**Supplementary materials**

Du Rietz E, Pettersson E, Brikell I, Ghirardi L, Chen Q, Hartman C, Lichtenstein P, Larsson H, Kuja-Halkola R. **Phenotypic and etiologic overlap between ADHD and neurodevelopmental, externalizing and internalizing disorders: separating unique from general psychopathology effects.**

**Supplementary Fig 1.** (a) Correlated factors solution: factor loadings and phenotypic correlations between the ADHD, neurodevelopmental, externalizing and internalizing factors. (b) Proportion of variance in the factors, and in their phenotypic correlations with ADHD, explained by additive genetic (A), shared (C) and non-shared (E) environmental effects.

**Supplementary Fig 2.** (a) Bifactor model solution: factor loadings and phenotypic correlations between ADHD, and the general P factor, neurodevelopmental-, externalizing- and internalizing-specific factors.

**Supplementary Fig 3.** (a) General factors solution using sibling pairs born closest together: factor loadings and phenotypic correlations between ADHD and the general P factor, neurodevelopmental-, externalizing- and internalizing-specific factors. (b) Proportion of variance in the factors, and in their phenotypic correlations with ADHD, explained by additive genetic (A), shared (C) and non-shared (E) environmental effects.

**Supplementary Fig 4.** Multiple general factors solutions with decreasing maximum follow-up age: proportion of phenotypic correlations with ADHD explained by general and specific additive genetic (A), shared (C) and non-shared (E) environmental effects.

**Supplementary Table 1.** Factor groups and codes for psychiatric disorders included in study.

**Supplementary Table 2**. Observed correlations between between psychiatric disorders within individuals.

**Supplementary Table 3.** Higher order factor loadings – General factor solution.

**Supplementary Table 4.** Observed within-individual correlations between clusters – General factors solution.

**Supplementary Table 5**. Observed between-siblings correlations between clusters – General factors solution.

**Supplementary Table 6**. Observed within-individual correlations between clusters – General factors solution with Internalizing-specific factor’s variance fixed at 0.

**Supplementary Table 7**. Observed between-sibling correlations between clusters – General factors solution with Internalizing-specific factor’svariance fixed at 0.

**Supplementary Table 8**. Likelihood ratio test General factor ACE-model with and without specific variance for Internalizing factor.

**Supplementary Table 9**. Observed correlations between siblings.

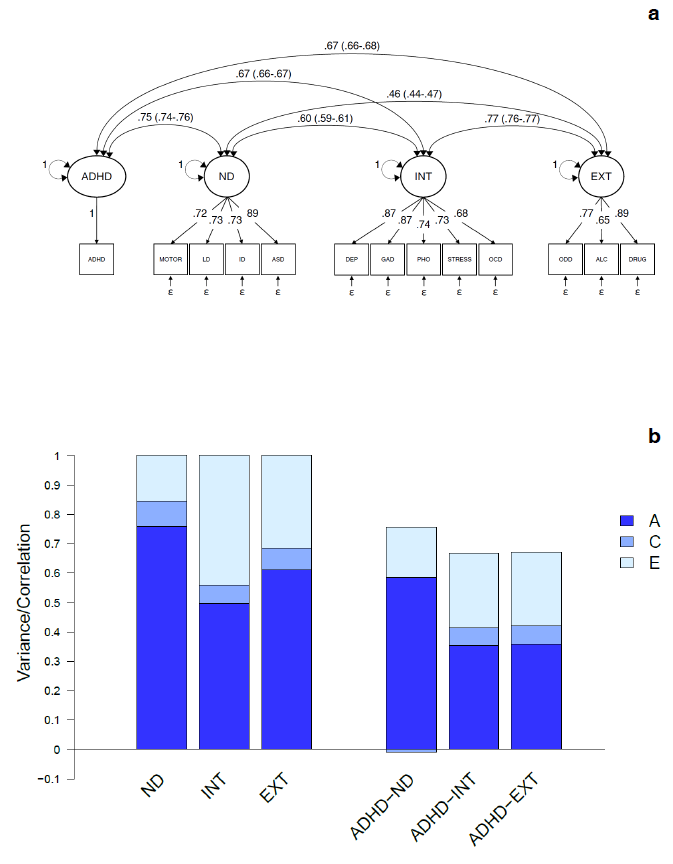
**Supplementary Table 10**. A, C, and E covariance for General factor model with Internalizing-specific factor’s variance fixed at 0 (diagonals are explained variance by factor [e.g. heritability]).

**Supplementary Table 11**. A, C, and E correlations for General factor model with Internalizing-specific factor’s variance fixed at 0.

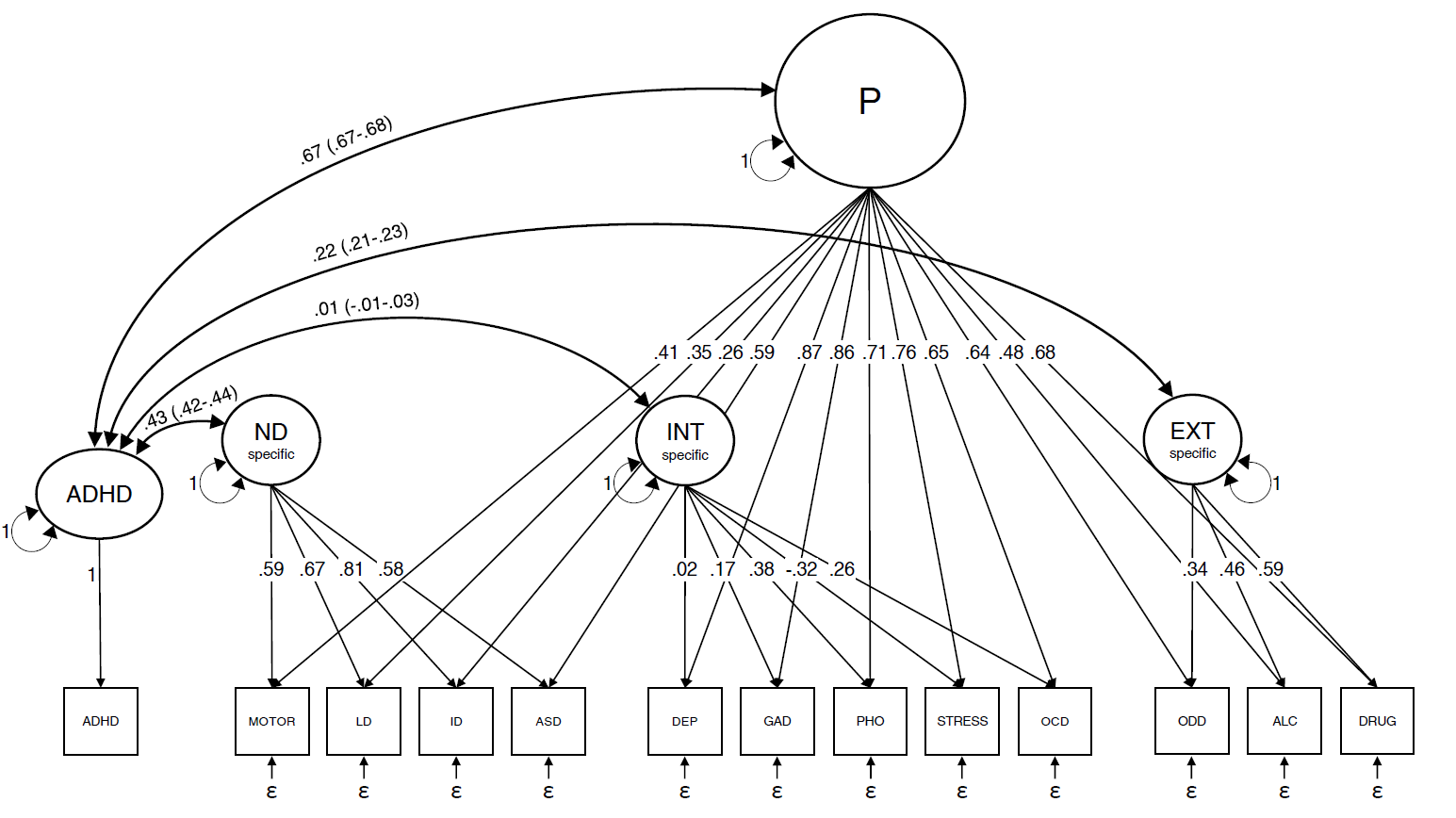
**Supplementary Table 12. Univariate ACE-models.**

**Supplementary Table 13**. Observed between-sibling correlations between clusters – Bifactor model.

**Supplementary Table 14. General psychopathology factor versus Specific ACE-contributions to covariance**

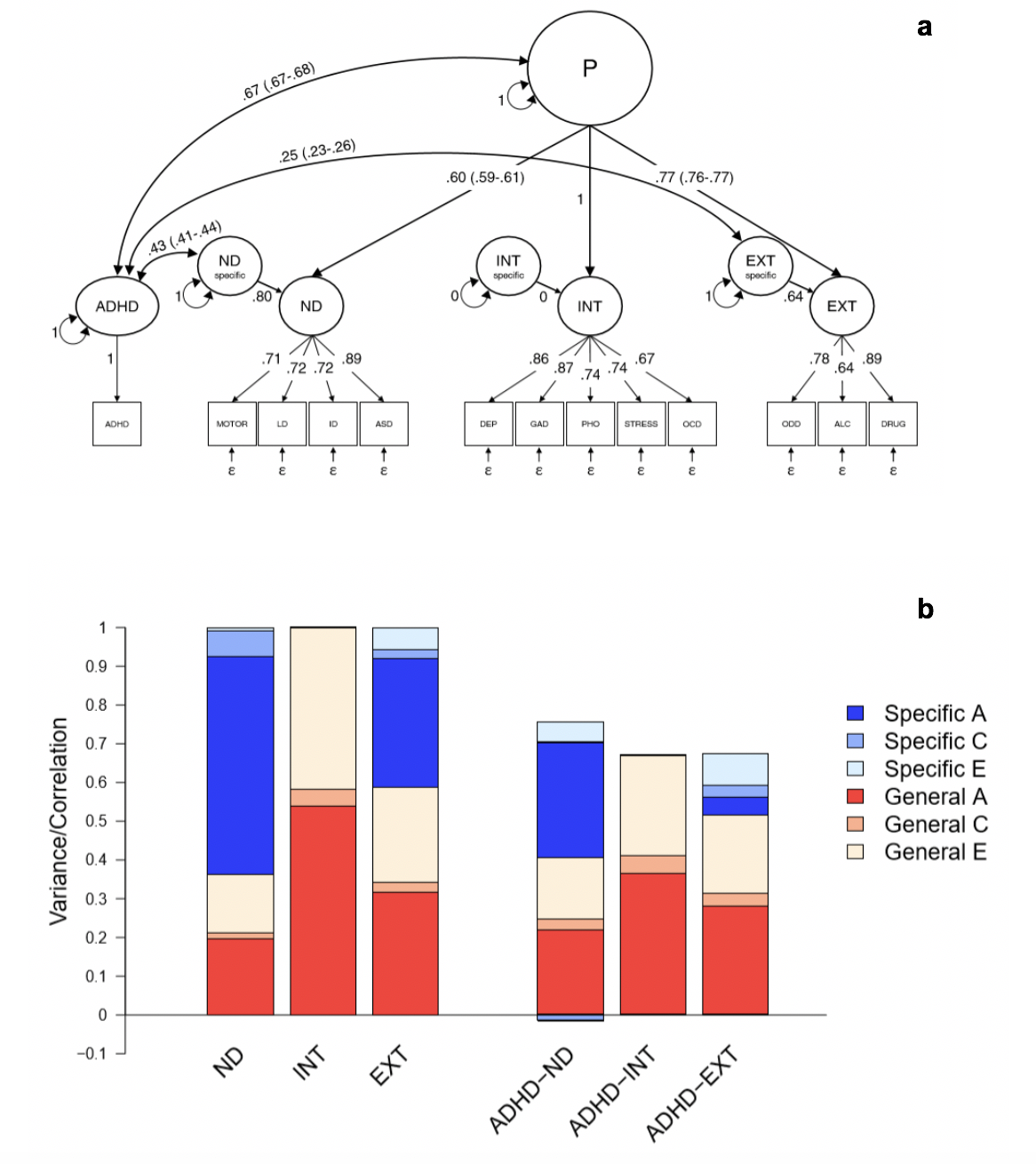
**Supplementary** **Fig 1.** (a) Correlated factors solution: factor loadings and phenotypic correlations between the ADHD, neurodevelopmental, internalizing and externalizing factors. (b) Proportion of variance in the factors, and in their phenotypic correlations with ADHD, explained by additive genetic (A), shared (C) and non-shared (E) environmental effects.

Note: ADHD; Attention-deficit/hyperactivity disorder, ND; Neurodevelopmental, INT; Internalizing, EXT; Externalizing, Motor; Motor disorders, LD; Learning and developmental disorders, ID; Intellectual disability, ASD; Autism spectrum disorder, DEP; Depression, GAD; Generalized anxiety disorders, PHO; Stress; Reactions to severe stress and adjustment disorders, OCD; Obsessive-compulsive disorder, ODD; Oppositional defiant and related disorders, ALC; Alcohol misuse, DRUG; Drug misuse.

**Supplementary** **Fig 2.** (a) Bifactor model solution: factor loadings and phenotypic correlations between ADHD and the general p factor, neurodevelopmental-, externalizing- and internalizing-specific factors.

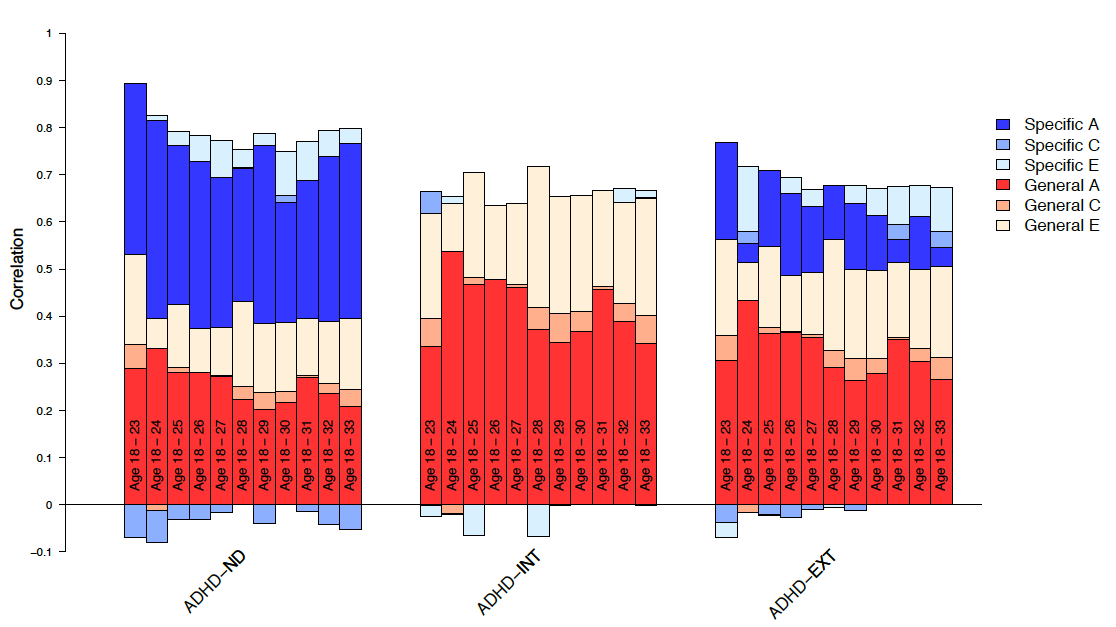
Note: ADHD; Attention-deficit/hyperactivity disorder, ND; Neurodevelopmental, INT; Internalizing, EXT; Externalizing, Motor; Motor disorders, LD; Learning and developmental disorders, ID; Intellectual disability, ASD; Autism spectrum disorder, DEP; Depression, GAD; Generalized anxiety disorders, PHO; Stress; Reactions to severe stress and adjustment disorders, OCD; Obsessive-compulsive disorder, ODD; Oppositional defiant and related disorders, ALC; Alcohol misuse, DRUG; Drug misuse.

**Supplementary Fig 3.** (a) General factors solution using sibling pairs born closest together: factor loadings and phenotypic correlations between ADHD and the general p factor, neurodevelopmental-, externalizing- and internalizing-specific factors. (b) Proportion of variance in the factors, and in their phenotypic correlations with ADHD, explained by additive genetic (A), shared (C) and non-shared (E) environmental effects.

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Note: ADHD; Attention-deficit/hyperactivity disorder, ND; Neurodevelopmental, INT; Internalizing, EXT; Externalizing, Motor; Motor disorders, LD; Learning and developmental disorders, ID; Intellectual disability, ASD; Autism spectrum disorder, DEP; Depression, GAD; Generalized anxiety disorders, PHO; Stress; Reactions to severe stress and adjustment disorders, OCD; Obsessive-compulsive disorder, ODD; Oppositional defiant and related disorders, ALC; Alcohol misuse, DRUG; Drug misuse.

**Supplementary Fig 4.** Multiple general factors solutions with decreasing maximum follow-up age: proportion of phenotypic correlations with ADHD explained by general and specific additive genetic (A), shared (C) and non-shared (E) environmental effects.



Note: General factors solution (where internalizing-specific factor’s variance is not fixed to 0) repeated while decreasing maximum follow-up age with 1 year at a time, with age spans ranging from 18-23 to 18-33 years.

**Supplementary Table 1.** Factor groups and codes for psychiatric disorders included in study

|  |  |  |  |
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| Group | Disorder | ICD-10 | ICD-9 |
| ADHD | ADHD | F90\* | 314 |
| Neuro-developmental | Autism spectrum disorders | F84.0, F84.1, F84.5, F84.8, F84.9 | 299A |
| Developmental disorders of speech/language & Learning disorders | F80, F81, F83 | 315A, 315B, 315D, 315W |
| Intellectual disability | F70-73, F78-79 | 317-319 |
| Motor disorders | F98.4, F82, F95 | 307D, 315E, 307C |
| Internalizing | Depression  (excluding depression with psychotic symptoms) | F32, F33, F34, F38, F39 | 300E, 296B, 301B311,298A |
| Other anxiety disorders | F41 | 300A |
| Phobic anxiety disorders | F40 | 300C |
| Obsessive-compulsive disorder | F42 | 300D |
| Post-traumatic stress disorders | F43.1 | 309W |
| Eating disorders | F50 | 307B, 307F |
| Externalizing | Conduct Disorders, Oppositional Defiant Disorder, Antisocial personality disorder | F91, F60.2 | 312, 313W  301H |
| Alcohol abuse | F10 | 303, 305A, 291 |
| Drug abuse (excluding smoking) | F11-F16, F18-F19 | 304, 305X, 292 |

**Note: ICD-9 diagnoses were coded using the Swedish version, using letters as the last digit.**

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| **Supplementary Table 2. Observed correlations between psychiatric disorders within individuals** | | | | | | | | | | | | | |
|  | Autism | Developmental disorders | Intellectual disability | Motor disorders | Depression | Anxiety | Phobias | Stress | OCD | ODD | Alcohol misuse | Drug misuse | ADHD |
|  | | | | | | | | | | | | | |
| Autism | 1.00 (1.00-1.00) | 0.52 (0.50-0.54) | 0.65 (0.63-0.66) | 0.56 (0.55-0.58) | 0.50 (0.49-0.51) | 0.45 (0.43-0.46) | 0.42 (0.40-0.44) | 0.35 (0.34-0.37) | 0.51 (0.49-0.52) | 0.46 (0.44-0.48) | 0.15 (0.14-0.17) | 0.29 (0.27-0.30) | 0.64 (0.63-0.65) |
| Developmental disorders |  | 1.00 (1.00-1.00) | 0.60 (0.59-0.62) | 0.58 (0.56-0.60) | 0.26 (0.25-0.28) | 0.24 (0.22-0.26) | 0.22 (0.19-0.25) | 0.24 (0.22-0.26) | 0.27 (0.24-0.30) | 0.44 (0.41-0.47) | 0.09 (0.06-0.11) | 0.16 (0.14-0.19) | 0.57 (0.56-0.58) |
| Intellectual disability |  |  | 1.00 (1.00-1.00) | 0.58 (0.57-0.60) | 0.19 (0.17-0.21) | 0.18 (0.17-0.20) | 0.18 (0.15-0.20) | 0.21 (0.20-0.23) | 0.29 (0.26-0.31) | 0.35 (0.32-0.37) | 0.06 (0.04-0.08) | 0.11 (0.09-0.13) | 0.46 (0.45-0.48) |
| Motor disorders |  |  |  | 1.00 (1.00-1.00) | 0.28 (0.26-0.30) | 0.26 (0.24-0.28) | 0.26 (0.23-0.29) | 0.22 (0.19-0.25) | 0.49 (0.47-0.51) | 0.40 (0.37-0.43) | 0.08 (0.06-0.11) | 0.17 (0.14-0.20) | 0.56 (0.54-0.57) |
| Depression |  |  |  |  | 1.00 (1.00-1.00) | 0.74 (0.74-0.74) | 0.64 (0.63-0.64) | 0.65 (0.65-0.66) | 0.54 (0.53-0.55) | 0.44 (0.43-0.46) | 0.41 (0.40-0.42) | 0.58 (0.57-0.59) | 0.58 (0.57-0.59) |
| Anxiety |  |  |  |  |  | 1.00 (1.00-1.00) | 0.67 (0.66-0.68) | 0.60 (0.59-0.61) | 0.58 (0.57-0.59) | 0.44 (0.42-0.46) | 0.43 (0.42-0.44) | 0.61 (0.60-0.62) | 0.55 (0.54-0.55) |
| Phobias |  |  |  |  |  |  | 1.00 (1.00-1.00) | 0.40 (0.38-0.41) | 0.53 (0.52-0.55) | 0.30 (0.27-0.32) | 0.29 (0.28-0.30) | 0.39 (0.38-0.41) | 0.45 (0.44-0.46) |
| Stress |  |  |  |  |  |  |  | 1.00 (1.00-1.00) | 0.37 (0.36-0.39) | 0.43 (0.41-0.45) | 0.38 (0.37-0.39) | 0.52 (0.51-0.53) | 0.46 (0.45-0.47) |
| OCD |  |  |  |  |  |  |  |  | 1.00 (1.00-1.00) | 0.32 (0.29-0.35) | 0.20 (0.19-0.22) | 0.30 (0.28-0.32) | 0.41 (0.40-0.42) |
| ODD |  |  |  |  |  |  |  |  |  | 1.00 (1.00-1.00) | 0.34 (0.32-0.36) | 0.51 (0.50-0.53) | 0.63 (0.62-0.64) |
| Alcohol misuse |  |  |  |  |  |  |  |  |  |  | 1.00 (1.00-1.00) | 0.60 (0.59-0.61) | 0.36 (0.35-0.37) |
| Drug misuse |  |  |  |  |  |  |  |  |  |  |  | 1.00 (1.00-1.00) | 0.54 (0.53-0.55) |
| ADHD |  |  |  |  |  |  |  |  |  |  |  |  | 1.00 (1.00-1.00) |
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Note: OCD; Obsessive-compulsive disorder, ODD; Oppositional defiant disorder, conduct disorder, antisocial personality disorder cluster, ADHD; Attention-deficit/hyperactivity disorder.

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| **Supplementary Table 3a. Higher order factor loadings – General factor solution** | | | | | | |
|  |  | Loadings ***from*** factors | | | | |
|  |  | General | ND specific | INT specific | EXT specific | ADHD specific |
| Loadings ***to*** subfactors | ND | 0.60 (NA-NA) | 0.80 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) |
| EXT | 0.99 (NA-NA) | 0.00 (NA-NA) | 0.11 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) |
| INT | 0.77 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.63 (NA-NA) | 0.00 (NA-NA) |
| ADHD | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 1.00 (NA-NA) |
| Note: Due to model fitting instability, the model with unique variance for Internalizing factor did not have valid standard errors. ND; Neurodevelopmental factor, INT; Internalizing factor, EXT; Externalizing factor, A; Additive genetic component, C; Shared environment component, E; Non-shared environment component. | | | | | | |

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| **Supplementary Table 3b. Likelihood ratio test for no unique variance in Internalizing factor** | | | | | | | |
| Model | ep | minus2LL | df | AIC | diffLL | diffdf | p |
| General factor model | 115 | 8817.60 | 10067293 | -20125768.40 |  |  |  |
| INT loading = 1 | 109 | 8824.91 | 10067299 | -20125773.09 | 7.32 | 6 | 0.293 |

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| **Supplementary Table 3c. Higher order factor loadings where Internalizing factor has no specific variance** | | | | | | |
|  |  | Loadings ***from*** factors | | | | |
|  |  | General | ND specific | INT specific | EXT specific | ADHD specific |
| Loadings ***to*** subfactors | ND | 0.60 (0.59-0.61) | 0.80 (0.79-0.81) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |
| EXT | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |
| INT | 0.77 (0.76-0.77) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.64 (0.63-0.65) | 0.00 (0.00-0.00) |
| ADHD | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) |
| Note: ND; Neurodevelopmental factor, INT; Internalizing factor, EXT; Externalizing factor, A; Additive genetic component, C; Shared environment component, E; Non-shared environment component. | | | | | | |

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| **Supplementary Table 4. Observed within-individual correlations between clusters - General factors solution** | | | | | |
|  | | | | | |
|  | General | ND | INT | EXT | ADHD |
|  | | | | | |
| General | 1.00 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.63 (NA-NA) |
| ND | 0.00 (NA-NA) | 1.00 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.46 (NA-NA) |
| INT | 0.00 (NA-NA) | 0.00 (NA-NA) | 1.00 (NA-NA) | 0.00 (NA-NA) | 0.40 (NA-NA) |
| EXT | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 1.00 (NA-NA) | 0.30 (NA-NA) |
| ADHD | 0.63 (NA-NA) | 0.46 (NA-NA) | 0.40 (NA-NA) | 0.30 (NA-NA) | 1.00 (NA-NA) |
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Note: ND; Neurodevelopmental factor, INT; Internalizing factor, EXT; Externalizing factor.

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| **Supplementary Table 5. Observed between-sibling correlations between clusters - General factor solution** | | | | | |
|  | | | | | |
|  | General | ND specific | INT specific | EXT specific | ADHD specific |
|  | | | | | |
| General | 0.33 (NA-NA) / 0.20 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.24 (NA-NA) |
| ND specific | 0.00 (NA-NA) | 0.53 (NA-NA) / 0.30 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.17 (NA-NA) |
| INT specific | 0.00 (NA-NA) | 0.00 (NA-NA) | -0.99 (NA-NA) / -0.99 (NA-NA) | 0.00 (NA-NA) | -0.05 (NA-NA) |
| EXT specific | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.00 (NA-NA) | 0.47 (NA-NA) / 0.25 (NA-NA) | 0.08 (NA-NA) |
| ADHD specific | 0.16 (NA-NA) | 0.04 (NA-NA) | -0.03 (NA-NA) | 0.07 (NA-NA) | 0.37 (NA-NA) / 0.19 (NA-NA) |
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| Note: Full siblings' correlations above diagonal, maternal half siblings' beneath diagonal. On diagonal written as full / half. ND; Neurodevelopmental factor, INT; Internalizing factor, EXT; Externalizing factor. | | | | | |

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| **Supplementary Table 6. Observed within-individual correlations between clusters - General factor solution with Internalizing-specific factor’s variance fixed at 0** | | | | | |
|  | | | | | |
|  | General | ND | INT | EXT | ADHD |
|  | | | | | |
| General | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.67 (0.66-0.67) |
| ND | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.43 (0.42-0.45) |
| INT | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |
| EXT | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.25 (0.24-0.27) |
| ADHD | 0.67 (0.66-0.67) | 0.43 (0.42-0.45) | 0.00 (0.00-0.00) | 0.25 (0.24-0.27) | 1.00 (1.00-1.00) |
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Note: ND; Neurodevelopmental factor, INT; Internalizing factor, EXT; Externalizing factor.

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| **Supplementary Table 7. Observed between-sibling correlations between clusters - General factor solution with Internalizing-specific factor’s variance fixed at 0** | | | | | |
|  | | | | | |
|  | General | ND specific | INT specific | EXT specific | ADHD specific |
|  | | | | | |
| General | 0.32 (0.31-0.33) / 0.20 (0.18-0.22) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.23 (0.22-0.25) |
| ND specific | 0.00 (0.00-0.00) | 0.53 (0.49-0.57) / 0.30 (0.23-0.37) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.17 (0.15-0.19) |
| INT specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) / 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |
| EXT specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.46 (0.42-0.51) / 0.24 (0.17-0.31) | 0.08 (0.06-0.11) |
| ADHD specific | 0.15 (0.13-0.17) | 0.04 (0.003-0.07) | 0.00 (0.00-0.00) | 0.07 (0.04-0.10) | 0.37 (0.36-0.39) / 0.19 (0.16-0.22) |
|  | | | | | |
| Note: Full siblings correlations above diagonal, maternal half siblings beneath diagonal. On diagonal written as full / half. **ND; Neurodevelopmental factor, INT; Internalizing factor, EXT; Externalizing factor**. | | | | | |

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| **Supplementary Table 8. Likelihood ratio test between General factor ACE-model with and without specific variance for Internalizing factor** | | | | | | | |
|  | | | | | | | |
| Model | ep | minus2LL | df | AIC | diffLL | diffdf | p |
|  | | | | | | | |
| General factor ACE-model | 115 | 8826.35 | 10067293 | -20125759.65 |  |  |  |
| INT loading = 1 | 109 | 8828.17 | 10067299 | -20125769.83 | 1.82 | 6 | 0.935 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Supplementary Table 9. Observed correlations between siblings** | | | | | | | | | |
|  | Autism | Developmental disorders | Intellectual disability | Motor disorders | Depression | Anxiety | Phobias | Stress | OCD | | ODD | Alcohol misuse | Drug misuse | ADHD | |
| Autism | 0.38 / 0.20 | 0.20 | 0.19 | 0.20 | 0.18 | 0.15 | 0.17 | 0.12 | 0.16 | | 0.16 | 0.07 | 0.09 | 0.25 | |
| Developmental disorders | 0.15 | 0.34 / 0.12 | 0.22 | 0.18 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 | | 0.10 | 0.05 | 0.08 | 0.20 | |
| Intellectual disability | 0.17 | 0.20 | 0.41 / 0.29 | 0.16 | 0.08 | 0.08 | 0.09 | 0.10 | 0.06 | | 0.15 | 0.05 | 0.08 | 0.15 | |
| Motor disorders | 0.17 | 0.06 | 0.12 | 0.28 / 0.17 | 0.13 | 0.13 | 0.13 | 0.10 | 0.16 | | 0.16 | 0.05 | 0.11 | 0.22 | |
| Depression | 0.10 | 0.06 | 0.03 | 0.07 | 0.24 / 0.15 | 0.22 | 0.20 | 0.20 | 0.16 | | 0.19 | 0.12 | 0.17 | 0.21 | |
| Anxiety | 0.08 | 0.09 | 0.03 | 0.06 | 0.13 | 0.23 / 0.16 | 0.20 | 0.19 | 0.17 | | 0.15 | 0.13 | 0.18 | 0.20 | |
| Phobias | 0.11 | 0.06 | -0.05 | 0.11 | 0.09 | 0.09 | 0.21 / 0.17 | 0.15 | 0.16 | | 0.15 | 0.12 | 0.13 | 0.18 | |
| Stress | 0.09 | 0.11 | 0.08 | 0.12 | 0.14 | 0.12 | 0.04 | 0.24 / 0.14 | 0.13 | | 0.20 | 0.13 | 0.18 | 0.16 | |
| OCD | 0.05 | 0.07 | 0.06 | 0.17 | 0.08 | 0.06 | 0.10 | 0.06 | 0.23 / 0.10 | | 0.12 | 0.08 | 0.10 | 0.13 | |
| ODD | 0.09 | 0.03 | 0.09 | -0.01 | 0.09 | 0.09 | 0.10 | 0.13 | 0.06 | | 0.29 / 0.20 | 0.14 | 0.19 | 0.25 | |
| Alcohol misuse | 0.07 | 0.07 | 0.07 | -0.02 | 0.08 | 0.09 | 0.06 | 0.07 | 0.03 | | 0.10 | 0.18 / 0.10 | 0.20 | 0.14 | |
| Drug misuse | 0.06 | 0.05 | 0.06 | 0.01 | 0.09 | 0.13 | 0.10 | 0.12 | 0.04 | | 0.14 | 0.12 | 0.32 / 0.19 | 0.19 | |
| ADHD | 0.14 | 0.08 | 0.08 | 0.10 | 0.14 | 0.13 | 0.11 | 0.10 | 0.09 | | 0.15 | 0.10 | 0.13 | 0.39 / 0.20 | |
|  | | | | | | | | | | | | | | |
| Note: Observed correlations from multivariate model. Full siblings' correlations above diagonal, maternal half siblings' beneath diagonal. On diagonal written as full / half.  OCD; Obsessive-compulsive disorder, ODD; Oppositional defiant disorder, conduct disorder, antisocial personality disorder cluster, ADHD; Attention-deficit/hyperactivity disorder. | | | | | | | | | | | | | | |

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| **Supplementary Table 10. A,C and E covariance for General factor model with Internalizing-specific factor’s variance fixed at 0 (diagonals are explained variance by factor [e.g. heritability])** | | | | | |
|  | | | | | |
|  | A General | A ND-specific | A INT-specific | A EXT-specific | A ADHD |
|  | | | | | |
| A General | 0.49 (0.40-0.58) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.35 (0.25-0.44) |
| A ND-specific | 0.00 (0.00-0.00) | 0.89 (0.58-1.19) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.46 (0.31-0.62) |
| A INT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |
| A EXT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.80 (0.46-1.14) | 0.06 (-0.10-0.22) |
| A ADHD | 0.35 (0.25-0.44) | 0.46 (0.31-0.62) | 0.00 (0.00-0.00) | 0.06 (-0.10-0.22) | 0.64 (0.50-0.78) |
|  | C General | C ND-specific | C INT-specific | C EXT-specific | C ADHD |
| C General | 0.07 (0.03-0.12) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.06 (0.02-0.10) |
| C ND-specific | 0.00 (0.00-0.00) | 0.09 (-0.05-0.22) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | -0.07 (-0.14-0.01) |
| C INT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |
| C EXT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.06 (-0.09-0.21) | 0.06 (-0.02-0.13) |
| C ADHD | 0.06 (0.02-0.10) | -0.07 (-0.14-0.01) | 0.00 (0.00-0.00) | 0.06 (-0.02-0.13) | 0.05 (-0.01-0.11) |
|  | E General | E ND-specific | E INT-specific | E EXT-specific | E ADHD |
| E General | 0.44 (0.39-0.49) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.26 (0.21-0.31) |
| E ND-specific | 0.00 (0.00-0.00) | 0.03 (-0.15-0.20) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.04 (-0.06-0.13) |
| E INT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |
| E EXT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.14 (-0.06-0.34) | 0.14 (0.04-0.23) |
| E ADHD | 0.26 (0.21-0.31) | 0.04 (-0.06-0.13) | 0.00 (0.00-0.00) | 0.14 (0.04-0.23) | 0.31 (0.23-0.39) |
|  | | | | | |

Note: ND; Neurodevelopmental factor, INT; Internalizing factor, EXT; Externalizing factor, A; Additive genetic component, C; Shared environment component, E; Non-shared environment component.

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| **Supplementary Table 11. A,C and E correlations for General factor model with Internalizing-specific factor’s variance fixed at 0** | | | | | |
|  | | | | | |
|  | A General | A ND-specific | A INT-specific | A EXT-specific | A ADHD |
|  | | | | | |
| A General | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.62 (0.48-0.75) |
| A ND-specific | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.62 (0.42-0.82) |
| A INT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |
| A EXT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.08 (-0.14-0.30) |
| A ADHD | 0.62 (0.48-0.75) | 0.62 (0.42-0.82) | 0.00 (0.00-0.00) | 0.08 (-0.14-0.30) | 1.00 (1.00-1.00) |
|  | C General | C ND-specific | C INT-specific | C EXT-specific | C ADHD |
| C General | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.99 (0.33-1.65) |
| C ND-specific | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | -0.99 (-2.69-0.71) |
| C INT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |
| C EXT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.99 (-0.59-2.57) |
| C ADHD | 0.99 (0.33-1.65) | -0.99 (-2.69-0.71) | 0.00 (0.00-0.00) | 0.99 (-0.59-2.57) | 1.00 (1.00-1.00) |
|  | E General | E ND-specific | E INT-specific | E EXT-specific | E ADHD |
| E General | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.71 (0.58-0.83) |
| E ND-specific | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.38 (-0.97-1.73) |
| E INT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |
| E EXT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 1.00 (1.00-1.00) | 0.65 (0.09-1.22) |
| E ADHD | 0.71 (0.58-0.83) | 0.38 (-0.97-1.73) | 0.00 (0.00-0.00) | 0.65 (0.09-1.22) | 1.00 (1.00-1.00) |
|  | | | | | |

Note: ND; Neurodevelopmental factor, INT; Internalizing factor, EXT; Externalizing factor, A; Additive genetic component, C; Shared environment component, E; Non-shared environment component.

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| **Supplementary Table 12. Univariate ACE-models** | | | |
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|  | A | C | E |
| Autism | 0.74 (0.65-0.84) | 0.02 (-0.11-0.15) | 0.27 (0.06-0.49) |
| Developmental disorders | 0.66 (0.45-0.87) | 0.01 (-0.24-0.27) | 0.35 (-0.10-0.80) |
| Intellectual disability | 0.73 (0.55-0.90) | 0.30 (-0.06-0.66) | 0.57 (0.06-1.09) |
| Motor disorders | 0.47 (0.04-0.90) | 0.15 (-0.31-0.60) | 0.68 (-0.19-1.55) |
| Depression | 0.45 (0.38-0.53) | 0.03 (-0.04-0.09) | 0.57 (0.43-0.71) |
| Anxiety | 0.37 (0.27-0.47) | 0.08 (0.00-0.16) | 0.71 (0.54-0.88) |
| Phobias | 0.24 (-0.10-0.57) | 0.16 (-0.10-0.42) | 0.93 (0.34-1.51) |
| Stress | 0.44 (0.32-0.56) | 0.04 (-0.06-0.13) | 0.60 (0.39-0.81) |
| OCD | 0.47 (0.21-0.74) | 0.00 (-0.87-0.87) | 0.53 (-0.60-1.66) |
| ODD | 0.58 (0.29-0.88) | 0.06 (-0.21-0.32) | 0.47 (-0.07-1.01) |
| Alcohol misuse | 0.32 (0.21-0.43) | 0.03 (-0.04-0.11) | 0.72 (0.53-0.90) |
| Drug misuse | 0.57 (0.46-0.68) | 0.09 (-0.02-0.20) | 0.52 (0.30-0.73) |
| ADHD | 0.76 (0.71-0.82) | 0.03 (-0.05-0.10) | 0.26 (0.14-0.39) |
|  | | | |

Note: A; Additive genetic component, C; Shared environment component, E; Non-shared environment component, OCD; Obsessive-compulsive disorder, ODD; Oppositional defiant disorder, conduct disorder, antisocial personality disorder cluster, ADHD; Attention-deficit/hyperactivity disorder.

**Supplementary Table 13.** Observed between-sibling correlations between clusters – Bifactor model.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | P | NDD-specific | INT-specific | EXT-specific | ADHD |
| P | 0.32 (0.31-0.33) / 0.19 (0.17-0.21) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.24 (0.22-0.25) |
| NDD-specific | 0.00 (0.00-0.00) | 0.53 (0.50-0.57) / 0.30 (0.24-0.36) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.16 (0.14-0.18) |
| INT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.26 (0.18-0.34) / 0.26 (0.12-0.40) | 0.00 (0.00-0.00) | 0.02 (-0.01-0.05) |
| EXT-specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.44 (0.39-0.48) / 0.23 (0.16-0.30) | 0.07 (0.05-0.10) |
| ADHD | 0.15 (0.13-0.17) | 0.04 (0.01-0.07) | 0.06 (0.02-0.10) | 0.06 (0.03-0.09) | 0.37 (0.36-0.39) / 0.19 (0.16-0.22) |
| Note: Full siblings' correlations above diagonal, maternal half siblings' beneath diagonal. On diagonal written as full / half | | | | | |

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|  | **Supplementary Table 14. General psychopathology factor versus Specific ACE-contributions to covariance** | | | | | | | | | | | | | |
|  |  | A ND | A INT | A EXT | A ADHD | C ND | C INT | C EXT | C ADHD | E ND | E INT | E EXT | E ADHD |
| ND | General P | 0.18 (0.14-0.21) |  |  |  | 0.03 (0.01-0.04) |  |  |  | 0.16 (0.14-0.18) |  |  |  |
| INT | General P | 0.29 (0.24-0.35) | 0.49 (0.40-0.58) |  |  | 0.04 (0.02-0.07) | 0.07 (0.03-0.12) |  |  | 0.26 (0.23-0.29) | 0.44 (0.39-0.49) |  |  |
| EXT | General P | 0.23 (0.18-0.27) | 0.38 (0.31-0.45) | 0.29 (0.24-0.34) |  | 0.03 (0.02-0.05) | 0.06 (0.03-0.09) | 0.04 (0.02-0.07) |  | 0.20 (0.18-0.22) | 0.34 (0.30-0.37) | 0.26 (0.23-0.29) |  |
| ADHD | General P | 0.21 (0.15-0.26) | 0.35 (0.25-0.44) | 0.27 (0.20-0.34) | 0.00 (0.00-0.00) | 0.04 (0.01-0.06) | 0.06 (0.02-0.10) | 0.05 (0.02-0.08) | 0.00 (0.00-0.00) | 0.16 (0.12-0.19) | 0.26 (0.21-0.31) | 0.20 (0.16-0.24) | 0.00 (0.00-0.00) |
| ND | Specific | 0.57 (0.37-0.76) |  |  |  | 0.06 (-0.03-0.14) |  |  |  | 0.02 (-0.09-0.13) |  |  |  |
| INT | Specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |  |  | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |  |  | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) |  |  |
| EXT | Specific | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.33 (0.19-0.47) |  | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.03 (-0.04-0.09) |  | 0.00 (0.00-0.00) | 0.00 (0.00-0.00) | 0.06 (-0.02-0.14) |  |
| ADHD | Specific | 0.37 (0.25-0.50) | 0.00 (0.00-0.00) | 0.04 (-0.07-0.14) | 0.64 (0.50-0.78) | -0.05 (-0.11-0.004) | 0.00 (0.00-0.00) | 0.04 (-0.01-0.08) | 0.05 (-0.01-0.11) | 0.03 (-0.05-0.10) | 0.00 (0.00-0.00) | 0.09 (0.03-0.15) | 0.31 (0.23-0.39) |

Note: ND; Neurodevelopmental factor, INT; Internalizing factor, EXT; Externalizing factor, A; Additive genetic component, C; Shared environment component, E; Non-shared environment component.