1 (0.5–1) | 1 (0.5–1.5) | 1.5 (1–1.5) |
| MMSE | 28.2 ± 1.7 | 26.6 ± 2.3 | 22.7 ± 3.9 | 24.7 ± 3.9 | 24.0 ± 3.7 | 23.9 ± 3.4 | 25.1 ± 3.3 | 24.3 ± 3.9 |
| GDS | 3.3 ± 2.8 | 3.3 ± 2.9 | 2.9 ± 2.6 | 3.4 ± 3.3 | 3.9 ± 3.0 | 4.3 ± 3.0 | 4.2 ± 3.3 | 4.4 ± 3.5 |
| VAT  A, 3 trials  B, 3 trials | 17.6 ± 1.0  16.7 ± 1.7 | 15.9 ± 2.8  13.3 ± 4.3 | 13.3 ± 4.0  9.5 ± 5.2 | 15.8 ± 3.1  13.3 ± 4.5 | 14.9 ± 3.3  13.1 ± 4.2 | 16.3 ± 2.8  14.5 ± 4.1 | 16.8 ± 2.0  15.7 ± 2.7 | 16.3 ± 2.8  14.5 ± 4.1 |
| AVLT  Immediate  Delayed | 41.6 ± 9.5  8.4 ± 2.9 | 30.2 ± 7.4  3.9 ± 2.6 | 23.5 ± 7.9  2.4 ± 2.5 | 29.3 ± 10.0  4.7 ± 3.4 | 25.3 ± 7.9  3.7 ± 2.7 | 25.3 ± 8.8  4.2 ± 2.7 | 28.3 ± 11.2  5.1 ± 3.5 | 28.1 ± 8.5  4.9 ± 2.9 |
| RCFT immediate recall | 19.5 ± 5.6 | 12.8 ± 5.6 | 8.9 ± 5.5 | 12.9 ± 7.4 | 12.4 ± 5.4 | 10.4 ± 4.6 | 15.4 ± 6.3 | 13.8 ± 4.9 |

All data displayed as mean ± standard deviation, except as noted otherwise.

*Abbreviations:* AD, Alzheimer’s disease; DLB, dementia with Lewy bodies; FTD, frontotemporal dementia; MCI, mild cognitive impairment; PPA, primary progressive aphasia; SCD, subjective cognitive decline; VD, vascular dementia.

**Supplemental Table 2.** Areas under the curves for distinguishing AD dementia from clinical stages and other types of dementia, with 95% confidence intervals, stratified by VAT version.

| AD dementia vs. | VAT-A/C | VAT-B/D | VAT-A/C + VAT-B/D |
| --- | --- | --- | --- |
| Clinical stage |  |  |  |
| *Both versions*  SCD  MCI | 0.88 [0.86, 0.89]  0.72 [0.69, 0.74] | 0.91 [0.90, 0.93]  0.71 [0.69, 0.74] | 0.93 [0.91, 0.94]  0.74 [0.71, 0.76] |
| *VAT A+B*  SCD  MCI | 0.87 [0.86, 0.89]  0.71 [0.68, 0.74] | 0.91 [0.90, 0.93]  0.71 [0.69, 0.74] | 0.93 [0.91, 0.94]  0.73 [0.71, 0.76] |
| *VAT C+D*  SCD  MCI | 0.88 [0.82, 0.93]  0.74 [0.64, 0.83] | 0.93 [0.88, 0.97]  0.75 [0.66, 0.84] | 0.93 [0.89, 0.96]  0.76 [0.67, 0.85] |
| Dementia type |  |  |  |
| *Both versions*  ftd  VD  DLB  PPA  Any type | 0.75 [0.71, 0.79]  0.71 [0.65, 0.77]  0.62 [0.57, 0.66]  0.80 [0.75, 0.85]  0.72 [0.69, 0.75] | 0.76 [0.72, 0.79]  0.72 [0.66, 0.77]  0.70 [0.66, 0.75]  0.85 [0.81, 0.89]  0.75 [0.73, 0.78] | 0.77 [0.73, 0.81]  0.73 [0.68, 0.79]  0.70 [0.66, 0.75]  0.86 [0.82, 0.90]  0.76 [0.73, 0.78] |
| *VAT A+B*  ftd  VD  DLB  PPA  Any type | 0.75 [0.71, 0.79]  0.71 [0.65, 0.77]  0.63 [0.58, 0.68]  0.81 [0.76, 0.87]  0.72 [0.70, 0.75] | 0.76 [0.72, 0.80]  0.71 [0.65, 0.77]  0.72 [0.67, 0.76]  0.85 [0.80, 0.89]  0.75 [0.73, 0.78] | 0.77 [0.73, 0.81]  0.73 [0.67, 0.79]  0.72 [0.67, 0.76]  0.86 [0.81, 0.90]  0.76 [0.74, 0.79] |
| *VAT C+D*  ftd  VD  DLB  PPA  Any type | 0.77 [0.64, 0.89]  0.68 [0.37, 0.99]  0.54 [0.38, 0.69]  0.81 [0.65, 0.96]  0.72 [0.64, 0.80] | 0.72 [0.59, 0.86]  0.77 [0.52, 1.00]  0.57 [0.43, 0.72]  0.90 [0.82, 0.99]  0.74 [0.66, 0.82] | 0.75 [0.62, 0.88]  0.75 [0.47, 1.00]  0.58 [0.43, 0.72]  0.89 [0.80, 0.98]  0.74 [0.66, 0.82] |

Parallel versions of AVLT (different word list) and RCFT (Modified Taylor Complex Figure) were also administered when the parallel version of the VAT was used.

*Abbreviations:* AD, Alzheimer’s disease; AVLT, Auditory Verbal Learning Task; DLB, dementia with Lewy bodies; FTD, frontotemporal dementia; MCI, mild cognitive impairment; PPA, primary progressive aphasia; RCFT, Rey Complex Figure Test; SCD, subjective cognitive decline; VAT, Visual Association Test; VD, vascular dementia.

**Supplemental Table 3.** Areas under the curves for distinguishing AD dementia from clinical stages and other types of dementia, with 95% confidence intervals, with and without carrying forward of scores.

| AD dementia vs. | VAT-A | VAT-B | VAT-A + VAT-B |
| --- | --- | --- | --- |
| Clinical stage |  |  |  |
| *With scores carried forward*  SCD  MCI | 0.88 [0.86, 0.89]  0.72 [0.69, 0.74] | 0.91 [0.90, 0.93]  0.71 [0.69, 0.74] | 0.93 [0.91, 0.94]  0.74 [0.71, 0.76] |
| *Without scores carried forward1*  SCD  MCI | 0.87 [0.85, 0.89]  0.71 [0.69, 0.74] | 0.90 [0.88, 0.92]  0.70 [0.68, 0.73] | 0.92 [0.90, 0.93]  0.72 [0.70, 0.75] |
| Dementia type |  |  |  |
| *With scores carried forward*  ftd  VD  DLB  PPA  Any type | 0.75 [0.71, 0.79]  0.71 [0.65, 0.77]  0.62 [0.57, 0.66]  0.80 [0.75, 0.85]  0.72 [0.69, 0.75] | 0.76 [0.72, 0.79]  0.72 [0.66, 0.77]  0.70 [0.66, 0.75]  0.85 [0.81, 0.89]  0.75 [0.73, 0.78] | 0.77 [0.73, 0.81]  0.73 [0.68, 0.79]  0.70 [0.66, 0.75]  0.86 [0.82, 0.90]  0.76 [0.73, 0.78] |
| *Without scores carried forward1*  ftd  VD  DLB  PPA  Any type | 0.75 [0.71, 0.79]  0.73 [0.67, 0.78]  0.62 [0.57, 0.66]  0.80 [0.74, 0.85]  0.72 [0.70, 0.75] | 0.76 [0.72, 0.80]  0.73 [0.67, 0.79]  0.70 [0.66, 0.75]  0.83 [0.78, 0.88]  0.75 [0.73, 0.78] | 0.78 [0.74, 0.82]  0.74 [0.69, 0.80]  0.71 [0.66, 0.75]  0.84 [0.79, 0.89]  0.76 [0.73, 0.79] |

1 Excluding the 324 participants who did not achieve a score of 6 on the second trial but were not administered a third set.

*Abbreviations:* AD, Alzheimer’s disease; AVLT, Auditory Verbal Learning Task; DLB, dementia with Lewy bodies; FTD, frontotemporal dementia; MCI, mild cognitive impairment; PPA, primary progressive aphasia; RCFT, Rey Complex Figure Test; SCD, subjective cognitive decline; VAT, Visual Association Test; VD, vascular dementia.

**Supplemental Table 4.** Predicting VAT performance based on average MTA score, stratified by VAT version.

| Model | Learned all on VAT A/C, but not on VAT B/D | | Did not learn all associations on VAT A/C, nor VAT B/D | |
| --- | --- | --- | --- | --- |
| OR [95%CI] | *p* | OR [95%CI] | *p* |
| 1: Unadjusted |  |  |  |  |
| *Both versions*  MTA 0.5  MTA 1  MTA 1.5  MTA 2  MTA 2.5  MTA ≥3 | 1.80 [1.34, 2.43]  2.80 [2.16, 3.64]  4.47 [3.31, 6.06]  4.25 [3.11, 5.81]  7.60 [4.82, 11.99]  7.35 [4.46, 12.13] | < .001  < .001  < .001  < .001  < .001  < .001 | 2.52 [1.81, 3.53]  3.38 [2.49, 4.58]  6.39 [4.56, 8.95]  6.14 [4.34, 8.68]  6.86 [3.99, 11.80]  13.37 [8.08, 22.13] | < .001  < .001  < .001  < .001  < .001  < .001 |
| *VAT A+B*  MTA 0.5  MTA 1  MTA 1.5  MTA 2  MTA 2.5  MTA ≥3 | 1.83 [1.35, 2.49]  3.06 [2.34, 4.00]  4.73 [3.46, 6.47]  4.76 [3.45, 6.57]  8.46 [5.26, 13.61]  7.20 [4.28, 12.11] | < .001  < .001  < .001  < .001  < .001  < .001 | 2.54 [1.77, 3.64]  3.55 [2.56, 4.92]  7.37 [5.17, 10.51]  6.46 [4.45, 9.37]  8.61 [4.92, 15.08]  13.04 [7.64, 22.26] | < .001  < .001  < .001  < .001  < .001  < .001 |
| *VAT C+D1*  MTA 0.5  MTA 1  MTA 1.5  MTA 2 or 2.5  MTA ≥3 | 1.38 [0.43, 4.42]  0.65 [0.20, 2.14]  2.00 [0.61, 6.57]  1.07 [0.32, 3.60]  9.00 [1.29, 62.59] | .343  .311  .208  .397  .034 | 2.03 [0.76, 5.41]  1.67 [0.69, 4.06]  1.07 [0.30, 3.84]  2.23 [0.86, 5.75]  14.40 [2.53, 81.98] | .146  .210  .397  .101  .004 |
| 2: Adjusted for age, sex, and education |  |  |  |  |
| *Both versions*  MTA 0.5  MTA 1  MTA 1.5  MTA 2  MTA 2.5  MTA ≥3 | 1.63 [1.20, 2.21]  2.18 [1.66, 2.88]  3.35 [2.43, 4.61]  3.16 [2.27, 4.41]  5.60 [3.47, 9.03]  5.13 [3.04, 8.65] | .003  < .001  < .001  < .001  < .001  < .001 | 2.37 [1.68, 3.33]  2.92 [2.11, 4.03]  5.31 [3.71, 7.60]  5.29 [3.66, 7.65]  6.23 [3.54, 10.97]  11.31 [6.66, 19.21] | < .001  < .001  < .001  < .001  < .001  < .001 |
| *VAT A+B*  MTA 0.5  MTA 1  MTA 1.5  MTA 2  MTA 2.5  MTA ≥3 | 1.64 [1.20, 2.25]  2.33 [1.76, 3.11]  3.47 [2.49, 4.85]  3.45 [2.45, 4.87]  6.11 [3.71, 10.07]  4.78 [2.77, 8.23] | .004  < .001  < .001  < .001  < .001  < .001 | 2.32 [1.61, 3.34]  2.90 [2.05, 4.09]  5.77 [3.95, 8.42]  5.19 [3.49, 7.71]  7.36 [4.09, 13.22]  9.97 [5.67, 17.53] | < .001  < .001  < .001  < .001  < .001  < .001 |
| *VAT C+D1*  MTA 0.5  MTA 1  MTA 1.5  MTA 2 or 2.5  MTA ≥3 | 1.54 [0.47, 5.03]  0.74 [0.22, 2.53]  2.05 [0.59, 7.12]  1.23 [0.34, 4.51]  10.70 [1.43, 80.06] | .310  .356  .209  .380  .028 | 2.74 [0.97, 7.77]  2.46 [0.94, 6.46]  1.44 [0.37, 5.52]  3.49 [1.21, 10.04]  21.65 [18.00, 26.04] | .066  .074  .347  .027  < .001 |

All models use MTA 0 and the group of patients learning all associations on both sets (A+B/C+D) as the reference. 1 The models for VAT-C+D did not support the MTA 2.5 due to limited observations; this category was folded into MTA 2.

*Abbreviations:* MTA, medial temporal lobe atrophy; OR, odds ratio; VAT, Visual Association Test; 95%CI, 95% confidence interval.

**Supplemental Table 5.** Predicting VAT performance based on average MTA score, with and without carrying forward of scores.

| Model | Learned all on VAT A, but not on VAT B | | Did not learn all associations on VAT A, nor VAT B | |
| --- | --- | --- | --- | --- |
| OR [95%CI] | *p* | OR [95%CI] | *p* |
| 1: Unadjusted |  |  |  |  |
| *With scores carried forward*  MTA 0.5  MTA 1  MTA 1.5  MTA 2  MTA 2.5  MTA ≥3 | 1.80 [1.34, 2.43]  2.80 [2.16, 3.64]  4.47 [3.31, 6.06]  4.25 [3.11, 5.81]  7.60 [4.82, 11.99]  7.35 [4.46, 12.13] | < .001  < .001  < .001  < .001  < .001  < .001 | 2.52 [1.81, 3.53]  3.38 [2.49, 4.58]  6.39 [4.56, 8.95]  6.14 [4.34, 8.68]  6.86 [3.99, 11.80]  13.37 [8.08, 22.13] | < .001  < .001  < .001  < .001  < .001  < .001 |
| *Without scores carried forward1*  MTA 0.5  MTA 1  MTA 1.5  MTA 2  MTA 2.5  MTA ≥3 | 1.89 [1.34, 2.65]  3.11 [2.32, 4.17]  4.92 [3.51, 6.90]  4.02 [2.81, 5.76]  7.08 [4.23, 11.85]  6.22 [3.48, 11.13] | < .001  < .001  < .001  < .001  < .001  < .001 | 2.29 [1.61, 3.26]  3.38 [2.46, 4.63]  6.04 [4.25, 8.57]  5.49 [3.82, 7.90]  6.73 [3.85, 11.78]  13.56 [8.12, 22.65] | < .001  < .001  < .001  < .001  < .001  < .001 |
| 2: Adjusted for age, sex, and education |  |  |  |  |
| *With scores carried forward*  MTA 0.5  MTA 1  MTA 1.5  MTA 2  MTA 2.5  MTA ≥3 | 1.63 [1.20, 2.21]  2.18 [1.66, 2.88]  3.35 [2.43, 4.61]  3.16 [2.27, 4.41]  5.60 [3.47, 9.03]  5.13 [3.04, 8.65] | .003  < .001  < .001  < .001  < .001  < .001 | 2.37 [1.68, 3.33]  2.92 [2.11, 4.03]  5.31 [3.71, 7.60]  5.29 [3.66, 7.65]  6.23 [3.54, 10.97]  11.31 [6.66, 19.21] | < .001  < .001  < .001  < .001  < .001  < .001 |
| *Without scores carried forward1*  MTA 0.5  MTA 1  MTA 1.5  MTA 2  MTA 2.5  MTA ≥3 | 1.76 [1.24, 2.49]  2.60 [1.90, 3.55]  3.98 [2.78, 5.71]  3.29 [2.24, 4.83]  5.64 [3.28, 9.70]  4.78 [2.61, 8.77] | .001  < .001  < .001  < .001  < .001  < .001 | 2.16 [1.51, 3.09]  3.06 [2.19, 2.59]  5.38 [3.71, 7.81]  5.05 [3.43, 7.44]  6.40 [3.57, 11.47]  12.20 [7.11, 20.95] | < .001  < .001  < .001  < .001  < .001  < .001 |

All models use MTA 0 and the group of patients learning all associations on both sets (A+B) as the reference. 1 Excluding the 324 participants who did not achieve a score of 6 on the second trial but were not administered a third set.

*Abbreviations:* MTA, medial temporal lobe atrophy; OR, odds ratio; VAT, Visual Association Test; 95%CI, 95% confidence interval.

**Supplemental Table 6.** Predicting VAT performance based on GCA and Fazekas scores.

| Model | Learned all on VAT A/C, but not on VAT B/D | | Did not learn all associations on VAT A/C, nor VAT B/D | |
| --- | --- | --- | --- | --- |
| OR [95%CI] | *p* | OR [95%CI] | *p* |
| 1: Unadjusted |  |  |  |  |
| GCA 1  GCA 2  GCA 3 | 2.74 [2.24, 3.35]  3.75 [2.86, 4.91]  4.46 [1.60, 12.44] | < .001  < .001  .004 | 3.23 [2.57, 4.07]  4.67 [3.48, 6.27]  4.23 [1.31, 13.68] | < .001  < .001  .016 |
| Fazekas 1  Fazekas 2  Fazekas 3 | 1.54 [1.25, 1.89]  1.67 [1.27, 2.18]  1.71 [1.17, 2.50] | < .001  < .001  .006 | 1.77 [1.41, 2.23]  1.85 [1.37, 2.49]  2.37 [1.60, 3.50] | < .001  < .001  < .001 |
| 2: Adjusted for age, sex, and education |  |  |  |  |
| GCA 1  GCA 2  GCA 3 | 2.06 [1.65, 2.56]  2.43 [1.81, 3.27]  2.89 [1.01, 8.28] | < .001  < .001  .048 | 2.67 [2.08, 3.42]  3.49 [2.52, 4.83]  3.35 [1.01, 11.14] | < .001  < .001  .048 |
| Fazekas 1  Fazekas 2  Fazekas 3 | 1.09 [0.87, 1.35]  0.93 [0.69, 1.24]  0.85 [0.57, 1.28] | .454  .597  .444 | 1.28 [1.00, 1.63]  1.09 [0.79, 1.50]  1.26 [0.83, 1.92] | .047  .618  .277 |

All models use GCA 0 or Fazekas 0 and the group of patients learning all associations on both sets (A+B/C+D) as the reference.

*Abbreviations:* GCA, global cortical atrophy; OR, odds ratio; VAT, Visual Association Test; 95%CI, 95% confidence interval.

**Supplemental Table 7.** Predicting VAT performance based on amyloid status, stratified by VAT version.

| Model | Learned all on VAT A/C, but not on VAT B/D | | Did not learn all associations on VAT A/C, nor VAT B/D | |
| --- | --- | --- | --- | --- |
| OR [95%CI] | *p* | OR [95%CI] | *p* |
| 1: Unadjusted  Both versions  VAT A+B  VAT C+D | 3.71 [3.00, 4.60]  3.88 [3.11, 4.83]  2.38 [0.94, 6.03] | < .001  < .001  .075 | 7.12 [5.46, 9.27]  7.04 [5.34, 9.27]  7.19 [2.68, 19.29] | < .001  < .001  < .001 |
| 2: Adjusted for age, sex, and education  Both versions  VAT A+B  VAT C+D | 3.38 [2.71, 4.22]  3.50 [2.78, 4.41]  2.41 [0.94, 6.19] | < .001  < .001  .075 | 6.35 [4.84, 8.34]  6.21 [4.67, 8.26]  6.74 [2.44, 18.63] | < .001  < .001  < .001 |
| 3: Adjusted for age, sex, education, and clinical diagnosis  Both versions  VAT A+B  VAT C+D | 1.49 [1.14, 1.94]  1.61 [1.23, 2.12]  0.19 [0.03, 1.11] | .006  .001  .073 | 1.90 [1.36, 2.64]  1.87 [1.33, 2.64]  1.75 [0.45, 6.83] | < .001  < .001  .289 |

All models use amyloid negative and the group of patients learning all associations on both sets (A+B/C+D) as the reference.

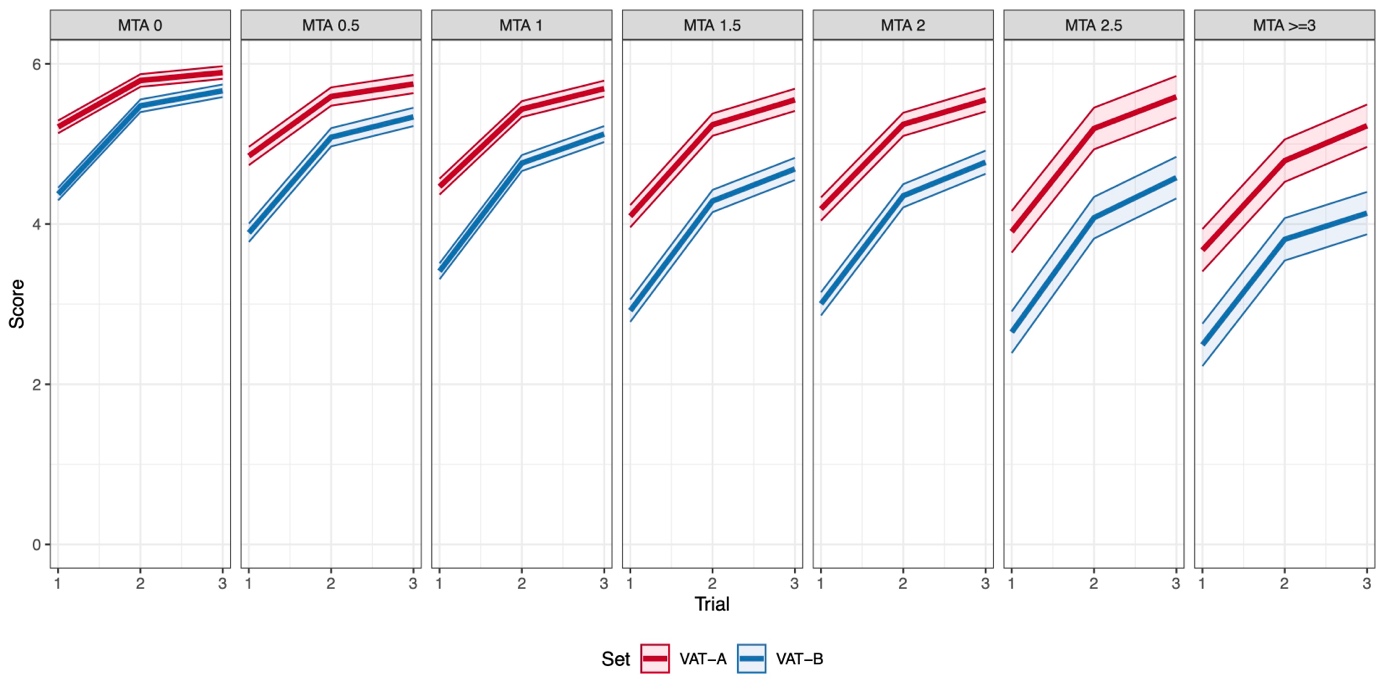
*Abbreviations:* OR, odds ratio; VAT, Visual Association Test; 95%CI, 95% confidence interval.

**Supplemental Table 8.** Predicting VAT performance based on amyloid status, with and without carrying forward of scores.

| Model | Learned all on VAT A, but not on VAT B | | Did not learn all associations on VAT A, nor VAT B | |
| --- | --- | --- | --- | --- |
| OR [95%CI] | *p* | OR [95%CI] | *p* |
| 1: Unadjusted  With scores carried forward  Without scores carried forward1 | 3.71 [3.00, 4.60]  4.19 [3.29, 5.33] | < .001  < .001 | 7.12 [5.46, 9.27]  7.76 [5.86, 10.28] | < .001  < .001 |
| 2: Adjusted for age, sex, and education  With scores carried forward  Without scores carried forward1 | 3.38 [2.71, 4.22]  3.96 [3.08, 5.10] | < .001  < .001 | 6.35 [4.84, 8.34]  7.09 [5.31, 9.47] | < .001  < .001 |
| 3: Adjusted for age, sex, education, and clinical diagnosis  With scores carried forward  Without scores carried forward1 | 1.49 [1.14, 1.94]  1.66 [1.23, 2.24] | .006  .001 | 1.90 [1.36, 2.64]  2.05 [1.45, 2.91] | < .001  < .001 |

All models use amyloid negative and the group of patients learning all associations on both sets (A+B) as the reference. 1 Excluding the 324 participants who did not achieve a score of 6 on the second trial but were not administered a third set.

*Abbreviations:* OR, odds ratio; VAT, Visual Association Test; 95%CI, 95% confidence interval.



**Supplemental Figure 1.** Learning curves over VAT-A (red) and VAT-B (blue), stratified by MTA score, among amyloid positive individuals.