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Supplemental Online Material: Appendix 1. Sample Size at Each Age

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | At least one timepoint | 14  mo | 20  mo | 24  mo | 36  mo | 4  yrs | 5  yrs | 7  yrs | 8  yrs | 9  yrs | 10  yrs | 11  yrs | 12  yrs | 17  yrs | 23  yrs |
| Concern  for Others Observed | 822 | 789 | 708 | 714 | 687 |  |  |  |  |  |  |  |  |  |  |
| Concern for Others Parent | 802 | 746 | 694 | 680 | 660 |  |  |  |  |  |  |  |  |  |  |
| Disregard  For Others  Observed | 822 | 789 | 708 | 714 | 687 |  |  |  |  |  |  |  |  |  |  |
| Disregard for Others  Parent | 802 | 746 | 696 | 661 | 660 |  |  |  |  |  |  |  |  |  |  |
| Aggression  Observed | 821 | 768 | 698 | 697 |  |  |  |  |  |  |  |  |  |  |  |
| Conduct Problems Parent | 869 |  |  |  |  | 581 | 491 | 599 |  | 638 | 578 | 492 | 652 |  |  |
| Conduct Problems Teacher | 794 |  |  |  |  |  |  | 574 | 533 | 509 | 511 | 501 | 438 |  |  |
| Conduct Problems Self | 741 |  |  |  |  |  |  |  |  |  |  |  |  | 741 |  |
| Psychopathy  Self | 753 |  |  |  |  |  |  |  |  |  |  |  |  |  | 753 |
| ASPD  Self | 763 |  |  |  |  |  |  |  |  |  |  |  |  |  | 763 |

Note. mo = months; yrs = years; parent = parent-reported; teacher = teacher-reported; self = self-reported; ASPD =

antisocial personality disorder symptoms. The total sample size (N = 956) is greater than the sample sizes at age 14 months because recruitment of twins continued after age 14 months.

Supplemental Online Material: Appendix 2. Percentage of Sample in Each Category of the Ordinal Variables

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Age | Mother- Rated  Concern  for Others | Mother- Rated Disregard  for Others | Observed Concern for Others | Observed Disregard for Others | Observed Aggression | Parent- Reported Conduct Problems | Teacher- Reported Conduct Problems | Self- Reported Conduct Problems | Self-  Reported  ASPD |
| 14 months | 0 – 35.5%  1 – 29.9%  2 – 24.5%  3 – 10.1% | 0 – 43.7%  1 – 23.5%  2 – 17.3%  3 – 15.5% | 0 – 30.4%  1 – 41.1%  2 – 19.8%  3 – 8.7% | 0 – 78.5%  1 – 15.5%  2 – 6.1% | 0 – 34.3%  1 – 14.8%  2 – 42.7%  3 – 8.1% |  |  |  |  |
| 20 months | 0 – 7.2%  1 – 24.6%  2 – 44.4%  3 – 23.8% | 0 – 35.2%  1 – 33.9%  2 – 18.5%  3 – 12.4% | 0 – 13.8%  1 – 36.3%  2 – 27.0%  3 – 22.9% | 0 – 87.9%  1 – 9.7%  2 – 2.4% | 0 – 32.0%  1 – 16.1%  2 – 42.1%  3 – 9.8% |  |  |  |  |
| 24 months | 0 – 5.4%  1 – 16.0%  2 –42.1%  3 – 36.5% | 0 – 35.1%  1 – 36.0%  2 – 17.7%  3 – 11.2% | 0 – 8.4%  1 – 26.3%  2 – 27.6%  3 – 37.7% | 0 – 88.5%  1 – 8.8%  2 – 2.7% | 0 – 37.6%  1 – 15.9%  2 – 40.0%  3 – 6.5% |  |  |  |  |
| 36 months | 0 – 2.1%  1 – 13.8%  2 – 47.1%  3 – 37.0% | 0 – 37.4%  1 – 36.7%  2 – 15.2%  3 – 10.8% | 0 – 10.3%  1 – 19.8%  2 – 25.8%  3 – 44.1% | 0 – 84.4%  1 – 11.9%  2 – 3.6% |  |  |  |  |  |
| 4 years |  |  |  |  |  | 0 – 22.0%  1 – 22.9%  2 – 26.5%  3 – 28.6% |  |  |  |
| 5 years |  |  |  |  |  | 0 – 21.2%  1 – 27.1%  2 – 25.3%  3 – 26.5% |  |  |  |
| 7 years |  |  |  |  |  | 0 – 32.1%  1 – 25.2%  2 – 20.2%  3 – 22.5% | 0 – 35.3%  1 – 26.3%  2 – 20.4%  3 – 17.8% |  |  |

Supplemental Online Material: Appendix 2. Percentage of sample in each category of the ordinal variables (continued)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Age | Mother- Rated  Concern  for Others | Mother- Rated Disregard  for Others | Observed Concern for Others | Observed Disregard for Others | Observed Aggression | Parent- Reported Conduct Problems | Teacher- Reported Conduct Problems | Self- Reported Conduct Problems | Self-  Reported  ASPD |
| 8 years |  |  |  |  |  |  | 0 – 34.1%  1 – 29.1%  2 – 19.3%  3 – 17.4% |  |  |
| 9 years |  |  |  |  |  | 0 – 36.1%  1 – 24.9%  2 – 20.1%  3 – 19.0% | 0 – 39.9%  1 – 23.2%  2 – 18.7%  3 – 18.3% |  |  |
| 10 years |  |  |  |  |  | 0 – 42.0%  1 – 23.4%  2 – 18.0%  3 – 16.6% | 0 – 36.6%  1 – 29.4%  2 – 17.8%  3 – 16.2% |  |  |
| 11 years |  |  |  |  |  | 0 – 45.5%  1 – 19.9%  2 – 20.1%  3 – 14.4% | 0 – 37.9%  1 – 28.5%  2 – 18.6%  3 – 15.0% |  |  |
| 12 years |  |  |  |  |  | 0 – 40.3%  1 – 25.9%  2 – 17.6%  3 – 16.1% | 0 – 41.6%  1 – 31.1%  2 – 16.2%  3 – 11.2% |  |  |
| 17 years |  |  |  |  |  |  |  | 0 – 61.9% to 98.5%  1 – 1.5%  to 38.1% |  |
| 23 years |  |  |  |  |  |  |  |  | 0 – 65.7% to 95.9%  1 – 4.1% to 34.3% |

Note. ASPD = antisocial personality disorder symptoms.

Supplemental Online Material: Appendix 3. Descriptive Statistics for Continuous Variables

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Mean | Standard Deviation | Skewness | Kurtosis |
| Psychopathy Factor 1 | 1.75 | .41 | .47 | -.20 |
| Psychopathy Factor 2 | 1.81 | .43 | .35 | -.10 |

Supplemental Online Material: Appendix 4. Biometrical Genetic Analyses

**Analyses**

In the phenotypic analyses, a latent variable approach was used to examine the common variance across time or assessments. We could not use a latent variable approach for the biometrical genetic analyses described below, as there were a number of bivariate missingness problems in the ordinal variables after the sample was split into four groups (i.e., MZ twin 1, MZ twin 2, DZ twin 1, and DZ twin 2). Therefore, plausible values (i.e., imputed factor scores using Bayesian estimation; Asparouhov & Muthén, 2010; von Davier, Gonzalez, & Mislevy, 2009) for observed disregard for others, parent-, teacher-, and self-reported conduct problems, and ASPD symptoms were imputed in 200 datasets using ESTIMATOR = BAYES, then analyzed in a factor 2 model.

**Results**

Appendix 5 presents the phenotypic correlations and the corresponding MZ and DZ twin correlations. The cross-twin correlations for disregard for others and the cross-trait cross-twin correlations between disregard for others and later traits (i.e., conduct problems, psychopathy factor 1, and ASPD symptoms) were similar for the MZ and DZ twins, suggesting no genetic influences and likely shared environmental influences. The within-trait correlations for conduct problems, psychopathy factor 1, and ASPD symptoms were higher for MZs than DZs, suggesting genetic influences on these variables. The cross-trait cross-twin correlations for the covariance between conduct problems and psychopathy factor 1/ASPD symptoms are also slightly higher for MZs than DZs, suggesting possible genetic influences and mostly shared environmental influences on these correlations.

We modeled the genetic and environmental covariances with a quadrivariate genetic Cholesky decomposition (see Appendices 6 and 7), which partitions the covariances between observed disregard for others, conduct problems, and psychopathy factor 1 into orthogonal genetic (A), shared environmental (C), and nonshared environmental (E) components. The first set (A1, C1, and E1) influences disregard for others, conduct problems, psychopathy factor 1, and ASPD symptoms. The second set (A2, C2, and E2) influences conduct problems, psychopathy factor 1, and ASPD symptoms after controlling for the influences on disregard for others. The third set (A3, C3, and E3) influences psychopathy factor 1 and ASPD symptoms after controlling for the influences on disregard for others and conduct problems. The fourth set (A4, C4, and E4) of influences are specific to ASPD symptoms.

Using the results of the quadrivariate model and path tracing rules, the magnitude of A, C, and E on disregard for others (*a2* = .06, *p* = .42; *c2* = .39, *p* = .02; *e2* = .54, *p* < .01), conduct problems (*a2* = .23, *p* = .03; *c2* = .61, *p* < .01; *e2* = .16, *p* < .01), psychopathy factor 1 (*a2* = .35, *p* < .01; *c2* = .14, *p* = .18; *e2* = .51, *p* < .01), and ASPD symptoms (*a2* = .16, *p* = .13; *c2* = .40, *p* < .01; *e2* = .44, *p* < .01) were calculated. It should be noted that these estimates from the quadrivariate model use additional information available from the cross-trait cross-twin correlations as well as the within-trait cross-twin correlations; as indicated above, the cross-trait cross-twin correlations were generally more similar between MZs and DZs than the within-trait cross-twin correlations.

Path tracing rules were also applied to estimate the influences of A, C, and E on the correlations between disregard for others and later traits (see Appendix 8). Shared environmental influences explained most of the correlation between disregard for others and conduct problems (*r* = .33, *p* = .06), between disregard for others and psychopathy factor 1 (*r* = .12, *p* = .35), and between disregard for others and ASPD symptoms (*r* = .23, *p* = .09), although these results were not significant.

Finally, path tracing rules were applied to estimate the correlation between conduct problems and psychopathy factor 1/ASPD symptoms shared in common with disregard for others vs. those independent from disregard for others (see Appendix 9). Although the influences shared in common with disregard for others did not contribute to the correlation between conduct problems and psychopathy factor 1/ASPD symptoms significantly, they explained 57% of the correlation between conduct problems and psychopathy factor 1 and 44% of the correlation between conduct problems and ASPD symptoms.

**Discussion**

There wasn’t adequate power to distinguish genetic vs. environmental contributions to the association between toddlerhood disregard for others and adulthood psychopathy factor 1 and ASPD symptoms, although there was a statistical trend for shared environmental influences on the correlation between disregard for others and ASPD symptoms. Approximately half of the association between childhood/adolescent conduct problems and adult psychopathy factor 1/ASPD symptoms was due to influences shared in common with toddlerhood observed disregard for others; again, there wasn’t adequate power to distinguish genetic vs. environmental contributions in these analyses.

**References**

Asparouhov, T., & Muthén, B. (2010). Plausible values for latent variables using Mplus. Technical report.

von Davier M., Gonzalez E., & Mislevy R. (2009). What are plausible values and why are they useful? IERI Monograph Series Issues and Methodologies in Large-Scale Assessments. Princeton, NJ: IER Institute. Educational Testing Service.

Supplemental Online Material: Appendix 5. Phenotypic, Within-Trait Cross-Twin, and Cross-Trait Cross-Twin Correlations

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | Correlation | | |
| Phenotypic | Monozygotic | Dizygotic |
| Disregard for Others | **--** | .41\* | .43\* |
| Conduct Problems | **--** | .83\*\* | .70\*\* |
| Psychopathy Factor 1 | **--** | .54\*\* | .24\*\* |
| ASPD | **--** | .55\*\* | .48\*\* |
| Disregard for Others- Conduct Problems | .43\*\* | .41\*\* | .39\* |
| Disregard for Others-  Psychopathy Factor 1 | .25\* | .17 | .12 |
| Disregard for Others-  ASPD | .30\* | .27\* | .26+ |
| Conduct Problems-  Psychopathy Factor 1 | .35\*\* | .34\*\* | .28\*\* |
| Conduct Problems-  ASPD | .80\*\* | .65\*\* | .56\*\* |
| Psychopathy Factor 1-  ASPD | .28\*\* | .26\*\* | .19\*\* |

Note. + *p* < .10, \* *p* < .05, \*\* *p* < .01. ASPD = antisocial personality disorder symptoms.

Supplemental Online Material Appendix 6: Genetic (A), Shared Environmental (C), and Nonshared Environmental (E) influences on Observed Disregard for Others, Conduct Problems, Psychopathy factor 1, and Antisocial Personality Disorder Symptoms.



Note. The measurement portion of the model for the higher-order conduct problems is shown in lighter gray, and standardized parameters are shown. See Table 3 for the quadrivariate Cholesky parameters. A1, C­­1, E1 = influences on observed disregard for others, which also influence conduct problems (CP), psychopathy factor 1, and antisocial personality disorder (ASPD) symptoms. A2, C­­2, E2 = influences shared in common by CP, psychopathy factor 1, and ASPD symptoms after controlling for those in common with observed disregard for others. A3, C­­3, E3 = influences shared in common by psychopathy factor 1 and ASPD symptoms after controlling for those in common with observed disregard for others and CP. A4, C­­4, E4 = influences specific to ASPD symptoms. APR, ATR, ASR, C­pr, CTR­, CSR, Epr, ETR, ESR = influences specific to parent-reported (PR), teacher-reported (TR), and self-reported (SR) CP,

Supplemental Online Material: Appendix 7. Results of Quadrivariate Cholesky Examining Toddlerhood Observed Disregard for Others, Childhood/Adolescent Higher-Order Conduct Problems, Adulthood Psychopathy Factor 1, and Adulthood Antisocial Personality Disorder Symptoms

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Observed Disregard for Others | Conduct Problems | Psychopathy Factor 1 | Antisocial Personality Disorder |
| A1 | .18 | .32 | .31 | .26 |
| C1 | .59\*\* | .54\* | .16 | .38+ |
| E1 | .73\*\* | .02 | .10 | .03 |
| A2 |  | .26 | .07 | .22 |
| C2 |  | .47 | .17 | .41 |
| E2 |  | .38\*\* | .01 | .37\*\* |
| A3 |  |  | .16 | .01 |
| C3 |  |  | .00 | .04 |
| E3 |  |  | .66\*\* | .01 |
| A4 |  |  |  | .00 |
| C4 |  |  |  | .00 |
| E4 |  |  |  | .50\*\* |

Note. Genetic (A), shared environmental (C), and nonshared environmental (E) influences. Standardized parameters are shown. The squares of the standardized values do not add up to 100% because results are averaged across multiple imputed datasets. A1, C­­1, E1 = influences on observed disregard for others, which also influence conduct problems (CP), psychopathy factor 1, and antisocial personality disorder (ASPD) symptoms. A2, C­­2, E2 = influences shared in common by CP, psychopathy factor 1, and ASPD symptoms after controlling for those in common with observed disregard for others. A3, C­­3, E3 = influences shared in common by psychopathy factor 1 and ASPD symptoms after controlling for those in common with observed disregard for others and CP. A4, C­­4, E4 = influences specific to ASPD symptoms.+ *p* < .10, \* *p* < .05, \*\* *p* < .01

Supplemental Online Material: Appendix 8. Correlations between Toddlerhood Observed Disregard for Others and Childhood/Adolescent Higher-Order Conduct Problems, Adulthood Psychopathy Factor 1, and Adulthood Antisocial Personality Disorder Symptoms due to Genetic (A), Shared environmental (C), and Nonshared environmental (E) influences

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Correlation | A | C | E | Total |
| Disregard for Others and Conduct Problems | .07 | .33+ | .02 | .41\*\* |
| Disregard for Others and Psychopathy Factor 1 | .06 | .11 | .08 | .25\* |
| Disregard for Others and Antisocial Personality Disorder | .05 | .23+ | .02 | .30\* |

Note. + *p* < .10, \* *p* < .05, \*\* *p* < .01. The *p* values are those from the *z*-statistic for the correlations due the genetic and environmental influences calculated with the MODEL CONSTRAINT command in Mplus. These parameters are similar, but not identical to those derived using the path tracing rules on the parameters in Appendix 6, because results in Appendix 6 are those averaged across multiple imputed datasets. A, C, and E do not always add up to the total due to rounding.

Supplemental Online Material: Appendix 9. Correlations between Childhood/Adolescent Higher-Order Conduct problems and Adulthood Psychopathy Factor 1/Adulthood Antisocial Personality Disorder Symptoms due to Influences Shared in Common with Toddlerhood Observed Disregard for Others

|  |  |  |  |
| --- | --- | --- | --- |
| Source of Covariance | | Conduct Problems and Psychopathy Factor 1 | Conduct Problems and Antisocial Personality Disorder |
| Shared in Common with Disregard for Others | A | .10 | .10 |
| C | .11 | .23 |
| E | .00 | .01 |
| Total | .21 | .34+ |
| Independent from Disregard for Others | A | .03 | .08 |
| C | .09 | .22 |
| E | .01 | .14\*\* |
| Total | .13 | .44\* |
| Total Correlation | | .34\*\* | .78\*\* |

Note. + *p* < .10, \* *p* < .05, \*\* *p* < .01. The *p* values are those from the *z*-statistic for the correlations due the genetic and environmental influences calculated with the MODEL CONSTRAINT command in Mplus. These parameters are similar, but not identical to those derived using the path tracing rules on the parameters in Appendix 6, because results in Appendix 6 are those averaged across multiple imputed datasets.

Supplemental Online Material: Appendix 10. Correlations between Observed Disregard for Others Assessed at Each Age and Adulthood Antisocial Personality Disorder and Psychopathy

|  |  |  |  |
| --- | --- | --- | --- |
|  | Antisocial  Personality Disorder | Factor 1  Psychopathy | Factor 2  Psychopathy |
| 14 months | .10 | .12\* | .08 |
| 20 months | .13 | .16\*\* | .08 |
| 24 months | .19\* | .06 | .00 |
| 36 months | -.08 | .00 | .00 |

Note. \* *p* < .05, \*\* *p* < .01

Supplemental Online Material: Appendix 11. Correlations between Toddlerhood Observed Disregard for Others and Individual Antisocial Personality Disorder Criteria

|  |  |
| --- | --- |
| Antisocial Personality  Disorder Criterion | Correlation with Disregard for Others |
| Failure to conform to social norms with respect to lawful behaviors | .20 |
| Deceitfulness | .63\*\* |
| Impulsivity and failure to plan ahead | .22 |
| Irritability and aggressiveness | .00 |
| Reckless disregard for the safety of self or others | .26+ |
| Irresponsibility at work or financially | .37\* |
| Lack of remorse | .32\* |

Note. + *p* < .10 \* *p* < .05, \*\* *p* < .01