Supplemental Materials

*EEG Data Acquisition*

During the MMN paradigm, EEG was recorded using a BioSemi ActiveTwo system (BioSemi B.V., Amsterdam, Netherlands) and 64-channel electrode caps. For ocular correction, vertical and horizontal electro-oculogram data were recorded from electrodes placed at the outer canthi of both eyes, and above and below the left eye. EEG data were continuously digitized at 1024Hz and referenced offline to averaged mastoid electrodes. Data underwent bandpass filtering (0.5-20Hz), segmentation into 500ms stimulus-locked epochs, baseline (-100 to 0ms) correction, ocular correction (Gratton *et al.* 1983), and ±70μV artifact rejection.

*Trials included in ERP averaging*

The number of trials included for RP and DN for each Standard Repetition for SZ and HC are summarized in Supplementary Table 1. There were no significant group differences in the number of trials rejected for RP or DN at Time 1 (*p*’s>0.32). Although a greater number of RP and DN trials were rejected for the SZ group at Time 2 (*p*’s<0.03), the mean number of RP and DN trials retained at Time 2 was greater than 80% in both groups.

*Cognitive, clinical, and functioning correlations with MMN indices*

We investigated cognitive correlates of the MMN indices measured at baseline in SZ and HC using hierarchical linear regression. For these analyses, each of the seven MCCB domain scores and the MCCB overall composite score were regressed on group (SZ vs. HC), the MMN index, and the interaction between group and the MMN index. When significant or trend-level effects were observed for the interaction term, bivariate correlations between the MMN index and the MCCB domain were reported for each group (see Supplementary Tables 3 and 4). Otherwise, the common slope was reported if it approached statistical significance. The MMN indices included in these analyses were: 1) memory trace for MMN, 2) memory trace for RP, 3) memory trace for DN, and 4) the traditional MMN amplitude.

A trend-level interaction effect between MMN memory trace and group were evident for the MCCB Speed of Processing domain score (SoP; *p*=0.10), where a larger MMN memory trace was associated with better SoP performance in SZ (*r*=-0.36, *p*<0.05), but not in HC (*r*=0.06, *p*=0.77). A similar interaction effect was also found for the RP memory trace (*p*=0.09), such that a larger RP memory trace was associated with a non-significant tendency for better SoP performance in SZ (*r*=0.23, *p*=0.15), but not in HC (*r*=-0.20, *p*=0.29).

A trend-level interaction effect between MMN memory trace and group was evident for MCCB Working Memory (WM, *p*=0.08), where a larger MMN memory trace was associated with better WM performance in HC (*r*=-0.42, *p*<0.05) but not in SZ (*r*=-0.01, *p*=0.96). This effect was reflected in the DN memory trace (*p*=0.05), with a larger DN memory trace associated with better WM performance in HC (*r*=-0.49, *p*=0.01), but not in SZ (*r*=-0.02, *p*=0.88). A significant interaction was also observed for traditional MMN amplitude (*p*=0.02). A larger MMN amplitude was associated with better WM performance in HC (*r*=-0.41, *p*<0.05). A trend-level correlation in the opposite direction was found in SZ (*r*=0.28, *p*=0.08).

For traditional MMN amplitude, an interaction with group was found for MCCB Visual Learning (VisL; *p*=0.05), where a larger MMN amplitude was associated with poorer VisL performance in SZ (*r*=0.32, *p*=0.04), but not in HC (*r*=-0.15, *p*=0.43).

Finally, a significant interaction effect was evident between RP memory trace and group for MCCB Reasoning and Problem Solving (RPS; *p*=0.03). In HC, a larger RP memory trace was associated with a tendency for poorer RPS performance (*r*=-0.35, *p*=0.06). This effect was not apparent in SZ (*r*=0.13, *p*=0.43). None of the above findings survived correction for multiple comparisons (Bonferroni correction critical *p*-value = 0.002, or 0.05/32 regression analyses).

Correlations between roving standard MMN indices and clinical and community functioning variables in the SZ group are summarized in Supplementary Table 3. None of the findings survived correction for multiple comparisons (Bonferroni correction critical *p*-value = 0.0002, or 0.05/221 correlation analyses).

Supplementary Table 1. Trials included in ERP averaging.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assessment | ERP | SZMean (*s.d.*) | HCMean (*s.d.*) | *t*(*df*), *p* |
| Time 1 | DN3 | 79.05 (8.98) | 80.93 (7.97) | *t*(68)=0.91, *p*=0.37 |
|  | DN8 | 76.93 (8.55) | 78.30 (8.44) | *t*(68)=0.67, *p*=0.51 |
|  | DN33 | 78.88 (8.61) | 80.73 (7.67) | *t*(68)=0.93, *p*=0.35 |
|  | RP3 | 238.43 (27.43) | 244.80 (25.28) | *t*(68)=0.99, *p*=0.32 |
|  | RP8 | 159.18 (17.89) | 162.73 (16.24) | *t*(68)=0.85, *p*=0.40 |
|  | RP33 | 79.98 (8.59) | 79.97 (9.64) | *t*(68)=0.00, *p*=1.00 |
| Time 2 | DN3 | 75.13 (12.12) | 82.22 (6.49) | *t*(63)=2.77, *p*=0.01 |
|  | DN8 | 72.45 (13.56) | 79.44 (6.42) | *t*(63)=2.48, *p*=0.02 |
|  | DN33 | 75.74 (12.35) | 81.44 (6.39) | *t*(63)=2.20, *p*=0.03 |
|  | RP3 | 227.03 (38.10) | 247.63 (19.52) | *t*(63)=2.58, *p*=0.01 |
|  | RP8 | 150.29 (27.62) | 164.89 (13.78) | *t*(63)=2.53, *p*=0.01 |
|  | RP33 | 75.89 (12.89) | 82.52 (6.10) | *t*(63)=2.48, *p*=0.02 |

Supplementary Table 2. Descriptive statistics for memory trace indices of MMN, repetition positivity (RP), and deviant negativity (DN).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | SZ Time 1*n*=40Mean (s.d.) | SZ Time 2*n*=38Mean (*s.d.*) | HC Time 1*n*=30Mean (*s.d.*) | HC Time 2*n*=27Mean (s.d.) |
| Memory trace: MMN | -1.46 (2.21) | -1.23 (2.57) | -1.50 (2.33) | -1.68 (2.47) |
| Memory trace: RP | 0.70 (1.25) | 0.90 (1.46) | 0.79 (1.06) | 0.88 (1.17) |
| Memory trace: DN  | -0.76 (1.61) | -0.33 (1.74) | -0.86 (1.76) | -0.80 (1.89) |

Note: SZ, schizophrenia group; HC, healthy control group.

Supplementary Table 3. Bivariate correlations between roving standard MMN indices and cognitive and functioning variables at baseline assessment in SZ.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | MMNMT | RPMT | DNMT | MMN3 | MMN8 | MMN33 | RP3 | RP8 | RP33 | DN3 | DN8 | DN33 | Overall MMN |
| MCCB OCS | -.17 | .17 | -.10 | .16 | .20 | -.09 | .13 | .06 | .28 | .23 | .26 | .10 | .14 |
| MCCB SoP | -.32\* | .23 | -.26 | .12 | .07 | -.28 | .15 | .14 | .36\* | .20 | .16 | -.08 | .03 |
| MCCB A/V | -.13 | .07 | -.12 | .21 | .10 | -.01 | .15 | .18 | .19 | .28 | .21 | .12 | .10 |
| MCCB WM | -.01 | -.02 | -.02 | .21 | .26 | .11 | .17 | .15 | .12 | .29 | .38\* | -.23 | .28 |
| MCCB VerbL | -.12 | .19 | -.02 | .04 | .12 | -.12 | .10 | -.04 | .27 | .08 | .12 | .05 | .07 |
| MCCB VisL | .19 | -.04 | .24 | .07 | .46\*\* | .25 | .05 | -.26 | .00 | .03 | .39\* | .30 | .32\* |
| MCCB RPS | -.08 | .13 | -.01 | .00 | .12 | -.08 | .05 | .00 | .17 | .10 | .14 | .02 | -.09 |
| MCCB SC | -.25 | .17 | -.21 | .16 | -.12 | -.18 | -.05 | .07 | .14 | .06 | -.10 | -.12 | -.06 |
| RFS Work† | -.01 | -.10 | -.09 | .11 | -.04 | .05 | -.03 | -.16 | -.14 | .03 | -.07 | -.05 | -.02 |
| RFS Ind.L† | -.25 | .06 | -.31\* | .19 | -.09 | -.15 | -.04 | -.03 | -.01 | .08 | -.09 | -.22 | -.03 |
| RFS Fam† | -.15 | .03 | -.18 | -.04 | .01 | -.19 | .25 | .08 | .23 | .13 | .06 | -.06 | -.02 |
| RFS Soc† | .00 | -.44\*\* | -.31 | -.03 | -.10 | .10 | .19 | -.07 | -.39\* | .12 | -.02 | -.19 | .10 |
| BPRS Pos | -.09 | .37\* | .17 | -.10 | -.13 | -.15 | -.26 | .09 | .17 | -.26 | -.10 | -.06 | -.13 |
| BPRS Neg | .01 | .17 | .14 | .11 | -.03 | -.07 | -.18 | -.11 | .03 | -.03 | -.10 | .11 | -.08 |
| BPRS Total | -.13 | .45\*\* | .17 | .00 | -.13 | -.14 | -.31 | .03 | .22 | -.21 | -.13 | -.01 | -.15 |
| CAINS MAP | .13 | .12 | .27 | -.03 | -.05 | .12 | -.08 | .00 | .06 | -.08 | -.05 | .19 | -.09 |
| CAINS Exp | -.02 | .17 | .11 | .05 | -.17 | .01 | -.20 | -.13 | .02 | -.09 | -.26 | .03 | -.13 |

Note: \*uncorrected p<0.05, \*\*uncorrected p<0.01; †uncorrected Spearman's ρ; MCCB, MATRICS Consensus Cognitive Battery; OCS, Overall Composite Score; SoP, Speed of Processing; A/V, Attention/Vigilance; WM, Working Memory; VerbL, Verbal Learning; VisL, Visual Learning; RPS, Reasoning and Problem Solving; SC, Social Cognition; RFS, Role Functioning Scale; Ind.L, independent living score; Fam, family score; Soc, social score; BPRS Brief Psychiatric Rating Scale; Pos, positive symptoms total; Neg, negative symptoms total; CAINS, Clinical Assessment Interview for Negative Symptoms; MAP, motivation and pleasure scale; Exp, expression scale; MMN, mismatch negativity; RP, repetition positivity; DN, deviant negativity; MT, memory trace.

Supplementary Table 4. Correlations between roving standard MMN indices and cognitive variables at baseline assessment in HC.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | MMNMT | RPMT | DNMT | MMN3 | MMN8 | MMN33 | RP3 | RP8 | RP33 | DN3 | DN8 | DN33 | Overall MMN |
| MCCB OCS | -.05 | -.13 | -.13 | -.24 | -.12 | -.23 | .38\* | .31 | .19 | -.02 | .11 | -.16 | -.22 |
| MCCB SoP | .06 | -.20 | -.01 | -.16 | -.04 | -.04 | .25 | .18 | .01 | -.02 | .10 | -.03 | -.12 |
| MCCB A/V | -.18 | .01 | -.17 | .02 | .08 | -.21 | .29 | .18 | .26 | .16 | .20 | -.05 | -.06 |
| MCCB WM | -.42\* | .12 | -.49\*\* | .08 | .01 | -.46\* | .17 | .21 | .28 | .14 | .10 | -.41\* | -.29 |
| MCCB VerbL | .11 | -.10 | .13 | -.38\* | -.23 | -.11 | .37\* | .25 | .21 | -.13 | .03 | .03 | -.08 |
| MCCB VisL | -.03 | -.12 | -.05 | -.29 | -.10 | -.23 | .46\* | .33 | .26 | .00 | .21 | -.06 | -.15 |
| MCCB RPS | .27 | -.35 | .08 | -.31 | -.04 | .13 | .16 | .03 | -.24 | -.20 | -.02 | -.08 | -.17 |
| MCCB SC | .02 | -.03 | -.05 | -.18 | -.27 | -.10 | .10 | .28 | .06 | -.11 | -.10 | -.14 | -.19 |

Note: \*uncorrected *p*<0.05, \*\*uncorrected *p*<0.01; MCCB, MATRICS Consensus Cognitive Battery; OCS, Overall Composite Score; SoP, Speed of Processing; A/V, Attention/Vigilance; WM, Working Memory; VerbL, Verbal Learning; VisL, Visual Learning; RPS, Reasoning and Problem Solving; SC, Social Cognition; MMN, mismatch negativity; RP, repetition positivity; DN, deviant negativity; MT, memory trace.

References

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