

## **Supplementary Material**

### **Is Cognition Integral to Psychopathology?**

#### **A Population-Based Cohort Study**

Anat Rotstein<sup>1,2</sup>

Suzanne Fund<sup>3</sup>

Stephen Z. Levine<sup>4</sup>

Abraham Reichenberg<sup>1,5</sup>

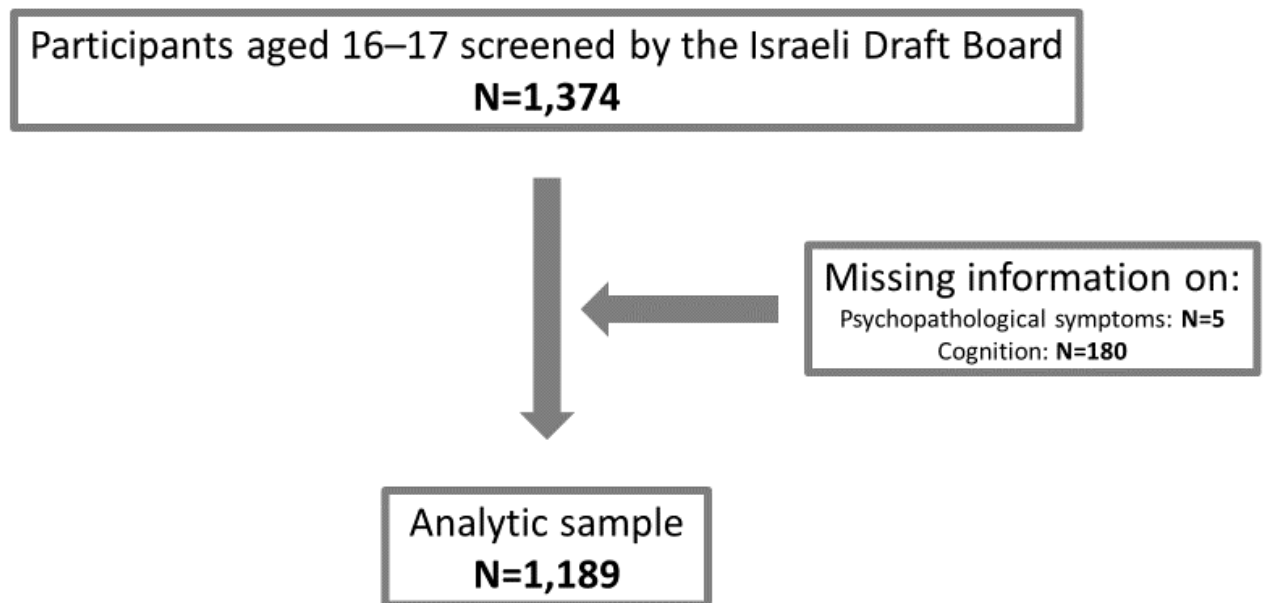
Judy Goldenberg<sup>3</sup>

1. Department of Psychiatry, Icahn School of Medicine at Mount Sinai, New York, New York.
2. Department of Gerontology, University of Haifa, Israel.
3. Department of Behavioral Sciences, Israel Defense Forces, Israel.
4. School of Public Health, University of Haifa, Israel.
5. Department of Environmental Medicine & Public Health, Icahn School of Medicine at Mount Sinai, New York, New York.

#### **Contents**

|  |    |
|--|----|
| sFigure 1: Study flow diagram.....   | 2  |
| sTable 1: Sample characteristics .....   | 3  |
| sTable 2: Factor loadings for a correlated-factors model of psychopathology .....  | 5  |
| sTable 3: Factor loadings for a correlated-factors model of psychopathology with cognition.....                              | 6  |
| sTable 4: Factor loadings for a hierarchical model of psychopathology .....  | 7  |
| sTable 5: Factor loadings for a hierarchical model of psychopathology with cognition .....                                   | 8  |
| sTable 6: Factor loadings for a single factor model of psychopathology .....   | 9  |
| sTable 7: Factor loadings for a single factor model of psychopathology with cognition .....                                  | 10 |
| sTable 8: Fit indices for models of psychopathology with and without cognition: Sensitivity analysis of subpopulations ..... | 11 |
| References.....  | 12 |

sFigure 1: Study flow diagram



sTable 1: Sample characteristics

|  | Mean (SD)    |
|--|--------------|
| <b>Cognition</b>                             |              |
| Categorization abilities                     | 15.66 (3.51) |
| Verbal understanding                         | 20.91 (5.73) |
| Visual-spatial problem-solving abilities     | 22.49 (5.59) |
| Mathematical reasoning                       | 13.18 (5.53) |
| <b>Psychopathology</b>                       |              |
| Alcohol abuse                                | 0.27 (0.56)  |
| Hard drugs abuse                             | 0.01 (0.13)  |
| Cannabis abuse                               | 0.04 (0.24)  |
| Trouble remembering things                   | 0.27 (0.70)  |
| Feeling blocked in getting things done       | 0.37 (0.76)  |
| Having to check and double-check what you do | 0.15 (0.58)  |
| Difficulty making decisions                  | 0.68 (0.95)  |
| Your mind going blank                        | 0.19 (0.56)  |
| Trouble concentrating                        | 0.91 (1.14)  |
| Feelings of being easily hurt                | 0.47 (0.90)  |
| Feeling that people are unfriendly           | 0.39 (0.78)  |
| Feeling inferior to others                   | 0.18 (0.54)  |
| Feeling very self-conscious with others      | 0.23 (0.62)  |
| Thoughts of ending your life                 | 0.04 (0.27)  |
| Feeling lonely                               | 0.35 (0.76)  |
| Feeling blue                                 | 0.73 (0.95)  |
| Feeling no interest in things                | 0.63 (0.97)  |
| Feeling hopeless about the future            | 0.29 (0.72)  |
| Feelings of worthlessness                    | 0.25 (0.71)  |
| Feeling tense or keyed up                    | 1.10 (1.05)  |
| Being suddenly scared for no reason          | 0.17 (0.55)  |
| Feeling fearful                              | 0.28 (0.71)  |
| Nervousness or shakiness inside              | 0.67 (0.96)  |
| Spells of terror or panic                    | 0.14 (0.58)  |

|   |             |
|---|-------------|
| Restlessness  | 0.33 (0.77) |
| Feeling easily annoyed or irritated                       | 0.89 (1.08) |
| Temper outbursts that you could not control               | 0.24 (0.69) |
| Having urges to beat, injure, or harm someone             | 0.12 (0.50) |
| Having urges to break or smash things                     | 0.15 (0.57) |
| Getting into frequent arguments                           | 0.29 (0.66) |
| Feeling afraid in open spaces or on the streets           | 0.14 (0.52) |
| Feeling afraid to travel on buses, subways, or trains     | 0.17 (0.62) |
| Avoiding certain things, places, or activities            | 0.20 (0.63) |
| Feeling uneasy in crowds                                  | 0.16 (0.55) |
| Feeling nervous when left alone                           | 0.18 (0.56) |
| Feeling others are to blame for most of your troubles     | 0.23 (0.58) |
| Feeling that most people cannot be trusted                | 0.63 (1.05) |
| Feeling watched or talked about by others                 | 0.46 (0.86) |
| Others not giving you proper credit for your achievements | 0.56 (0.93) |
| Feeling that people will take advantage if you let them   | 0.38 (0.86) |
| The idea that someone else can control your thoughts      | 0.06 (0.31) |
| Feeling lonely even when with people                      | 0.42 (0.86) |
| The idea that you should be punished for your sins        | 0.20 (0.61) |
| Never feeling close to another person                     | 0.27 (0.65) |
| The idea that something is wrong with your mind           | 0.15 (0.57) |

Note.

Abbreviations. SD: Standard Deviation

sTable 2: Factor loadings for a correlated-factors model of psychopathology

**Factor loadings**

|    | Ex   | In   | TD    |
|----|------|------|-------|
| SA | .512 | 0    | 0     |
| CD | .808 | 0    | 0     |
| IS | .911 | 0    | 0     |
| De | 0    | .978 | 0     |
| An | 0    | .915 | 0     |
| PA | 0    | .884 | 0     |
| OC | 0    | 0    | .941  |
| Ps | 0    | 0    | 1.009 |
| PI | 0    | 0    | .914  |

Note.

Abbreviations. Ex: Externalizing; In: Internalizing; TD: Thought Disorder; SA: Substance Abuse; CD: Conduct Disorder (i.e., Hostility); IS: Interpersonal Sensitivity; De: Depression; An: Anxiety; PA: Phobic Anxiety; OC: Obsessive-Compulsive; Ps: Psychoticism; PI: Paranoid Ideation.

The numbers represent the standardized loadings beta estimates. Due to multicollinearity, the standardized loadings estimates can exceed the bounds of (-1,1) (Deegan Jr, 1978).

sTable 3: Factor loadings for a correlated-factors model of psychopathology with cognition

**Factor loadings**

|    | Ex   | In   | TD    | IQ   |
|----|------|------|-------|------|
| VU | 0    | 0    | 0     | .850 |
| VS | 0    | 0    | 0     | .831 |
| MR | 0    | 0    | 0     | .797 |
| Ca | 0    | 0    | 0     | .861 |
| SA | .522 | 0    | 0     | 0    |
| CD | .812 | 0    | 0     | 0    |
| IS | .905 | 0    | 0     | 0    |
| De | 0    | .977 | 0     | 0    |
| An | 0    | .914 | 0     | 0    |
| PA | 0    | .887 | 0     | 0    |
| OC | 0    | 0    | .941  | 0    |
| Ps | 0    | 0    | 1.006 | 0    |
| PI | 0    | 0    | .916  | 0    |

Note.

Abbreviations. Ex: Externalizing; In: Internalizing; TD: Thought Disorder; SA: Substance Abuse; CD: Conduct Disorder (i.e., Hostility); IS: Interpersonal Sensitivity; De: Depression; An: Anxiety; PA: Phobic Anxiety; OC: Obsessive-Compulsive; Ps: Psychoticism; PI: Paranoid Ideation; IQ: Intelligence Quotient; VU: Verbal Understanding; VS: Visual-Spatial problem-solving abilities; MR: Mathematical reasoning; Ca: Categorization abilities.

The numbers represent the standardized loadings beta estimates. Due to multicollinearity, the standardized loadings estimates can exceed the bounds of (-1,1) (Deegan Jr, 1978).

sTable 4: Factor loadings for a hierarchical model of psychopathology

**Factor loadings**

|    | Ex   | In   | TD    | P     |
|----|------|------|-------|-------|
| SA | .512 | 0    | 0     | 0     |
| CD | .808 | 0    | 0     | 0     |
| IS | .911 | 0    | 0     | 0     |
| De | 0    | .978 | 0     | 0     |
| An | 0    | .915 | 0     | 0     |
| PA | 0    | .884 | 0     | 0     |
| OC | 0    | 0    | .941  | 0     |
| Ps | 0    | 0    | 1.009 | 0     |
| PI | 0    | 0    | .914  | 0     |
| Ex | 0    | 0    | 0     | 1.018 |
| In | 0    | 0    | 0     | 1.007 |
| TD | 0    | 0    | 0     | 1.023 |

Note.

Abbreviations. P: A general factor of psychopathology; Ex: Externalizing; In: Internalizing; TD: Thought Disorder; SA: Substance Abuse; CD: Conduct Disorder (i.e., Hostility); IS: Interpersonal Sensitivity; De: Depression; An: Anxiety; PA: Phobic Anxiety; OC: Obsessive-Compulsive; Ps: Psychoticism; PI: Paranoid Ideation.

The numbers represent the standardized loadings beta estimates. Due to multicollinearity, the standardized loadings estimates can exceed the bounds of (-1,1) (Deegan Jr, 1978).

sTable 5: Factor loadings for a hierarchical model of psychopathology with cognition

**Factor loadings**

|    | Ex   | In   | TD    | IQ   | P     |
|----|------|------|-------|------|-------|
| VU | 0    | 0    | 0     | .849 | 0     |
| VS | 0    | 0    | 0     | .831 | 0     |
| MR | 0    | 0    | 0     | .800 | 0     |
| Ca | 0    | 0    | 0     | .859 | 0     |
| SA | .521 | 0    | 0     | 0    | 0     |
| CD | .811 | 0    | 0     | 0    | 0     |
| IS | .905 | 0    | 0     | 0    | 0     |
| De | 0    | .977 | 0     | 0    | 0     |
| An | 0    | .914 | 0     | 0    | 0     |
| PA | 0    | .888 | 0     | 0    | 0     |
| OC | 0    | 0    | .941  | 0    | 0     |
| Ps | 0    | 0    | 1.007 | 0    | 0     |
| PI | 0    | 0    | .916  | 0    | 0     |
| Ex | 0    | 0    | 0     | 0    | 1.024 |
| In | 0    | 0    | 0     | 0    | 1.001 |
| TD | 0    | 0    | 0     | 0    | 1.027 |
| IQ | 0    | 0    | 0     | 0    | -.253 |

Note.

Abbreviations. P: A general factor of psychopathology; Ex: Externalizing; In: Internalizing; TD: Thought Disorder; SA: Substance Abuse; CD: Conduct Disorder (i.e., Hostility); IS: Interpersonal Sensitivity; De: Depression; An: Anxiety; PA: Phobic Anxiety; OC: Obsessive-Compulsive; Ps: Psychoticism; PI: Paranoid Ideation; IQ: Intelligence Quotient; VU: Verbal Understanding; VS: Visual-Spatial problem-solving abilities; MR: Mathematical reasoning; Ca: Categorization abilities.

The numbers represent the standardized loadings beta estimates. Due to multicollinearity, the standardized loadings estimates can exceed the bounds of (-1,1) (Deegan Jr, 1978).



sTable 6: Factor loadings for a single factor model of psychopathology

**Factor loadings**

|    | P     |
|----|-------|
| SA | .520  |
| CD | .822  |
| IS | .928  |
| De | .986  |
| An | .921  |
| PA | .888  |
| OC | .953  |
| Ps | 1.023 |
| PI | .926  |
| P  | 0     |

Note.

Abbreviations. P: A general factor of psychopathology; Ex: Externalizing; In: Internalizing; TD: Thought Disorder; SA: Substance Abuse; CD: Conduct Disorder (i.e., Hostility); IS: Interpersonal Sensitivity; De: Depression; An: Anxiety; PA: Phobic Anxiety; OC: Obsessive-Compulsive; Ps: Psychoticism; PI: Paranoid Ideation.

The numbers represent the standardized loadings beta estimates. Due to multicollinearity, the standardized loadings estimates can exceed the bounds of (-1,1) (Deegan Jr, 1978).

sTable 7: Factor loadings for a single factor model of psychopathology with cognition

**Factor loadings**

|    | P     |
|----|-------|
| VU | -.237 |
| VS | -.226 |
| MR | -.241 |
| Ca | -.236 |
| SA | .530  |
| CD | .829  |
| IS | .925  |
| De | .982  |
| An | .917  |
| PA | .891  |
| OC | .954  |
| Ps | 1.021 |
| PI | .928  |
| P  | 0     |

Note.

Abbreviations. P: A general factor of psychopathology; Ex: Externalizing; In: Internalizing; TD: Thought Disorder; SA: Substance Abuse; CD: Conduct Disorder (i.e., Hostility); IS: Interpersonal Sensitivity; De: Depression; An: Anxiety; PA: Phobic Anxiety; OC: Obsessive-Compulsive; Ps: Psychoticism; PI: Paranoid Ideation; VU: Verbal Understanding; VS: Visual-Spatial problem-solving abilities; MR: Mathematical reasoning; Ca: Categorization abilities.

The numbers represent the standardized loadings beta estimates. Due to multicollinearity, the standardized loadings estimates can exceed the bounds of (-1,1) (Deegan Jr, 1978).

sTable 8: Fit indices for models of psychopathology with and without cognition: Sensitivity analysis of subpopulations

| Model  | RMSEA | TLI   | CFI   |
|--|-------|-------|-------|
| <b>Top 20% of most symptomatic participants (N=245)</b>                |       |       |       |
| A correlated-factors model of psychopathology <u>without</u> cognition | 0.080 | 0.888 | 0.895 |
| A correlated-factors model of psychopathology <u>with</u> cognition    | 0.085 | 0.859 | 0.867 |
| A hierarchical model of psychopathology <u>without</u> cognition       | 0.080 | 0.888 | 0.895 |
| A hierarchical model of psychopathology <u>with</u> cognition          | 0.083 | 0.867 | 0.874 |
| A single factor model of psychopathology <u>without</u> cognition      | 0.081 | 0.885 | 0.891 |
| A single factor model of psychopathology <u>with</u> cognition         | 0.087 | 0.853 | 0.862 |
| <b>Males (N=603)</b>   |       |       |       |
| A correlated-factors model of psychopathology <u>without</u> cognition | 0.033 | 0.994 | 0.994 |
| A correlated-factors model of psychopathology <u>with</u> cognition    | 0.042 | 0.989 | 0.989 |
| A hierarchical model of psychopathology <u>without</u> cognition       | 0.033 | 0.993 | 0.994 |
| A hierarchical model of psychopathology <u>with</u> cognition          | -     | -     | -     |
| A single factor model of psychopathology <u>without</u> cognition      | 0.033 | 0.994 | 0.994 |
| A single factor model of psychopathology <u>with</u> cognition         | -     | -     | -     |
| <b>Females (N=586)</b>   |       |       |       |
| A correlated-factors model of psychopathology <u>without</u> cognition | 0.036 | 0.992 | 0.992 |
| A correlated-factors model of psychopathology <u>with</u> cognition    | 0.038 | 0.989 | 0.990 |
| A hierarchical model of psychopathology <u>without</u> cognition       | 0.036 | 0.992 | 0.992 |
| A hierarchical model of psychopathology <u>with</u> cognition          | -     | -     | -     |
| A single factor model of psychopathology <u>without</u> cognition      | 0.036 | 0.992 | 0.992 |
| A single factor model of psychopathology <u>with</u> cognition         | -     | -     | -     |
| <b>Models based only on psychotic symptoms (Full sample; N=1189)</b>   |       |       |       |
| A correlated-factors model of psychopathology <u>without</u> cognition | 0.020 | 0.997 | 0.998 |
| A correlated-factors model of psychopathology <u>with</u> cognition    | 0.034 | 0.990 | 0.991 |
| A hierarchical model of psychopathology <u>without</u> cognition       | 0.020 | 0.997 | 0.998 |
| A hierarchical model of psychopathology <u>with</u> cognition          | 0.034 | 0.990 | 0.991 |
| A single factor model of psychopathology <u>without</u> cognition      | -     | -     | -     |
| A single factor model of psychopathology <u>with</u> cognition         | -     | -     | -     |

Note. Empty cells represent instances in which the model does not converge to a final solution. The goodness of fit was determined by the Tucker–Lewis Index (TLI) where values over 0.95 represent good fit, the Comparative Fit Index (CFI) where values over 0.95 represent good fit, and the Root-Mean-Square Error of Approximation (RMSEA), where values under 0.05 represent good fit.

## References

Deegan Jr, J. (1978). On the occurrence of standardized regression coefficients greater than one. *Educational and Psychological Measurement*, 38(4), 873-888.