**SUPPLEMENTARY MATERIAL**

Table S1 – Concurrent and longitudinal multivariate model fit comparisons

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Comparisons to saturated model | | | | | Comparisons to full ACE model | | |  | |
|  | -2LL | df | χ2 | Δ df | p-value | χ2 | Δ df | p-value | AIC | Size-adjusted BIC |
| Concurrent Models | | | | | | | | | | |
| Saturated | 13136.66 | 4440 |  |  |  |  |  |  | 4256.66 | 14042.03 |
| IPM/Cholesky ACE | 13390.74 | 4632 | 254.09 | 192 | <.01 |  |  |  | 4126.74 | 13491.34 |
| **IPM/Cholesky AE** | **13390.98** | **4638** | **254.32** | **198** | **<.01** | **.24** | **6** | **1.00** | **4114.98** | **13466.43** |
| IPM/Cholesky CE | 13418.16 | 4638 | 281.51 | 198 | <.01 | 27.42 | 6 | <.01 | 4142.17 | 13493.61 |
| IPM/Cholesky E | 13552.70 | 4644 | 416.04 | 204 | <.01 | 161.96 | 12 | <.01 | 4624.70 | 13602.99 |
| Longitudinal Models | | | | | | | | | | |
| Saturated | 18344.11 | 5349 |  |  |  |  |  |  | 7646.11 | 19249.48 |
| IPM/Cholesky ACE | 18596.13 | 5541 | 252.03 | 192 | <.01 |  |  |  | 7514.13 | 18696.73 |
| **IPM/Cholesky AE** | **18598.56** | **5547** | **254.46** | **198** | **<.01** | **2.43** | **6** | **0.88** | **7504.56** | **18674.01** |
| IPM/Cholesky CE | 18620.30 | 5547 | 276.19 | 198 | <.01 | 24.17 | 6 | <.01 | 7526.30 | 18695.75 |
| IPM/Cholesky E | 18769.85 | 5553 | 425.74 | 204 | <.01 | 173.72 | 12 | <.01 | 7663.85 | 18820.15 |

*Notes*

-2LL – minus twice the log likelihood; df- degrees of freedom; Δ df – degrees of freedom difference; p – probability; AIC – Akaike’s information criterion; BIC – Bayesian’s information criterion, IPM – independent pathway model

Three variable independent pathway model and Cholesky decomposition estimate the same number of parameters, therefore fit statistics for these models are presented together.

The best fitting model (shown in bold) was selected based on the principle of parsimony and lowest AIC and BIC value. A difference in AIC between two models of 2 or less, provides equivalent support for both models (in which case the most parsimonious model should be chosen), a difference of 3 indicates that the lower AIC model has considerably more support and a difference of more than 10, indicates that the lower AIC model is a substantially better fit compared to the higher AIC model ([Wagenmakers & Farrell, 2004](#_ENREF_3)). Shared-environmental, but not genetic influences can be dropped from the models without significant deterioration of the fit. The AIC and BIC values suggest that dropping C lead to improvement of the models.

The multivariate genetic models were significantly different from the saturated model indicating poor fit, however this is common in studies with large sample sizes because minimal variance differences between groups can be highly statistically significant.

In longitudinal models, common non-shared environmental influences loaded only on hopelessness, thus did not represent a truly common environmental factor (Table S2). For this reason common non-shared environmental factor was dropped (comparison to AE model: χ2= 16.95, Δ df=3, p<.01 , Δ AIC= -10.95, Δ size adjusted BIC= -4.37).

Table S2 – Full ACE Independent Pathways Model results

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Common Influences | | | Variable-specific Influences | | |
| AC | CC | EC | AS | CS | ES |
| **Concurrent model** | | | | | | |
| Attributional style  Time 2 | .25  (.05-.51) | .04  (.00-.22) | .22  (.11-.36) | .14  (.00-.25) | .00  (.00-.00) | .36  (.24-.48) |
| Hopelessness  Time 2 | .16  (.01-.31) | .03  (.00-.22) | .27  (.15-.45) | .18  (.00-.27) | .00  (.00-.10) | .36  (.21-.48) |
| Depression  Time 2 | .33  (.08-.54) | .01  (.00-.15) | .11  (.05-.19) | .14  (.00-.28) | .00  (.00-.10) | .42  (.35-.50) |
| **Longitudinal model** | | | | | | |
| Attributional style  Time 1 | .13  (.02-.42) | .09  (.02-.42) | .01  (.00-.08) | .18  (.00-.30) | .00  (.00-.14) | .59  (.51-.68) |
| Hopelessness  Time 2 | .11  (.01-.30) | .07  (.00-.24) | .64  (.11-.78) | .18  (.00-.27) | .00  (.00-.12) | .00  (.00-.50) |
| Depression  Time 3 | .34  (.05-.45) | .01  (.00-.10) | .03  (.01-.17) | .00  (.00-.21) | .00  (.00-.08) | .62  (.48-.72) |

*Notes*

AC– additive genetic influences acting via a common factor on all variables, CC –shared environmental influences acting via a common factor on all variables, EC – non-shared environmental influences acting via a common factor on all variables, AS – additive genetic influences acting on a specific variable, CS –shared environmental influences acting on a specific variable, ES – non-shared environmental influences acting on a specific variable.

95% Confidence Intervals (CIs) are presented in brackets. CIs not inclusive of zeros indicate significant influences. Non-overlapping CIs mean significant difference between the values.

Table S3 – Full ACE Cholesky Decomposition results

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | A1 | A2 | A3 | C1 | C2 | C2 | E1 | E2 | E3 |
| **Concurrent model** | | | | | | | | | |
| Attributional style  Time 2 | .39  (.13-.52) |  |  | .04  (.00-.22) |  |  | .57  (.48-.68) |  |  |
| Hopelessness  Time 2 | .10  (.00-.28) | .24  (.03-.32) |  | .03  (.00-.22) | .00  (.00-.13) |  | .10  (.05-.18) | .53  (.45-.63) |  |
| Depression  Time 2 | .21  (.06-.50) | .03  (.00-.26) | .23  (.00-.31) | .01  (.00-.15) | .00  (.00-.13) | .00  (.00-.13) | .04  (.01-.08) | .02  (.00-.05) | .47  (.40-.54) |
| **Longitudinal model** | | | | | | | | | |
| Attributional style  Time 1 | .30  (.10-.46) |  |  | .09  (.00-.23) |  |  | .61  (.52-.60) |  |  |
| Hopelessness  Time 2 | .05  (.00-.24) | .24  (.02-.36) |  | .07  (.00-.24) | .00  (.00-.14) |  | .01  (.00-.05) | .62  (.52-.74) |  |
| Depression  Time 3 | .16  (.03-.41) | .05  (.00-.28) | .13  (.00-.27) | .01  (.00-.10) | .00  (.00-.10) | .00  (.00-.09) | .00  (.00-.01) | .03  (.01-.07) | .62  (.52-.73) |

*Notes*

A1 -3– additive genetic influences, C1 -3– shared environmental influences, E1 -3– non-shared environmental influences

95% Confidence Intervals (CIs) are presented in brackets. CIs not inclusive of zeros indicate significant influences. Non-overlapping CIs mean significant difference between the values.

All paths are standardised. Square root of these values should be taken to obtain variance paths.

Univariate results for attributional style and depression symptoms have been presented before ([Lau & Eley, 2008](#_ENREF_1); [Lau, Rijsdijk, & Eley, 2006](#_ENREF_2); [Zavos, Rijsdijk, Gregory, & Eley, 2010](#_ENREF_4)), but can also be calculated by adding all the paths contributing to the variable (e.g. heritability of depression at time 2 is .21+.03+.23=.47).

**References**

Lau, J. Y. F., & Eley, T. C. (2008). Attributional style as a risk marker of genetic effects for adolescent depressive symptoms. *Journal of Abnormal Psychology, 117*(4), 849-859.

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Zavos, H., Rijsdijk, F. V., Gregory, A. M., & Eley, T. C. (2010). Genetic influences on the cognitive biases associated with anxiety and depression symptoms in adolescents. *Journal of Affective Disorders, 124*(1), 45-53.