**Developmental Trajectories of Premorbid Functioning Predict Cognitive Remediation Treatment Response in First-Episode Schizophrenia**

SUPPLEMENT

[SUPPLEMENTAL TABLES 2](#_Toc115438045)

[Supplemental Table 1. Sample characteristics by intervention protocol. 2](#_Toc115438046)

[Supplemental Table 2. Premorbid adjustment scores by developmental period and trajectory classification. 3](#_Toc115438047)

[Supplemental Table 3. Characteristics of developmental trajectory classifications in overall sample. 4](#_Toc115438048)

[Supplemental Table 4. Cognitive remediation baseline, 6-month follow-up, and gain scores. 5](#_Toc115438049)

[Supplemental Table 5. Cognitive remediation gains by intervention protocol. 6](#_Toc115438050)

[Supplemental Table 6. Developmental trajectories by intervention protocol. 7](#_Toc115438051)

[Supplemental Table 7. Multiple regression model of developmental trajectories predicting cognitive remediation gains in speed of processing, accounting for key demographic and clinical variables. 8](#_Toc115438052)

[SUPPLEMENTAL FIGURES 9](#_Toc115438053)

[Supplemental Figure 1. Study flowchart. 9](#_Toc115438054)

[Supplemental Figure 2. Developmental trajectory classifications for schizophrenia participants and healthy participants in the overall sample. 10](#_Toc115438055)

[Supplemental Figure 2. All cognitive remediation gains by developmental trajectories. 11](#_Toc115438056)

[SUPPLEMENTAL REFERENCES 12](#_Toc115438057)

## SUPPLEMENTAL TABLES

### Supplemental Table 1. Sample characteristics by intervention protocol.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | NET/NEAR (*N*=34) | BrainHQ(*N*=28) |  |  |  |
| Characteristic | Mean/*N* | SD/% | Mean/*N* | SD/% | Statistic | *df* | *p* |
| Age (years) | 21.56 | 2.86 | 23.18 | 4.23 | 3.204 | 1, 60 | 0.079 |
| Sex (male) | 25 | 73.5% | 23 | 82.1% | 0.252 | 1 | 0.616 |
| Parental Education (years) | 13.97 | 4.28 | 13.73 | 3.37 | 0.042 | 1, 57 | 0.839 |
| Race |  |  |  |  |  |  |  |
|  African-American | 12 | 35.3% | 7 | 25.0% | 0.358 | 1 | 0.550 |
|  Asian-American/Pacific Islander | 4 | 11.8% | 1 | 3.6% | 0.505 | 1 | 0.477 |
|  Caucasian | 15 | 44.1% | 7 | 25.0% | 1.687 | 1 | 0.194 |
|  Hispanic/Latinx | 0 | 0.0% | 7 | 25.0% | 7.248 | 1 | 0.007 |
|  Native American | 3 | 8.8% | 1 | 3.6% | 0.101 | 1 | 0.750 |
|  Multiracial/Other | 0 | 0.0% | 5 | 17.9% | 4.415 | 1 | 0.036 |
| Age at Psychosis Onset (years) | 20.38 | 3.28 | 21.89 | 4.21 | 2.518 | 1, 60 | 0.118 |
| Illness Duration (years) | 1.18 | 1.47 | 1.29 | 0.98 | 0.114 | 1, 60 | 0.737 |

*Note.* Results of one-way ANOVAs are presented for age, parental education, age at psychosis onset, and illness duration, whereas chi-square tests are reported for sex and race. Parental education was computed from the mean of maternal education and paternal education. NET/NEAR: Neurocognitive Enhancement Therapy (NET; Bell, Bryson, Greig, Corcoran, & Wexler, 2001) and Neuropsychological Educational Approach to Remediation (NEAR; Medalia, Herlands, & Revheim, 2009). BrainHQ: Posit Science BrainHQ (Mahncke et al., 2006).

### Supplemental Table 2. Premorbid adjustment scores by developmental period and trajectory classification.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Stable-Good(*N*=98) | Deteriorating(*N*=86) | Stable-Poor(*N*=31) |
| Developmental Period | Mean | SD | Mean | SD | Mean | SD |
| Childhood |  0.59 | 0.44 | 1.68 | 0.67 | 2.52 | 0.71 |
| Early Adolescence |  0.74 | 0.40 | 1.84 | 0.47 | 3.06 | 0.39 |
| Late Adolescence |  1.09 | 0.77 | 2.07 | 0.86 | 3.31 | 0.70 |

*Note.* Adjustment scores based on Cannon-Spoor Premorbid Adjustment Scale (PAS; Cannon-Spoor, Potkin, & Wyatt, 1982), with higher scores representing worse adjustment.

### Supplemental Table 3. Characteristics of developmental trajectory classifications in overall sample.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Stable-Good(*N*=98) | Deteriorating(*N*=86) | Stable-Poor(*N*=31) |  |  |  |
| Characteristic | Mean/*N* | SD/% | Mean/*N* | SD/% | Mean/*N* | SD/% | Statistic | *df* | *p* |
| Age (years) |  22.62 | 4.04  |  22.53 | 4.12  |  21.23 | 2.89  | 1.589 | 2, 212 | 0.207 |
| Sex (male) |  59 | 60.2%  |  66 | 76.7%  |  27 | 87.1% | 10.750 | 2 | 0.005  |
| Parental Education (years) |  14.33 | 3.64  |  13.40 | 4.10  |  12.76 | 2.82  | 2.521 | 2, 206 | 0.083  |
| Race |   |   |   |   |   |   |  |  |   |
|  African-American |  14 |  14.3% | 15  | 17.4% |  11 | 35.5% | 7.116 | 2 | 0.029  |
|  Asian-American/Pacific Islander |  14 |  14.3% |  13 | 15.1% |  2 | 6.5% | 1.564 | 2 | 0.457  |
|  Caucasian |  57 |  58.2% |  41 | 47.7% |  11 | 35.5% | 5.370 | 2 | 0.068  |
|  Hispanic/Latinx |  5 |  5.1% |  5 | 5.8% |  1 | 3.2% | 0.315 | 2 | 0.854  |
|  Native American |  2 |  2.0% |  1 | 1.2% |  2 | 6.5% | 2.715 | 2 | 0.257  |
|  Multiracial/Other |  6 |  6.1% |  11 | 12.8% |  4 |  12.9% | 2.870 | 2 | 0.238  |
| Schizophrenia Diagnosis | 67 | 68.4% | 73 | 84.9% | 30 | 96.8% | 14.411 | 2 | <0.001 |
| Age at Psychosis Onset (years) |  21.25 | 4.03  | 21.51 | 4.55  | 19.83 | 3.27  | 1.791 | 2, 164 | 0.170  |
| Illness Duration (years) |  1.14 | 1.33  |  1.31 | 1.67  |  1.40 | 1.22  | 0.410 | 2, 164 | 0.664  |

*Note.* Results of one-way ANOVAs are presented for age, parental education, age at psychosis onset, and illness duration, whereas chi-square tests are reported for schizophrenia diagnosis, sex, and race.

### Supplemental Table 4. Cognitive remediation baseline, 6-month follow-up, and gain scores.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Baseline | Follow-Up | Gain | Significant Gain |
| Cognitive Domain | Mean | SD | Mean | SD | Mean | SD | *t* | *df* | *p* |
| Overall Composite | 29.90 | 15.17 | 33.42 | 15.39 | 3.53 | 6.38 | 4.243 | 58 | <0.001 |
| Speed of Processing | 34.69 | 14.38 | 39.87 | 14.25 | 5.18 | 9.28 | 4.391 | 61 | <0.001 |
| Attention/Vigilance | 34.97 | 10.73 | 35.66 | 11.29 | 0.69 | 6.43 | 0.830 | 58 | 1.000 |
| Working Memory | 39.56 | 14.95 | 41.56 | 12.74 | 2.00 | 7.77 | 2.026 | 61 | 0.377 |
| Verbal Learning | 39.19 | 10.54 | 42.13 | 12.34 | 2.94 | 7.83 | 2.935 | 61 | 0.036 |
| Visual Learning | 34.79 | 11.79 | 36.05 | 13.25 | 1.26 | 9.88 | 1.003 | 61 | 1.000 |
| Reasoning & Problem Solving | 41.66 |  9.91 | 44.08 | 10.92 | 2.42 | 8.01 | 2.380 | 61 | 0.164 |
| Social Cognition | 39.05 | 12.65 | 41.24 | 12.28 | 2.19 | 9.74 | 1.773 | 61 | 0.649 |

*Note.* *N*=62. Results of one-sample t-tests for cognitive remediation gains are presented. Cognitive remediation gains are differences in T-scores (mean=50, SD=10) between baseline and after 6 months of cognitive remediation, with positive values indicating cognitive improvements. Cognitive remediation scores were complete except for 3 scores in attention/vigilance (and thus also in overall composite). *p*-values are Bonferroni-corrected for multiple comparisons.

### Supplemental Table 5. Cognitive remediation gains by intervention protocol.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | NET/NEAR(*N*=34) | BrainHQ(*N*=29) |  |  |  |  |
| Cognitive Domain | Mean | SD | Mean | SD | *t* |  | *df* | *p* |
| Overall Composite | 3.03 | 6.60 | 4.07 | 6.21 | -0.62 |  | 56.89 | 0.536 |
| Speed of Processing | 5.06 | 8.70 | 5.32 | 10.10 | -0.11 |  | 53.68 | 0.914 |
| Attention/Vigilance | 1.74 | 6.08 | -0.46 | 6.71 | 1.32 |  | 54.80 | 0.193 |
| Working Memory | 0.50 | 7.99 | 3.82 | 7.23 | -1.72 |  | 59.42 | 0.091 |
| Verbal Learning | 3.12 | 7.77 | 2.71 | 8.03 | 0.20 |  | 56.99 | 0.842 |
| Visual Learning | 1.15 | 10.10 | 1.39 | 9.78 | -0.10 |  | 58.39 | 0.923 |
| Reasoning & Problem Solving | 3.06 | 7.77 | 1.64 | 8.36 | 0.69 |  | 55.92 | 0.496 |
| Social Cognition | 1.38 | 9.70 | 3.18 | 9.87 | -0.72 |  | 57.34 | 0.475 |

*Note.* Results of Welch’s two-sample t-tests are presented. Cognitive remediation gains are differences in T-scores (mean=50, SD=10) between baseline and after 6 months of cognitive remediation, with positive values indicating cognitive improvements.

### Supplemental Table 6. Developmental trajectories by intervention protocol.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Stable-Good(*N*=21) | Deteriorating(*N*=28) | Stable-Poor(*N*=13) |
| Intervention | *N* | % | *N* | % | *N* | % |
| NET/NEAR | 11 | 17.7% | 18 | 29.0% | 5 | 8.1% |
| BrainHQ | 10 | 16.1% | 10 | 16.1% | 8 | 12.9% |

*Note.* Developmental trajectory classifications did not differ significantly between intervention protocols ($χ$2(2)=2.468, *p*=0.291). NET/NEAR: Neurocognitive Enhancement Therapy (NET; Bell et al., 2001) and Neuropsychological Educational Approach to Remediation (NEAR; Medalia et al., 2009). BrainHQ: Posit Science BrainHQ (Mahncke et al., 2006).

### Supplemental Table 7. Multiple regression model of developmental trajectories predicting cognitive remediation gains in speed of processing, accounting for key demographic and clinical variables.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| Coefficient | Estimate | SE | *t* | *p* |
| *Intercept* | 16.277 | 9.782 | 1.66 | 0.102 |
| Age (years) | -1.176 | 0.960 | -1.23 | 0.226 |
| Sex (male) | -3.080 | 3.187 | -0.97 | 0.339 |
| Parental Education (years) | -1.290 | 2.489 | -0.52 | 0.607 |
| Race (Caucasian) | -0.489 | 0.311 | -1.57 | 0.122 |
| Age at Psychosis Onset (years) | 1.165 | 0.912 | 1.28 | 0.207 |
| Intervention Protocol (BrainHQ) | -2.756 | 2.491 | -1.11 | 0.274 |
| Trajectory (Stable-Good) | 3.870 | 2.835 | 1.37 | 0.178 |
| Trajectory (Stable-Poor) | 9.013 | 3.280 | 2.75 | 0.008 |

*Note.* Overall model: *F*(8, 50)=2.02, *p*=0.063.

## SUPPLEMENTAL FIGURES

### Supplemental Figure 1. Study flowchart.



### Supplemental Figure 2. Developmental trajectory classifications for schizophrenia participants and healthy participants in the overall sample.



### Supplemental Figure 3. All cognitive remediation gains by developmental trajectories.



*Note.* Cognitive remediation gains are differences in T-scores (mean=50, SD=10) between baseline and after 6 months of cognitive remediation, with positive values indicating cognitive improvements.

## SUPPLEMENTAL REFERENCES

Bell, M., Bryson, G., Greig, T., Corcoran, C., & Wexler, B. E. (2001). Neurocognitive enhancement therapy with work therapy: effects on neuropsychological test performance. *Arch Gen Psychiatry, 58*(8), 763-768. doi:10.1001/archpsyc.58.8.763

Cannon-Spoor, H. E., Potkin, S. G., & Wyatt, R. J. (1982). Measurement of premorbid adjustment in chronic schizophrenia. *Schizophr Bull, 8*(3), 470-484. doi:10.1093/schbul/8.3.470

Mahncke, H. W., Connor, B. B., Appelman, J., Ahsanuddin, O. N., Hardy, J. L., Wood, R. A., . . . Merzenich, M. M. (2006). Memory enhancement in healthy older adults using a brain plasticity-based training program: a randomized, controlled study. *Proc Natl Acad Sci U S A, 103*(33), 12523-12528. doi:10.1073/pnas.0605194103

Medalia, A., Herlands, T., & Revheim, N. (2009). *Cognitive Remediation for Psychological Disorders: Therapist Guide* (1st ed.): Oxford University Press.