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| Table S1. Sample characteristics stratified by gender  |
| **DEMOGRAPHICS** | Men | Women | Gender differences |
| Age (years) | 64.78 (7.36) | 63.88 (7.64) | -- |
| Education (years) | 14.90 (2.96) | 14.44 (2.63) | -- |
| Disease duration (years) | 7.82 (5.00) | 7.79 (4.58) | -- |
| UPDRS motor score (on levodopa) | 27.19 (8.41) | 24.95 (9.89) | -- |
| DRS-2 total | 137.22 (3.62) | 138.78 (3.70) | *F*(1,136) = 5.30, *p* = 0.023 |
| MMSE total | 28.22 (1.64) | 28.73 (1.36) | -- |
| **MOOD SYMPTOMS** |  |  |  |
| BDI-II total | 9.93 (6.55) | 11.10 (6.82) | -- |
| AS total | 11.66 (6.22) | 10.95 (5.74) | -- |
| Symptom Dimensions | -- | -- | -- |
|  Depression only | 3.48 (3.77) | 3.88 (4.04) | -- |
|  Apathy only | 9.06 (5.33) | 8.56 (4.68) | -- |
|  Anhedonia | 4.44 (1.71) | 4.32 (1.82) | -- |
|  Somatic | 5.96 (3.09) | 6.73 (3.06) | -- |
| **COGNITIVE COMPOSITES** |  |  |  |
| Immediate Verbal Memory *z*-score | -0.78 (0.75) | -0.29 (0.98) | *F*(1,136) = 10.25, *p* = 0.002 |
| Delayed Verbal Memory *z*-score | -0.66 (0.85) | 0.01 (1.01) | *F*(1,136) = 15.99, *p* < 0.001 |
| Executive Function *z*-score | -0.50 (0.92) | -0.26 (0.82) | -- |
| *Note.* *z*-scores were calculated based on demographically adjusted (test-specific manuals or Heaton) norms. UPDRS = Unified Parkinson’s Disease Rating Scale; DRS-2 = Dementia Rating Scale, 2nd Edition; MMSE = Mini-Mental State Examination; BDI-II = Beck Depression Inventory, 2nd Edition; AS = Apathy Scale. |

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| Table S2. Regression coefficients for exploratory analyses on gender differences in depression and apathy symptom dimensions and cognitive performance |
|  | **Immediate Memory** | **Delayed Memory** | **Executive Function** |
|  | **Parameter estimate** **[95% CI]** | ***p*** | ***η2p*** | **Parameter estimate** **[95% CI]** | ***p*** | ***η2p*** | **Parameter estimate** **[95% CI]** | ***p*** | ***η2p*** |
| **MEN** |  |  |  |  |  |  |  |  |  |  |  |  |
|  DRS-2 total | **0.05**  | **[0.00, 0.09]** | **0.03** | **0.06** | **0.07**  | **[0.02, 0.12]** | **<0.01** | **0.09** | **0.06** | **[0.01, 0.11]** | **0.02** | **0.07** |
|  Depression | -0.03  | [-0.08, 0.03] | 0.40 | 0.01 | **-0.08**  | **[-0.15, -0.02]** | **0.01** | **0.08** | 0.00  | [-0.06, 0.07] | 0.93 | 0.00 |
|  Apathy | -0.02  | [-0.06, 0.02] | 0.27 | 0.02 | -0.01  | [-0.05, 0.03] | 0.54 | 0.00 | -0.03  | [-0.07, 0.02] | 0.23 | 0.02 |
|  Anhedonia | 0.06  | [-0.04, 0.17] | 0.24 | 0.02 | **0.16**  | **[0.05, 0.27]** | **<0.01** | **0.09** | 0.04  | [-0.08, 0.15] | 0.52 | 0.01 |
|  Somatic | 0.02  | [-0.04, 0.08] | 0.52 | 0.01 | 0.04  | [-0.02, 0.11] | 0.19 | 0.02 | 0.06 | [-0.01, 0.12] | 0.10 | 0.03 |
|  |  |  |  |  |  |  |  |  |  |
|  *F* | 1.70 |  |  | 4.26 |  |  | 2.27 |  |  |
|  *R*2 | 0.09 |  |  | 0.21 |  |  | 0.12 |  |  |
|  Model *p* |  | 0.14 |  |  | <0.01 |  |  | 0.06 |  |
|  |  |  |  |  |  |  |  |  |  |
| **WOMEN** |  |  |  |  |  |  |  |  |  |
|  DRS-2 total | 0.08  | [-0.01, 0.17] | 0.08 | 0.09 | 0.07  | [-0.02, 0.17] | 0.13 | 0.07 | 0.05 | [-0.04, 0.13] | 0.26 | 0.04 |
|  Depression | -0.06  | [-0.16, 0.03] | 0.17 | 0.06 | -0.02  | [-0.11, 0.08] | 0.73 | 0.00 | -0.00  | [-0.09, 0.08] | 0.97 | 0.00 |
|  Apathy | 0.00  | [-0.08, 0.09] | 0.98 | 0.00 | -0.02  | [-0.11, 0.07] | 0.68 | 0.01 | -0.01  | [-0.08, 0.07] | 0.88 | 0.00 |
|  Anhedonia | -0.09  | [-0.32, 0.13] | 0.40 | 0.02 | -0.20  | [-0.43, 0.04] | 0.10 | 0.08 | -0.06  | [-0.26, 0.14] | 0.56 | 0.01 |
|  Somatic | 0.09  | [-0.03, 0.20] | 0.13 | 0.07 | 0.10  | [-0.02, 0.22] | 0.11 | 0.08 | 0.07 | [-0.03, 0.18] | 0.17 | 0.06 |
|  |  |  |  |  |  |  |  |  |  |
|  *F* | 2.37 |  |  | 2.30 |  |  | 0.77 |  |  |
|  *R*2 | 0.26 |  |  | 0.26 |  |  | 0.10 |  |  |
|  Model *p* |  | 0.06 |  |  | 0.07 |  |  | 0.58 |  |
| *Note.* DRS-2 = Dementia Rating Scale, 2nd Edition. Bold data indicates significance at *p* < 0.05. |

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| Table S3. Sample characteristics stratified by side-of-onset  |
| **DEMOGRAPHICS** | Left | Right | Side-of-onset differences |
| Age (years) | 65.02 (8.11) | 63.86 (7.00) | -- |
| Gender (M/F) | 35/14 | 51/26 | -- |
| Education (years) | 15.00 (2.92) | 14.45 (2.87) | -- |
| Disease duration (years) | 7.66 (4.27) | 8.14 (5.34) | -- |
| UPDRS motor score (on levodopa) | 26.77 (8.74) | 26.31 (9.40) | -- |
| DRS-2 total | 138.39 (3.35) | 137.12 (3.84) | -- |
| MMSE total | 28.76 (8.74) | 28.10 (1.64) | *F*(1,124) = 5.21, *p* = 0.024 |
| **MOOD SYMPTOMS** |  |  |  |
| BDI-II total | 10.83 (6.77) | 10.28 (6.74) | -- |
| AS total | 11.31 (5.84) | 11.59 (6.38) | -- |
| Symptom Dimensions | -- | -- | -- |
|  Depression only | 3.88 (4.15) | 3.62 (3.80) | -- |
|  Apathy only | 8.67 (5.15) | 9.11 (5.26) | -- |
|  Anhedonia | 4.40 (1.79) | 4.37 (1.71) | -- |
|  Somatic | 6.51 (3.08) | 6.09 (3.21) | -- |
| **COGNITIVE COMPOSITES** |  |  |  |
| Immediate Verbal Memory *z*-score | -0.41 (0.75) | -0.77 (0.91) | *F*(1,124) = 5.55, *p* = 0.020 |
| Delayed Verbal Memory *z*-score | -0.17 (0.85) | -0.64 (0.98) | *F*(1,124) = 7.57, *p* = 0.007 |
| Executive Function *z*-score | -0.34 (0.91) | -0.52 (0.87) | -- |
| *Note.* *z*-scores were calculated based on demographically adjusted (test-specific manuals or Heaton) norms. UPDRS = Unified Parkinson’s Disease Rating Scale; DRS-2 = Dementia Rating Scale, 2nd Edition; MMSE = Mini-Mental State Examination; BDI-II = Beck Depression Inventory, 2nd Edition; AS = Apathy Scale. |

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| Table S4. Regression coefficients for exploratory analyses on side-of-onset differences in depression and apathy symptom dimensions and cognitive performance |
|  | **Immediate Memory** | **Delayed Memory** | **Executive Function** |
|  | **Parameter estimate** **[95% CI]** | ***p*** | ***η2p*** | **Parameter estimate** **[95% CI]** | ***p*** | ***η2p*** | **Parameter estimate** **[95% CI]** | ***p*** | ***η2p*** |
| **LEFT** |  |  |  |  |  |  |  |  |  |  |  |  |
|  DRS-2 total | 0.04  | [-0.03, 0.11] | 0.21 | 0.04 | **0.09**  | **[0.02, 0.16]** | **0.01** | **0.15** | 0.06 | [-0.02, 0.13] | 0.14 | 0.06 |
|  Depression | -0.04  | [-0.12, 0.03] | 0.27 | 0.03 | **-0.09**  | **[-0.17, -0.01]** | **0.03** | **0.11** | -0.02  | [-0.10, 0.06] | 0.63 | 0.01 |
|  Apathy | -0.02  | [-0.07, 0.04] | 0.51 | 0.01 | 0.04  | [-0.02, 0.09] | 0.19 | 0.04 | 0.01  | [-0.05, 0.07] | 0.78 | 0.00 |
|  Anhedonia | -0.02  | [-0.16, 0.12] | 0.81 | 0.00 | -0.10  | [-0.24, 0.05] | 0.20 | 0.04 | -0.00  | [-0.16, 0.15] | 0.97 | 0.00 |
|  Somatic | -0.00  | [-0.08, 0.08] | 0.94 | 0.00 | 0.01  | [-0.07, 0.09] | 0.81 | 0.00 | 0.03 | [-0.06, 0.12] | 0.48 | 0.01 |
|  |  |  |  |  |  |  |  |  |  |
|  *F* | 1.55 |  |  | 3.72 |  |  | 0.81 |  |  |
|  *R*2 | 0.16 |  |  | 0.32 |  |  | 0.09 |  |  |
|  Model *p* |  | 0.20 |  |  | <0.01 |  |  | 0.55 |  |
|  |  |  |  |  |  |  |  |  |  |
| **RIGHT** |  |  |  |  |  |  |  |  |  |
|  DRS-2 total | **0.08**  | **[0.02, 0.14]** | **<0.01** | **0.10** | **0.09**  | **[0.03, 0.15]** | **<0.01** | **0.13** | 0.05 | [-0.01, 0.10] | 0.07 | 0.05 |
|  Depression | -0.06  | [-0.12, 0.01] | 0.11 | 0.04 | -0.06  | [-0.13, 0.01] | 0.11 | 0.04 | -0.01  | [-0.07, 0.06] | 0.87 | 0.00 |
|  Apathy | -0.01  | [-0.06, 0.04] | 0.72 | 0.00 | -0.04  | [-0.09, 0.03] | 0.18 | 0.03 | -0.03  | [-0.07, 0.02] | 0.30 | 0.02 |
|  Anhedonia | 0.06  | [-0.09, 0.21] | 0.42 | 0.01 | 0.15  | [-0.00, 0.31] | 0.06 | 0.06 | 0.03  | [-0.11, 0.17] | 0.67 | 0.00 |
|  Somatic | 0.06  | [-0.02, 0.14] | 0.12 | 0.04 | 0.07  | [-0.02, 0.15] | 0.11 | 0.04 | 0.07 | [-0.00, 0.15] | 0.05 | 0.06 |
|  |  |  |  |  |  |  |  |  |  |
|  *F* | 2.27 |  |  | 3.23 |  |  | 1.48 |  |  |
|  *R*2 | 0.15 |  |  | 0.20 |  |  | 0.10 |  |  |
|  Model *p* |  | 0.06 |  |  | 0.01 |  |  | 0.21 |  |
| *Note.* DRS-2 = Dementia Rating Scale, 2nd Edition. Bold data indicates significance at *p* < 0.05. |

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| Table S5. Sample characteristics stratified by disease subtype  |
| **DEMOGRAPHICS** | Tremor | Non-tremor | Subtype differences |
| Age (years) | 64.73 (7.53) | 63.68 (7.06) | -- |
| Gender (M/F) | 77/33 | 20/8 | -- |
| Education (years) | 14.61 (2.85) | 15.36 (2.87) | -- |
| Disease duration (years) | 7.98 (4.84) | 7.15 (5.02) | -- |
| UPDRS motor score (on levodopa) | 26.94 (9.13) | 24.88 (7.91) | -- |
| DRS-2 total | 137.63 (3.62) | 137.89 (4.06) | *--* |
| MMSE total | 28.31 (1.65) | 28.61 (1.26) | -- |
| **MOOD SYMPTOMS** |  |  |  |
| BDI-II total | 10.42 (6.77) | 9.81 (6.15) | -- |
| AS total | 11.58 (6.17) | 10.92 (5.75) | -- |
| Symptom Dimensions | -- | -- | -- |
|  Depression only | 3.65 (3.82) | 3.38 (4.03) | -- |
|  Apathy only | 9.04 (5.25) | 8.44 (4.71) | -- |
|  Anhedonia | 4.47 (1.79) | 4.12 (1.51) | -- |
|  Somatic | 6.22 (3.11) | 6.11 (3.06) | -- |
| **COGNITIVE COMPOSITES** |  |  |  |
| Immediate Verbal Memory *z*-score | -0.66 (0.88) | -0.51 (0.73) | *--* |
| Delayed Verbal Memory *z*-score | -0.50 (0.95) | -0.31 (0.94) | *--* |
| Executive Function *z*-score | -0.47 (0.93) | -0.26 (0.78) | -- |
| *Note.* *z*-scores were calculated based on demographically adjusted (test-specific manuals or Heaton) norms. UPDRS = Unified Parkinson’s Disease Rating Scale; DRS-2 = Dementia Rating Scale, 2nd Edition; MMSE = Mini-Mental State Examination; BDI-II = Beck Depression Inventory, 2nd Edition; AS = Apathy Scale. |

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| Table S6. Regression coefficients for exploratory analyses on disease subtype differences in depression and apathy symptom dimensions and cognitive performance |
|  | **Immediate Memory** | **Delayed Memory** | **Executive Function** |
|  | **Parameter estimate** **[95% CI]** | ***p*** | ***η2p*** | **Parameter estimate** **[95% CI]** | ***p*** | ***η2p*** | **Parameter estimate** **[95% CI]** | ***p*** | ***η2p*** |
| **TREMOR DOMINANT** |  |  |  |  |  |  |  |  |  |  |  |  |
|  DRS-2 total | **0.06**  | **[0.02, 0.11]** | **0.01** | **0.07** | **0.08**  | **[0.03, 0.13]** | **<0.01** | **0.09** | **0.07** | **[0.02, 0.12]** | **<0.01** | **0.09** |
|  Depression | -0.06  | [-0.13, 0.00] | 0.07 | 0.04 | **-0.08**  | **[-0.15, -0.01]** | **0.03** | **0.05** | 0.02  | [-0.05, 0.08] | 0.64 | 0.00 |
|  Apathy | -0.01 | [-0.05, 0.04] | 0.79 | 0.00 | 0.00  | [-0.05, 0.05] | 0.93 | 0.00 | -0.01  | [-0.06, 0.03] | 0.52 | 0.00 |
|  Anhedonia | 0.06  | [-0.06, 0.17] | 0.33 | 0.01 | 0.06  | [-0.06, 0.18] | 0.32 | 0.01 | -0.01  | [-0.12, 0.10] | 0.84 | 0.00 |
|  Somatic | 0.04  | [-0.02, 0.11] | 0.20 | 0.02 | 0.05  | [-0.02, 0.12] | 0.13 | 0.02 | 0.04 | [-0.02, 0.10] | 0.20 | 0.02 |
|  |  |  |  |  |  |  |  |  |  |
|  *F* | 2.90 |  |  | 3.68 |  |  | 2.58 |  |  |
|  *R*2 | 0.13 |  |  | 0.16 |  |  | 0.12 |  |  |
|  Model *p* |  | 0.02 |  |  | <0.01 |  |  | 0.03 |  |
|  |  |  |  |  |  |  |  |  |  |
| **NON-TREMOR DOMINANT** |  |  |  |  |  |  |  |  |
|  DRS-2 total | 0.07  | [-0.00, 0.14] | 0.05 | 0.20 | **0.12**  | **[0.02, 0.22]** | **0.02** | **0.27** | 0.02 | [-0.06, 0.10] | 0.60 | 0.02 |
|  Depression | -0.03 | [-0.10, 0.03] | 0.31 | 0.06 | -0.05  | [-0.14, 0.05] | 0.30 | 0.06 | -0.02  | [-0.10, 0.05] | 0.54 | 0.02 |
|  Apathy | -0.04  | [-0.09, 0.02] | 0.23 | 0.08 | -0.04  | [-0.13, 0.04] | 0.30 | 0.06 | -0.05  | [-0.12, 0.02] | 0.14 | 0.12 |
|  Anhedonia | -0.17 | [-0.37, 0.02] | 0.08 | 0.17 | 0.07  | [-0.21, 0.34] | 0.62 | 0.01 | 0.08  | [-0.15, 0.31] | 0.46 | 0.03 |
|  Somatic | 0.08  | [-0.01, 0.17] | 0.06 | 0.18 | 0.05  | [-0.07, 0.17] | 0.38 | 0.04 | **0.10** | **[0.01, 0.20]** | **0.04** | **0.21** |
|  |  |  |  |  |  |  |  |  |  |
|  *F* | 3.70 |  |  | 2.11 |  |  | 1.52 |  |  |
|  *R*2 | 0.51 |  |  | 0.37 |  |  | 0.30 |  |  |
|  Model *p* |  | 0.02 |  |  | 0.11 |  |  | 0.23 |  |
| *Note.* DRS-2 = Dementia Rating Scale, 2nd Edition. Bold data indicates significance at *p* < 0.05. |