**SUPPLEMENTARY MATERIAL**

**Gene-environment interaction using polygenic scores: Do polygenic scores for psychopathology moderate associations between family environments and behavior problems?**

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| **Supplementary figure 1.** Matrix of correlations between environmental measures and latent factors, behaviour problems and genome-wide polygenic scores (GPS). |
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**Supplementary note 1**

Exploratory factor analysis (EFA)

To explore the factor structure of environmental measures at age 3 and 4, we conducted an EFA of the environmental measures at each age (i.e., twin and family-specific environmental risk composites, parental discipline, and smacking/shouting) and SES (assessed at first contact). EFA analyses were conducted in *psych* for R (Revelle, 2020; R Core Team, 2020) and involved a sample of 4414 unrelated twins, created by randomly selecting one twin per pair.

EFA yielded a two-factor structure (**Supplementary figure 2**), with twin and family-specific environmental risk composites and SES loading strongly on factor 1, which we refer to as an environmental risk factor, and parental discipline and smacking/shouting loading strongly on factor 2, which we refer to as the discipline factor). Correlations between environmental risk and discipline factors was moderate (0.40) (**Supplementary figure 3**).

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| **Supplementary figure 2.** Scree plot of environmental measures at age 3 and 4. |
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| **Supplementary figure 3.** Factor structure of environmental measures at age 3 and 4. |
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**Supplementary note 2**

Confirmatory factor analysis (CFA).

Factor scores for environmental risk and discipline were created using CFA because CFA uses Full Information Maximum Likelihood to account for data missingness. EFA was conducted on a sample consisting of one randomly selected member of each twin pair; CFA was performed on the other member of the twin pairs. The factor structure suggested by EFA was used as the structure for CFA, which was analysed using *lavaan* for R (Rosseel, 2012; R Core Team, 2020). The CFA two-factor model is illustrated in **Supplementary figure 4.** CFA model fit indices are presented in **Supplementary table 1**.

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| **Supplementary figure 4.** Illustration of the 2-factor CFA model. |

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| **Supplementary table 1.** CFA model fit indices. | |
| Comparative fit index (**CFI**) | 0.68 |
| Tucker-Lewis Index (**TLI**) | 0.55 |
| Akaike (**AIC**) | 146839.01 |
| Bayesian (**BIC**) | 147041.33 |
| Root Mean Square Error of Approximation (**RMSEA**) (95% CIs) | 0.26 (0.25-0.26) |

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| Supplementary table 2. Descriptive statistics. | | | |
|  | N | Mean | SD |
| 1st contact |  |  |  |
| SES | 9676 | 0.12 | 1.00 |
| Age 3 |  |  |  |
| Smack/shout | 5711 | -0.03 | 1.00 |
| Parental discipline | 5704 | -0.03 | 0.99 |
| Environmental risk composite (twin-specific) | 5726 | -0.04 | 0.98 |
| Environmental risk composite (family-specific) | 5742 | -0.04 | 0.98 |
| Age 4 |  |  |  |
| Smack/shout | 8085 | -0.02 | 0.99 |
| Parental discipline | 8073 | -0.02 | 1.00 |
| Environmental risk composite (twin-specific) | 8125 | -0.04 | 0.98 |
| Environmental risk composite (family-specific) | 8156 | -0.05 | 0.99 |
| Age 7 |  |  |  |
| Hyperactivity/inattention | 6842 | 2.86 | 2.67 |
| Conduct problems | 6845 | 0.72 | 1.35 |
| Emotional symptoms | 6815 | 1.31 | 1.78 |
| Peer relationship problems | 6834 | 1.06 | 1.48 |
| Age 9 |  |  |  |
| Hyperactivity/inattention | 3262 | 2.55 | 2.44 |
| Conduct problems | 3266 | 0.52 | 1.17 |
| Emotional symptoms | 3270 | 1.37 | 1.85 |
| Peer relationship problems | 3275 | 0.85 | 1.45 |
| Age 12 |  |  |  |
| Hyperactivity/inattention | 5708 | 2.16 | 2.48 |
| Conduct problems | 5709 | 0.58 | 1.27 |
| Emotional symptoms | 5697 | 1.21 | 1.79 |
| Peer relationship problems | 5706 | 1.03 | 1.59 |
| *Note.* The environmental measures were standardized. N= sample size; SD= standard deviation. | | | |

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| Supplementary table 3. Linear regression results predicting behaviour problems from environmental factors and genome-wide polygenic scores (GPS). | | | | | | | |
| Outcome | **Predictor** | **BETA** | **SE** | **T** | **P** | **R2** | **N** |
| Hyperactivity/inattention (age 7) | Environmental risk factor | 0.14 | 0.01 | 11.53 | <0.001 | 0.020 | 6629 |
| Discipline factor | 0.15 | 0.01 | 12.88 | <0.001 | 0.024 | 6629 |
| ADHD GPS | 0.14 | 0.01 | 11.75 | <0.001 | 0.020 | 6684 |
| Neuroticism GPS | 0.01 | 0.01 | 1.17 | 0.24 | <0.001 | 6684 |
| Hyperactivity/inattention (age 9) | Environmental risk factor | 0.16 | 0.02 | 9.54 | <0.001 | 0.027 | 3236 |
|  | Discipline factor | 0.15 | 0.02 | 8.83 | <0.001 | 0.024 | 3236 |
|  | ADHD GPS | 0.13 | 0.02 | 7.65 | <0.001 | 0.018 | 3260 |
|  | Neuroticism GPS | 0.03 | 0.02 | 1.69 | 0.09 | 0.001 | 3260 |
| Hyperactivity/inattention (age 12) | Environmental risk factor | 0.15 | 0.01 | 11.30 | <0.001 | 0.022 | 5653 |
|  | Discipline factor | 0.12 | 0.01 | 9.14 | <0.001 | 0.015 | 5653 |
|  | ADHD GPS | 0.13 | 0.01 | 9.87 | <0.001 | 0.017 | 5708 |
|  | Neuroticism GPS | 0.03 | 0.01 | 2.16 | 0.03 | 0.001 | 5708 |
| Conduct problems (age 7) | Environmental risk factor | 0.13 | 0.01 | 10.93 | <0.001 | 0.018 | 6632 |
|  | Discipline factor | 0.13 | 0.01 | 11.51 | <0.001 | 0.020 | 6632 |
|  | ADHD GPS | 0.11 | 0.01 | 9.15 | <0.001 | 0.012 | 6687 |
|  | Neuroticism GPS | 0.03 | 0.01 | 2.17 | 0.03 | 0.001 | 6687 |
| Conduct problems (age 9) | Environmental risk factor | 0.13 | 0.02 | 7.95 | <0.001 | 0.019 | 3240 |
|  | Discipline factor | 0.10 | 0.02 | 6.44 | <0.001 | 0.013 | 3240 |
|  | ADHD GPS | 0.10 | 0.02 | 6.20 | <0.001 | 0.012 | 3264 |
|  | Neuroticism GPS | 0.03 | 0.02 | 1.82 | 0.07 | 0.001 | 3264 |
| Conduct problems (age 12) | Environmental risk factor | 0.15 | 0.01 | 12.12 | <0.001 | 0.025 | 5654 |
|  | Discipline factor | 0.11 | 0.01 | 8.82 | <0.001 | 0.014 | 5654 |
|  | ADHD GPS | 0.10 | 0.01 | 8.26 | <0.001 | 0.012 | 5709 |
|  | Neuroticism GPS | 0.02 | 0.01 | 1.81 | 0.07 | 0.001 | 5709 |
| Emotional symptoms (age 7) | Environmental risk factor | 0.08 | 0.01 | 6.96 | <0.001 | 0.007 | 6602 |
|  | Discipline factor | 0.04 | 0.01 | 3.63 | <0.001 | 0.002 | 6602 |
|  | ADHD GPS | 0.04 | 0.01 | 3.46 | <0.001 | 0.002 | 6657 |
|  | Neuroticism GPS | 0.07 | 0.01 | 5.63 | <0.001 | 0.005 | 6657 |
| Emotional symptoms (age 9) | Environmental risk factor | 0.08 | 0.02 | 4.67 | <0.001 | 0.007 | 3244 |
|  | Discipline factor | 0.04 | 0.02 | 2.50 | 0.01 | 0.002 | 3244 |
|  | ADHD GPS | 0.04 | 0.02 | 2.57 | 0.01 | 0.002 | 3268 |
|  | Neuroticism GPS | 0.05 | 0.02 | 3.20 | <0.001 | 0.003 | 3268 |
| Emotional symptoms (age 12) | Environmental risk factor | 0.06 | 0.01 | 4.69 | <0.001 | 0.004 | 5642 |
|  | Discipline factor | 0.03 | 0.01 | 2.32 | 0.02 | 0.001 | 5642 |
|  | ADHD GPS | 0.05 | 0.01 | 4.03 | <0.001 | 0.003 | 5697 |
|  | Neuroticism GPS | 0.05 | 0.01 | 3.89 | <0.001 | 0.003 | 5697 |
| Peer relationship problems (age 7) | Environmental risk factor | 0.10 | 0.01 | 7.92 | <0.001 | 0.009 | 6622 |
|  | Discipline factor | 0.07 | 0.01 | 5.55 | <0.001 | 0.005 | 6622 |
|  | ADHD GPS | 0.04 | 0.01 | 3.72 | <0.001 | 0.002 | 6677 |
|  | Neuroticism GPS | 0.02 | 0.01 | 1.49 | 0.14 | <0.001 | 6677 |
| Peer relationship problems (age 9) | Environmental risk factor | 0.08 | 0.02 | 4.88 | <0.001 | 0.007 | 3249 |
|  | Discipline factor | 0.07 | 0.02 | 4.20 | <0.001 | 0.005 | 3249 |
|  | ADHD GPS | 0.05 | 0.02 | 3.05 | <0.001 | 0.003 | 3273 |
|  | Neuroticism GPS | 0.02 | 0.02 | 1.31 | 0.19 | 0.001 | 3273 |
| Peer relationship problems (age 12) | Environmental risk factor | 0.06 | 0.01 | 4.45 | <0.001 | 0.003 | 5651 |
|  | Discipline factor | 0.04 | 0.01 | 3.39 | <0.001 | 0.002 | 5651 |
|  | ADHD GPS | 0.05 | 0.01 | 3.78 | <0.001 | 0.002 | 5706 |
|  | Neuroticism GPS | 0.02 | 0.01 | 1.79 | 0.07 | 0.001 | 5706 |
| *Note.* SE= standard error of the beta; T= the t-statistic; P= p-value; R2= proportion of variance explained; N= sample size. | | | | | | | |

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| Supplementary table 4. Multiple regression results predicting behaviour problems jointly from environmental factors and genome-wide polygenic scores (G+E) and from their interaction (GxE). | | | | | | | | | | |
| Outcome | **G predictor** | **E predictor** | **BETA** | **SE** | **T** | **P** | **R2 G+E** | **R2 GxE** | | **N** |
| Hyperactivity/inattention (age 7) | ADHD GPS | Environmental risk factor | 0.12 | 0.01 | 10.51 | <0.001 | 0.036 | <0.001 | 6629 | |
| Hyperactivity/inattention (age 9) | ADHD GPS | Environmental risk factor | 0.12 | 0.02 | 6.88 | <0.001 | 0.041 | 0.001 | 3236 | |
| Hyperactivity/inattention (age 12) | ADHD GPS | Environmental risk factor | 0.11 | 0.01 | 8.77 | <0.001 | 0.035 | <0.001 | 5653 | |
| Hyperactivity/inattention (age 7) | ADHD GPS | Discipline factor | 0.13 | 0.01 | 10.57 | <0.001 | 0.040 | <0.001 | 6629 | |
| Hyperactivity/inattention (age 9) | ADHD GPS | Discipline factor | 0.12 | 0.02 | 7.12 | <0.001 | 0.039 | 0.003 | 3236 | |
| Hyperactivity/inattention (age 12) | ADHD GPS | Discipline factor | 0.12 | 0.01 | 9.09 | <0.001 | 0.029 | <0.001 | 5653 | |
|  |  |  |  |  |  |  |  |  |  | |
| Hyperactivity/inattention (age 7) | Neuroticism GPS | Environmental risk factor | <0.001 | 0.01 | 0.10 | 0.92 | 0.020 | <0.001 | 6629 | |
| Hyperactivity/inattention (age 9) | Neuroticism GPS | Environmental risk factor | 0.02 | 0.02 | 0.93 | <0.001 | 0.028 | 0.001 | 3236 | |
| Hyperactivity/inattention (age 12) | Neuroticism GPS | Environmental risk factor | 0.02 | 0.01 | 1.76 | <0.001 | 0.022 | 0.001 | 5653 | |
| Hyperactivity/inattention (age 7) | Neuroticism GPS | Discipline factor | <0.001 | 0.01 | 0.32 | 0.02 | 0.024 | <0.001 | 6629 | |
| Hyperactivity/inattention (age 9) | Neuroticism GPS | Discipline factor | 0.02 | 0.02 | 1.19 | <0.001 | 0.024 | <0.001 | 3236 | |
| Hyperactivity/inattention (age 12) | Neuroticism GPS | Discipline factor | 0.03 | 0.01 | 2.08 | <0.001 | 0.015 | <0.001 | 5653 | |
|  |  |  |  |  |  |  |  |  |  | |
| Conduct problems  (age 7) | ADHD GPS | Environmental risk factor | 0.10 | 0.01 | 8.14 | <0.001 | 0.027 | <0.001 | 6632 | |
| Conduct problems  (age 9) | ADHD GPS | Environmental risk factor | 0.09 | 0.02 | 5.53 | <0.001 | 0.028 | 0.002 | 3240 | |
| Conduct problems  (age 12) | ADHD GPS | Environmental risk factor | 0.09 | 0.01 | 7.16 | <0.001 | 0.034 | 0.002 | 5654 | |
| Conduct problems  (age 7) | ADHD GPS | Discipline factor | 0.10 | 0.01 | 8.23 | <0.001 | 0.029 | 0.001 | 6632 | |
| Conduct problems  (age 9) | ADHD GPS | Discipline factor | 0.09 | 0.02 | 5.72 | <0.001 | 0.023 | 0.002 | 3240 | |
| Conduct problems  (age 12) | ADHD GPS | Discipline factor | 0.10 | 0.01 | 7.60 | <0.001 | 0.023 | 0.004 | 5654 | |
|  |  |  |  |  |  |  |  |  |  | |
| Conduct problems  (age 7) | Neuroticism GPS | Environmental risk factor | 0.01 | 0.01 | 1.12 | -0.06 | 0.018 | <0.001 | 6632 | |
| Conduct problems  (age 9) | Neuroticism GPS | Environmental risk factor | 0.02 | 0.02 | 1.21 | -0.03 | 0.020 | 0.001 | 3240 | |
| Conduct problems  (age 12) | Neuroticism GPS | Environmental risk factor | 0.02 | 0.01 | 1.37 | -0.09 | 0.026 | 0.001 | 5654 | |
| Conduct problems  (age 7) | Neuroticism GPS | Discipline factor | 0.02 | 0.01 | 1.49 | -0.03 | 0.020 | <0.001 | 6632 | |
| Conduct problems  (age 9) | Neuroticism GPS | Discipline factor | 0.02 | 0.02 | 1.43 | <0.001 | 0.013 | 0.001 | 3240 | |
| Conduct problems  (age 12) | Neuroticism GPS | Discipline factor | 0.02 | 0.01 | 1.78 | -0.01 | 0.014 | <0.001 | 5654 | |
|  |  |  |  |  |  |  |  |  |  | |
| Emotional symptoms (age 7) | ADHD GPS | Environmental risk factor | 0.03 | 0.01 | 2.82 | <0.001 | 0.008 | 0.001 | 6602 | |
| Emotional symptoms (age 9) | ADHD GPS | Environmental risk factor | 0.04 | 0.02 | 2.24 | 0.02 | 0.008 | 0.001 | 3244 | |
| Emotional symptoms (age 12) | ADHD GPS | Environmental risk factor | 0.05 | 0.01 | 3.63 | <0.001 | 0.006 | 0.001 | 5642 | |
| Emotional symptoms (age 7) | ADHD GPS | Discipline factor | 0.04 | 0.01 | 3.15 | <0.001 | 0.003 | <0.001 | 6602 | |
| Emotional symptoms (age 9) | ADHD GPS | Discipline factor | 0.04 | 0.02 | 2.46 | 0.01 | 0.004 | <0.001 | 3244 | |
| Emotional symptoms (age 12) | ADHD GPS | Discipline factor | 0.05 | 0.01 | 3.86 | <0.001 | 0.004 | <0.001 | 5642 | |
|  |  |  |  |  |  |  |  |  |  | |
| Emotional symptoms (age 7) | Neuroticism GPS | Environmental risk factor | 0.06 | 0.01 | 5.02 | <0.001 | 0.011 | 0.001 | 6602 | |
| Emotional symptoms (age 9) | Neuroticism GPS | Environmental risk factor | 0.05 | 0.02 | 2.91 | <0.001 | 0.009 | 0.001 | 3244 | |
| Emotional symptoms (age 12) | Neuroticism GPS | Environmental risk factor | 0.05 | 0.01 | 3.36 | <0.001 | 0.006 | <0.001 | 5642 | |
| Emotional symptoms (age 7) | Neuroticism GPS | Discipline factor | 0.07 | 0.01 | 5.36 | <0.001 | 0.006 | <0.001 | 6602 | |
| Emotional symptoms (age 9) | Neuroticism GPS | Discipline factor | 0.05 | 0.02 | 3.07 | <0.001 | 0.005 | 0.001 | 3244 | |
| Emotional symptoms (age 12) | Neuroticism GPS | Discipline factor | 0.05 | 0.01 | 3.59 | <0.001 | 0.003 | <0.001 | 5642 | |
|  |  |  |  |  |  |  |  |  |  | |
| Peer relationship problems (age 7) | ADHD GPS | Environmental risk factor | 0.04 | 0.01 | 2.90 | <0.001 | 0.01 | <0.001 | 6622 | |
| Peer relationship problems (age 9) | ADHD GPS | Environmental risk factor | 0.05 | 0.02 | 2.55 | 0.01 | 0.011 | <0.001 | 3249 | |
| Peer relationship problems (age 12) | ADHD GPS | Environmental risk factor | 0.04 | 0.01 | 3.29 | <0.001 | 0.009 | 0.001 | 5651 | |
| Peer relationship problems (age 7) | ADHD GPS | Discipline factor | 0.04 | 0.01 | 3.16 | <0.001 | 0.005 | <0.001 | 6622 | |
| Peer relationship problems (age 9) | ADHD GPS | Discipline factor | 0.05 | 0.02 | 2.72 | 0.01 | 0.006 | <0.001 | 3249 | |
| Peer relationship problems (age 12) | ADHD GPS | Discipline factor | 0.04 | 0.01 | 3.33 | <0.001 | 0.008 | <0.001 | 5651 | |
|  |  |  |  |  |  |  |  |  |  | |
| Peer relationship problems (age 7) | Neuroticism GPS | Environmental risk factor | 0.01 | 0.01 | 0.72 | <0.001 | 0.009 | <0.001 | 6622 | |
| Peer relationship problems (age 9) | Neuroticism GPS | Environmental risk factor | 0.02 | 0.02 | 0.90 | <0.001 | 0.008 | <0.001 | 3249 | |
| Peer relationship problems (age 12) | Neuroticism GPS | Environmental risk factor | 0.02 | 0.01 | 1.57 | <0.001 | 0.004 | <0.001 | 5651 | |
| Peer relationship problems (age 7) | Neuroticism GPS | Discipline factor | 0.01 | 0.01 | 1.14 | <0.001 | 0.005 | <0.001 | 6622 | |
| Peer relationship problems (age 9) | Neuroticism GPS | Discipline factor | 0.02 | 0.02 | 1.03 | <0.001 | 0.006 | <0.001 | 3249 | |
| Peer relationship problems (age 12) | Neuroticism GPS | Discipline factor | 0.02 | 0.01 | 1.74 | 0.01 | 0.003 | <0.001 | 5651 | |
| *Note.* SE= standard error of the beta; T= the t-statistic; P= p-value; R2 G+E= proportion of variance explained jointly by environmental factors and GPS; R2 GxE= proportion of variance explained by the interaction between environmental factors and GPS, controlling for their main effects; N= sample size. | | | | | | | | | | |

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| Supplementary table 5. Results of the analysis of variance between behaviour problems, environmental factors, genome-wide polygenic scores (GPS) and their interaction, as well as statistical significance of results in Supplementary table 4. | | | | | | | | |
| Outcome | **G predictor** | **E predictor** | **F G** | **F E** | **F GxE** | **P G** | **P E** | **P GxE** |
| Hyperactivity/inattention (age 7) | ADHD GPS | Environmental risk factor | 137.93 | 107.54 | 0.05 | <0.001 | <0.001 | 0.83 |
| Hyperactivity/inattention (age 9) | ADHD GPS | Environmental risk factor | 62.41 | 75.93 | 2.87 | <0.001 | <0.001 | 0.09 |
| Hyperactivity/inattention (age 12) | ADHD GPS | Environmental risk factor | 100.15 | 104.51 | 2.86 | <0.001 | <0.001 | 0.09 |
| Hyperactivity/inattention (age 7) | ADHD GPS | Discipline factor | 138.67 | 140.78 | 2.64 | <0.001 | <0.001 | 0.10 |
| Hyperactivity/inattention (age 9) | **ADHD GPS** | **Discipline factor** | **62.37** | **67.98** | **8.69** | **<0.001** | **<0.001** | **0.00** |
| Hyperactivity/inattention (age 12) | ADHD GPS | Discipline factor | 99.47 | 67.48 | 1.31 | <0.001 | <0.001 | 0.25 |
|  |  |  |  |  |  |  |  |  |
| Hyperactivity/inattention (age 7) | Neuroticism GPS | Environmental risk factor | 0.96 | 131.89 | 2.96 | 0.33 | <0.001 | 0.09 |
| Hyperactivity/inattention (age 9) | Neuroticism GPS | Environmental risk factor | 2.58 | 89.19 | 3.48 | 0.11 | <0.001 | 0.06 |
| Hyperactivity/inattention (age 12) | **Neuroticism GPS** | **Environmental risk factor** | **5.46** | **124.64** | **6.75** | **0.02** | **<0.001** | **0.01** |
| Hyperactivity/inattention (age 7) | Neuroticism GPS | Discipline factor | 0.97 | 164.89 | 0.12 | 0.33 | <0.001 | 0.73 |
| Hyperactivity/inattention (age 9) | Neuroticism GPS | Discipline factor | 2.57 | 76.78 | 0.58 | 0.11 | <0.001 | 0.45 |
| Hyperactivity/inattention (age 12) | Neuroticism GPS | Discipline factor | 5.41 | 82.31 | 1.08 | 0.02 | <0.001 | 0.30 |
|  |  |  |  |  |  |  |  |  |
| Conduct problems (age 7) | ADHD GPS | Environmental risk factor | 85.78 | 100.15 | 2.19 | <0.001 | <0.001 | 0.14 |
| Conduct problems (age 9) | **ADHD GPS** | **Environmental risk factor** | **39.68** | **53.12** | **7.19** | **<0.001** | **<0.001** | **0.01** |
| Conduct problems (age 12) | **ADHD GPS** | **Environmental risk factor** | **70.55** | **126.13** | **10.62** | **<0.001** | **<0.001** | **<0.001** |
| Conduct problems (age 7) | **ADHD GPS** | **Discipline factor** | **86.01** | **114.56** | **6.24** | **<0.001** | **<0.001** | **0.01** |
| Conduct problems (age 9) | **ADHD GPS** | **Discipline factor** | **39.44** | **35.41** | **5.03** | **<0.001** | **<0.001** | **0.03** |
| Conduct problems (age 12) | **ADHD GPS** | **Discipline factor** | **69.92** | **64.83** | **20.64** | **<0.001** | **<0.001** | **<0.001** |
|  |  |  |  |  |  |  |  |  |
| Conduct problems (age 7) | Neuroticism GPS | Environmental risk factor | 3.79 | 116.60 | 2.85 | 0.05 | <0.001 | 0.09 |
| Conduct problems (age 9) | Neuroticism GPS | Environmental risk factor | 3.07 | 61.53 | 3.86 | 0.08 | <0.001 | 0.05 |
| Conduct problems (age 12) | **Neuroticism GPS** | **Environmental risk factor** | **4.11** | **144.16** | **5.83** | **0.04** | **<0.001** | **0.02** |
| Conduct problems (age 7) | Neuroticism GPS | Discipline factor | 3.80 | 130.60 | 2.60 | 0.05 | <0.001 | 0.11 |
| Conduct problems (age 9) | Neuroticism GPS | Discipline factor | 3.05 | 40.55 | 2.28 | 0.08 | <0.001 | 0.13 |
| Conduct problems (age 12) | Neuroticism GPS | Discipline factor | 4.06 | 76.63 | 1.28 | 0.04 | <0.001 | 0.26 |
|  |  |  |  |  |  |  |  |  |
| Emotional symptoms (age 7) | **ADHD GPS** | **Environmental risk factor** | **12.21** | **43.71** | **5.29** | **<0.001** | **<0.001** | **0.02** |
| Emotional symptoms (age 9) | ADHD GPS | Environmental risk factor | 7.19 | 19.23 | 3.59 | 0.01 | <0.002 | 0.06 |
| Emotional symptoms (age 12) | ADHD GPS | Environmental risk factor | 16.54 | 17.83 | 3.21 | <0.001 | <0.003 | 0.07 |
| Emotional symptoms (age 7) | ADHD GPS | Discipline factor | 12.14 | 10.89 | 0.57 | <0.001 | <0.004 | 0.45 |
| Emotional symptoms (age 9) | ADHD GPS | Discipline factor | 7.15 | 5.19 | 0.07 | 0.01 | 0.02 | 0.79 |
| Emotional symptoms (age 12) | ADHD GPS | Discipline factor | 16.49 | 3.68 | 0.77 | <0.001 | 0.06 | 0.38 |
|  |  |  |  |  |  |  |  |  |
| Emotional symptoms (age 7) | **Neuroticism GPS** | **Environmental risk factor** | **29.85** | **42.51** | **4.14** | **<0.001** | **<0.001** | **0.04** |
| Emotional symptoms (age 9) | Neuroticism GPS | Environmental risk factor | 10.26 | 19.78 | 2.79 | <0.001 | <0.001 | 0.10 |
| Emotional symptoms (age 12) | Neuroticism GPS | Environmental risk factor | 14.18 | 19.54 | 0.16 | <0.001 | <0.001 | 0.69 |
| Emotional symptoms (age 7) | Neuroticism GPS | Discipline factor | 29.70 | 11.35 | 1.99 | <0.001 | <0.001 | 0.16 |
| Emotional symptoms (age 9) | **Neuroticism GPS** | **Discipline factor** | **10.22** | **5.58** | **4.04** | **<0.001** | **0.02** | **0.04** |
| Emotional symptoms (age 12) | Neuroticism GPS | Discipline factor | 14.14 | 4.85 | 1.42 | <0.001 | 0.03 | 0.23 |
|  |  |  |  |  |  |  |  |  |
| Peer relationship problems (age 7) | ADHD GPS | Environmental risk factor | 13.69 | 57.15 | 3.06 | <0.001 | <0.001 | 0.08 |
| Peer relationship problems (age 9) | ADHD GPS | Environmental risk factor | 9.46 | 20.66 | 0.62 | <0.001 | <0.001 | 0.43 |
| Peer relationship problems (age 12) | **ADHD GPS** | **Environmental risk factor** | **13.38** | **16.27** | **5.08** | **<0.001** | **<0.001** | **0.02** |
| Peer relationship problems (age 7) | ADHD GPS | Discipline factor | 13.62 | 27.15 | 0.05 | <0.001 | <0.001 | 0.82 |
| Peer relationship problems (age 9) | ADHD GPS | Discipline factor | 9.44 | 15.64 | 0.06 | <0.001 | <0.001 | 0.81 |
| Peer relationship problems (age 12) | ADHD GPS | Discipline factor | 13.35 | 9.15 | 0.28 | <0.001 | <0.001 | 0.60 |
|  |  |  |  |  |  |  |  |  |
| Peer relationship problems (age 7) | Neuroticism GPS | Environmental risk factor | 1.74 | 61.40 | 1.62 | 0.19 | <0.001 | 0.20 |
| Peer relationship problems (age 9) | Neuroticism GPS | Environmental risk factor | 1.52 | 23.01 | 1.15 | 0.22 | <0.001 | 0.28 |
| Peer relationship problems (age 12) | Neuroticism GPS | Environmental risk factor | 3.59 | 18.65 | 0.03 | 0.06 | <0.001 | 0.87 |
| Peer relationship problems (age 7) | Neuroticism GPS | Discipline factor | 1.74 | 30.16 | 2.09 | 0.19 | <0.001 | 0.15 |
| Peer relationship problems (age 9) | Neuroticism GPS | Discipline factor | 1.52 | 17.22 | 1.01 | 0.22 | <0.001 | 0.32 |
| Peer relationship problems (age 12) | Neuroticism GPS | Discipline factor | 3.58 | 11.04 | 0.20 | 0.06 | <0.001 | 0.66 |
| *Note.* F G= F-statistic of the association between GPS and behaviour problems; F E= F-statistics of the association between environmental factors and behaviour problems; F GxE= F-statistic of the association between the interaction between GPS & environmental factors and behaviour problems; P G= p-value of the association between GPS and behaviour problems; P E= p-value of the association between environmental factors and behaviour problems; P GxE= p-value of the association between the interaction between GPS & environmental factors and behaviour problems. Significant interactions are presented in bold. | | | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Supplementary table 6. Results of 2x2 analyses of variance of behaviour problems predicted by extremes of environmental factors (+/- 1 SD), extremes genome-wide polygenic scores (+/- 1 SD) and their interaction (GxE). | | | | | | | | |
| Outcome | G predictor | E predictor | F G | F E | F GxE | P G | P E | P GxE |
| Hyperactivity/inattention (age 9) | ADHD GPS | Discipline factor | 5.88 | 20.53 | 2.56 | 0.02 | <0.001 | 0.11 |
| Hyperactivity/inattention (age 12) | Neuroticism GPS | Environmental risk factor | 2.23 | 26.14 | 7.53 | 0.14 | <0.001 | 0.01 |
|  |  |  |  |  |  |  |  |  |
| Conduct problems (age 9) | ADHD GPS | Environmental risk factor | 15.51 | 10.15 | 1.87 | <0.001 | 0.002 | 0.17 |
| Conduct problems (age 12) | ADHD GPS | Environmental risk factor | 24.59 | 12.99 | 1.04 | <0.001 | <0.001 | 0.31 |
| Conduct problems (age 7) | ADHD GPS | Discipline factor | 19.35 | 25.03 | 0.63 | <0.001 | <0.001 | 0.43 |
| Conduct problems (age 9) | ADHD GPS | Discipline factor | 6.33 | 14.75 | 0.93 | 0.01 | <0.001 | 0.34 |
| Conduct problems (age 12) | ADHD GPS | Discipline factor | 18.25 | 11.01 | 6.91 | <0.001 | 0.001 | 0.01 |
| Conduct problems (age 12) | Neuroticism GPS | Environmental risk factor | 1.01 | 33.17 | 3.31 | 0.32 | <0.001 | 0.07 |
|  |  |  |  |  |  |  |  |  |
| Emotional symptoms (age 7) | ADHD GPS | Environmental risk factor | 7.07 | 19.99 | 7.93 | 0.01 | <0.001 | 0.01 |
| Emotional symptoms (age 7) | Neuroticism GPS | Environmental risk factor | 18.34 | 6.21 | 2.29 | <0.001 | 0.01 | 0.13 |
| Emotional symptoms (age 9) | Neuroticism GPS | Discipline factor | 0.03 | 0.98 | 0.54 | 0.87 | 0.32 | 0.46 |
|  |  |  |  |  |  |  |  |  |
| Peer relationship problems (age 12) | ADHD GPS | Environmental risk factor | 3.05 | 1.02 | 2.26 | 0.08 | 0.31 | 0.13 |
| *Note.* F G= F-statistic of the association between GPS and behaviour problems; F E= F-statistics of the association between environmental factors and behaviour problems; F GxE= F-statistic of the association between the interaction between GPS & environmental factors and behaviour problems; P G= p-value of the association between GPS and behaviour problems; P E= p-value of the association between environmental factors and behaviour problems; P GxE= p-value of the association between the interaction between GPS & environmental factors and behaviour problems. Extremes refer to 1 standard deviation above and below the mean. | | | | | | | | |

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