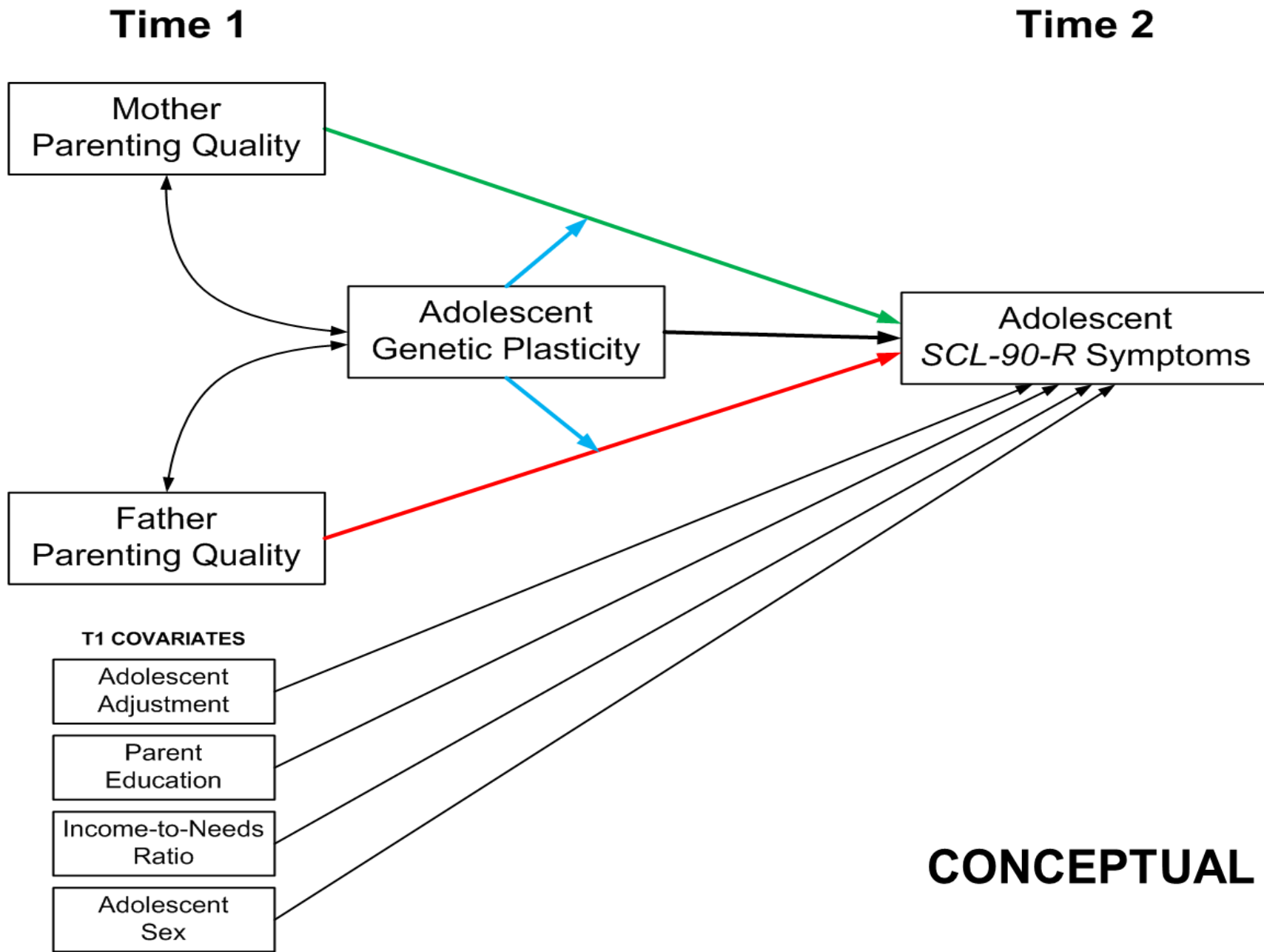


# Parenting and Adolescents' Psychological Adjustment: Longitudinal Moderation by Adolescents' Genetic Sensitivity

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**CONCEPTUAL MODEL**

Diathesis Stress Model

Differential Susceptibility  
Model

## Candidate Gene Approach

Pros: Easier to trace underlying biological pathways

Cons: Difficult to replicate

Complex psychological outcomes are unlikely to be influenced by single candidate genes.

## Polygenic Index Score Approach

Pros: Assesses additive effects of several genetic variants, each with a small effect size.

Cons: Effect of one variant may contradict the effect of another variant

Difficult to determine underlying biological pathways

# Current Study

- Does Adolescents' genetic sensitivity moderate the longitudinal associations between mothers' and fathers' parenting and adolescents' anxiety, depression and hostility?

# Family Transitions Project

## Participants

- N = 323 families, 177 female adolescents, 146 male adolescents
- Age at Time 1 = 12.6 years, age at Time 2 = 13.6 years

# Measures

- Mothers' and Fathers' Parenting Quality
- Observations of videotaped family interaction
- Combined 5 positive and 3 negative codes for each parent
- High scores = more hostility and less warmth
- Adolescents' Psychological Adjustment

SCL-90-R

Depression

Anxiety

Hostility



# Measures continued

- Polygenic Sensitivity Score

short (s) allele of 5-HTTLPR in *5-HTT* (accounting for SNP rs25531)

A1 allele of the Taq1A polymorphism in *ANKK1/DRD2*

7R allele of exon-3 VNTR in *DRD4*

10R allele of the 5' VNTR in *DAT*

Met allele of the Val158Met polymorphism in *COMT*

Scoring: 0 = none of these alleles

1 = one of these alleles

2 = two of these alleles

Polygenic Sensitivity index score = sum of scores on the 5 polymorphisms, range = 1–8 ( $M = 4.41$ ,  $SD = 1.36$ )

# Multiple Regression Analyses

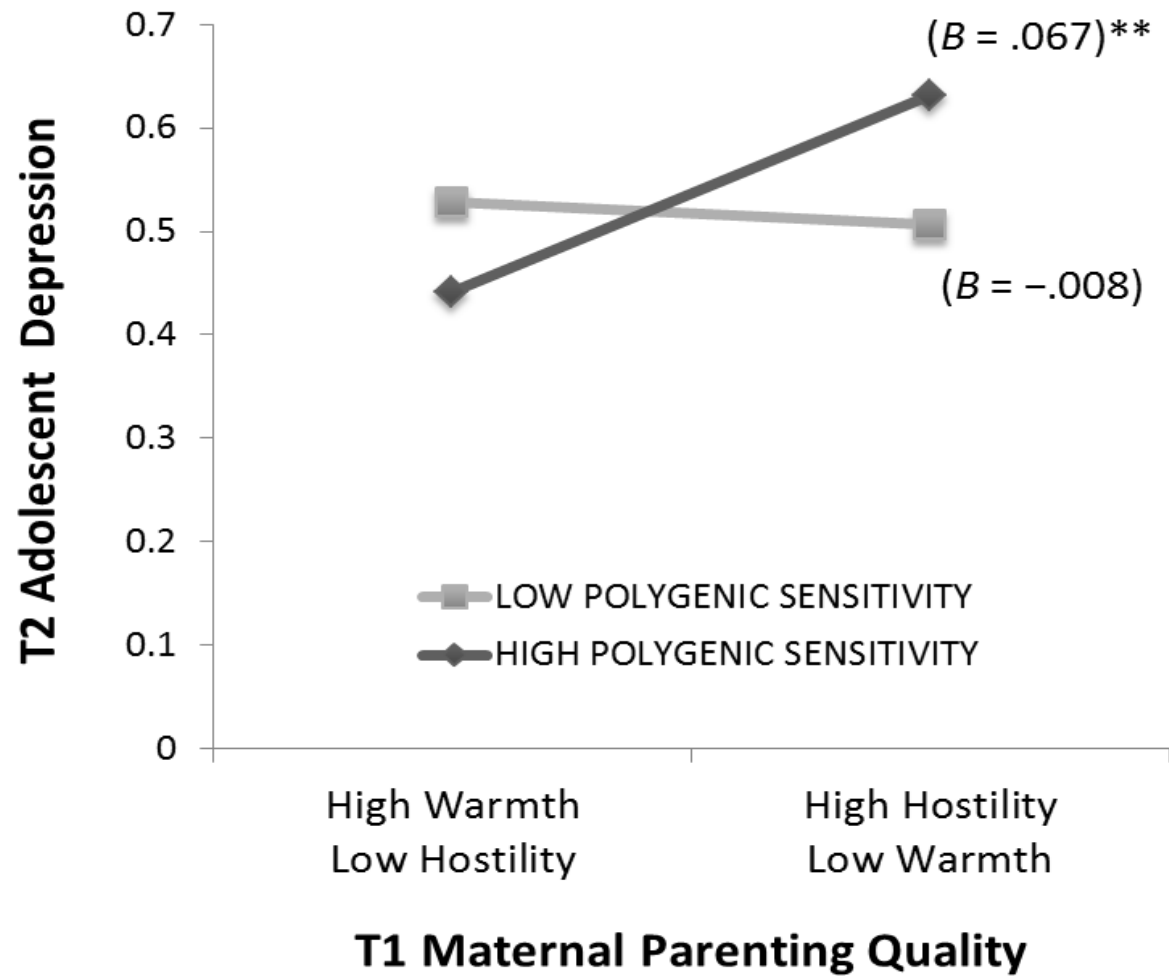
Autoregressive approach to model change in adolescent depressive, anxiety, and hostility symptoms from T1 to T2.

Run Separately for mothers and fathers.

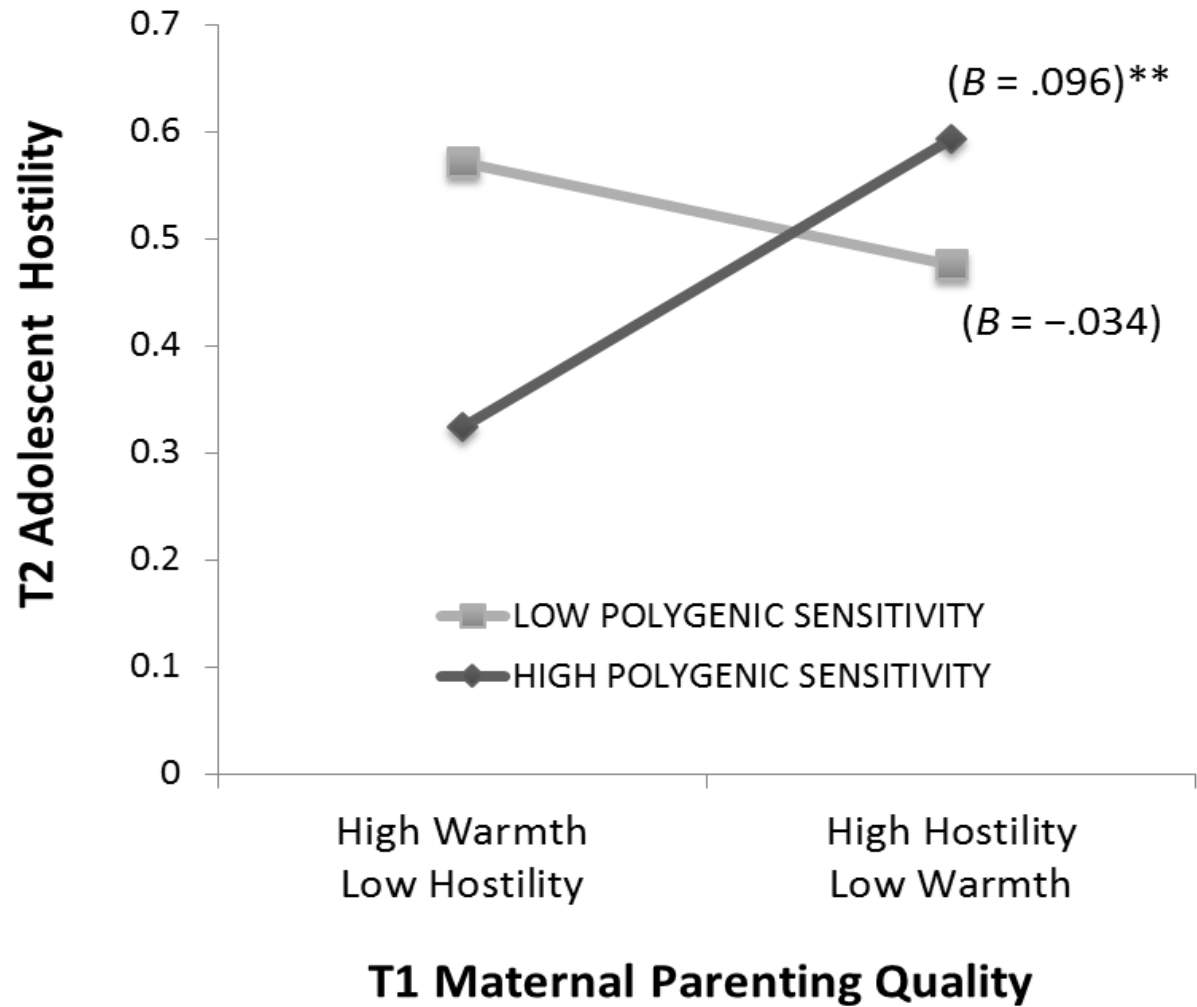
Controls: adolescent sex, parent educational attainment, and family income-to-needs ratio.

All continuous independent variables were grand mean centered prior to conducting moderation analyses.

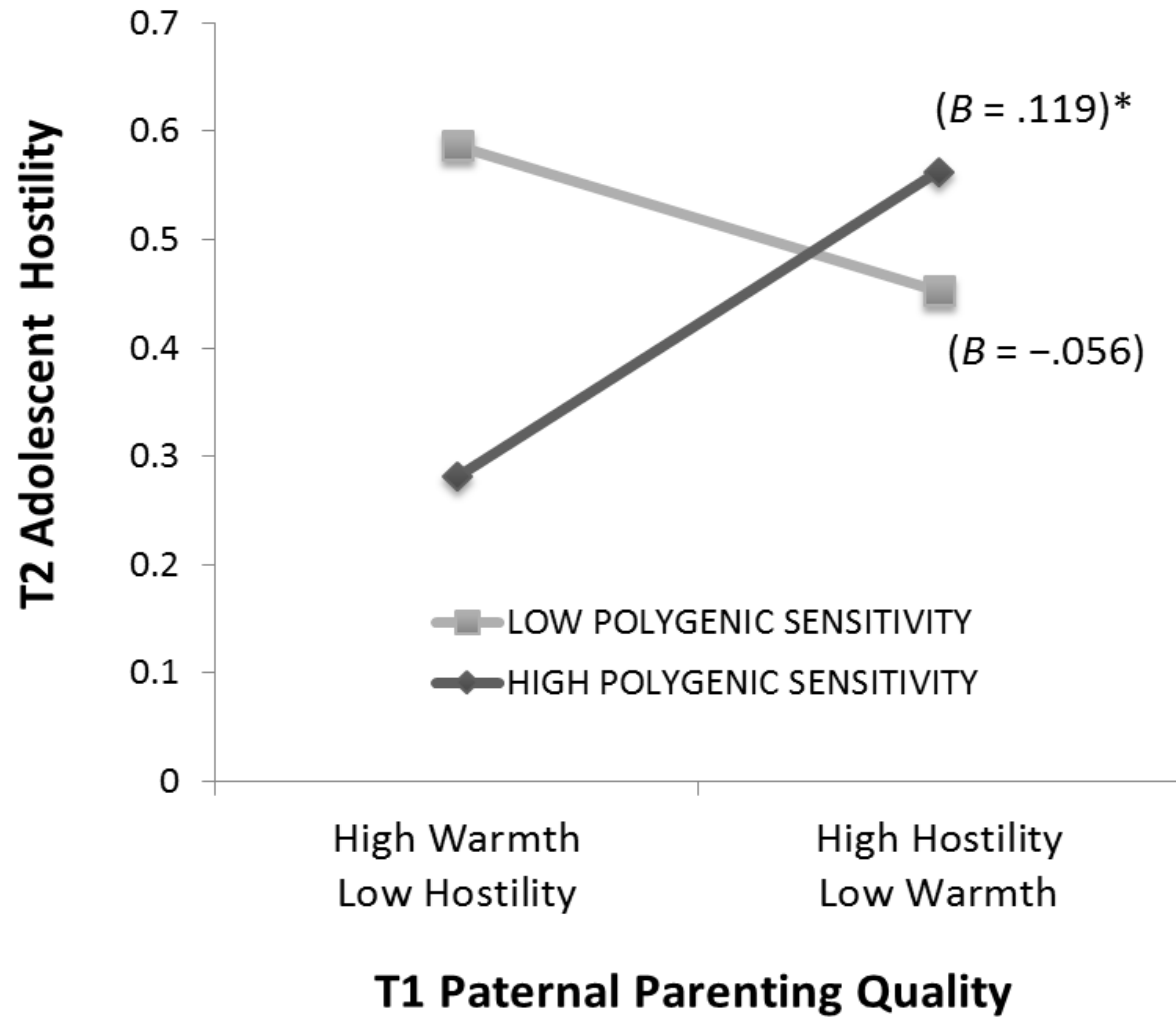
$R^2\Delta$  were used to assess the significance of moderation effects.



Effect of parenting on adolescent adjustment as moderated by adolescent polygenic sensitivity.  $B$  = unstandardized regression coefficient.  
 \*\*  $p < .01$ .



Effect of maternal parenting on adolescent hostility as moderated by adolescent polygenic sensitivity.  $B$  = unstandardized regression coefficient.  
 \*\*  $p < .01$ .



Effect of paternal parenting on adolescent hostility as moderated by adolescent polygenic sensitivity.  $B$  = unstandardized regression coefficient.  
\*  $p < .05$ .

# Parenting and Adolescents' Psychological Adjustment: Longitudinal Moderation by Adolescents' Genetic Sensitivity

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Table 1

*Descriptive Statistics and Intercorrelations Among Study Variables*

|                                     | <i>M or %</i> | <i>SD</i> | <i>1</i>          | <i>2</i>         | <i>3</i> | <i>4</i>          | <i>5</i>         | <i>6</i> | <i>7</i> | <i>8</i>          | <i>9</i> | <i>10</i> | <i>11</i> | <i>12</i> |
|-------------------------------------|---------------|-----------|-------------------|------------------|----------|-------------------|------------------|----------|----------|-------------------|----------|-----------|-----------|-----------|
| Time 1: Predictors                  |               |           |                   |                  |          |                   |                  |          |          |                   |          |           |           |           |
| 1. Adolescent depressive symptoms   | .63           | .61       | —                 |                  |          |                   |                  |          |          |                   |          |           |           |           |
| 2. Adolescent anxiety symptoms      | .51           | .53       | .78***            | —                |          |                   |                  |          |          |                   |          |           |           |           |
| 3. Adolescent hostility symptoms    | .61           | .68       | .67***            | .69***           | —        |                   |                  |          |          |                   |          |           |           |           |
| 4. Maternal parenting quality       | 3.25          | 1.40      | .07               | .10 <sup>†</sup> | .13*     | —                 |                  |          |          |                   |          |           |           |           |
| 5. Paternal parenting quality       | 3.63          | 1.19      | .08               | .10 <sup>†</sup> | .15**    | .47***            | —                |          |          |                   |          |           |           |           |
| 6. Adolescent polygenic sensitivity | 4.41          | 1.36      | -.02              | -.01             | -.02     | .01               | .01              | —        |          |                   |          |           |           |           |
| 7. Adolescent sex (male)            | 45%           | —         | -.13*             | .02              | .07      | .01               | -.01             | .02      | —        |                   |          |           |           |           |
| Time 1: Family SES                  |               |           |                   |                  |          |                   |                  |          |          |                   |          |           |           |           |
| 8. Maternal education               | 13.27         | 1.63      | -.04              | -.03             | -.08     | -.15**            | -.19**           | .03      | .04      | —                 |          |           |           |           |
| 9. Paternal education               | 13.62         | 2.24      | -.11 <sup>†</sup> | .13*             | -.08     | -.09 <sup>†</sup> | -.25***          | .06      | -.05     | .04               | —        |           |           |           |
| 10. Family income-to-needs ratio    | 2.93          | 2.18      | .03               | .13*             | -.03     | -.14*             | -.15**           | -.06     | -.01     | .08               | .25***   | —         |           |           |
| Time 2 Outcomes                     |               |           |                   |                  |          |                   |                  |          |          |                   |          |           |           |           |
| 11. Adolescent depressive symptoms  | .47           | .48       | .53***            | .45***           | .36***   | .11 <sup>†</sup>  | .05              | .02      | -.18**   | -.02              | .04      | .02       | —         |           |
| 12. Adolescent anxiety symptoms     | .39           | .48       | .42***            | .44***           | .37***   | .13*              | .07              | -.05     | -.04     | -.10 <sup>†</sup> | -.08     | -.03      | .70***    | —         |
| 13. Adolescent hostility symptoms   | .48           | .55       | .38***            | .44***           | .51***   | .13*              | .10 <sup>†</sup> | -.05     | .02      | .03               | -.01     | .02       | .62***    | .64***    |

Note. ( $N = 323$ ). Psychiatric symptoms assessed using the *SCL-90-R*.

<sup>†</sup> $p < .10$ , \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$  (2-tailed tests).

Statistical models ( $y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \varepsilon_i$ )

$y_i$  = T2 adolescent outcome

$X_1$  = parenting quality

$X_2$  = adolescent polygenic sensitivity

( $X_3 = X_1 \times X_2$ ) = GxE interaction

All continuous independent variables were grand mean centered prior to conducting moderation analyses.

$R^2\Delta$  were used to assess the significance of moderation effects (Cohen et al., 2003).



Table 2

*Gene by Environment Interactions Between Adolescent Cumulative Polygenic Sensitivity and Maternal Parenting Quality Predicting Change in Adolescent Adjustment*

| <i>Predictors</i>                                 | Depression |             |         |              | Anxiety  |             |         |              | Hostility |             |         |              |
|---|------------|-------------|---------|--------------|----------|-------------|---------|--------------|-----------|-------------|---------|--------------|
|   | <i>B</i>   | <i>SE B</i> | $\beta$ | $\Delta R^2$ | <i>B</i> | <i>SE B</i> | $\beta$ | $\Delta R^2$ | <i>B</i>  | <i>SE B</i> | $\beta$ | $\Delta R^2$ |
| Main Effects                                      |            |             |         |              |          |             |         |              |           |             |         |              |
| Adolescent sex <sup>a</sup>                       | -.12       | .05         | -.12*   |              | -.04     | .05         | -.05    |              | -.02      | .05         | -.02    |              |
| Previous adolescent symptoms                      | .40        | .04         | .51***  |              | .39      | .05         | .43***  |              | .41       | .04         | .51***  |              |
| Maternal parenting quality                        | .03        | .02         | .07     |              | .03      | .02         | .08     |              | .03       | .02         | .08     |              |
| Adolescent polygenic sensitivity                  | .01        | .02         | .03     |              | -.01     | .02         | -.04    |              | -.02      | .02         | -.05    |              |
| <i>R</i> <sup>2</sup>                             |            | .296***     |         |              |          | .212***     |         |              |           | .274***     |         |              |
| Interaction Effects                               |            |             |         |              |          |             |         |              |           |             |         |              |
| Maternal Parenting $\times$ Polygenic Sensitivity | .03        | .01         | .11*    | .011*        | .04      | .01         | .15**   | .021**       | .05       | .01         | .17**   | .027**       |

*Notes.* ( $N = 323$ ). Predictors were measured at Time 1. Psychiatric symptoms assessed using the *SCL-90-R*. All main effect predictor variables were entered simultaneously in Step 1. Socioeconomic indicators including parent education and family income-to-needs ratio were included as statistical controls; however, none were statistically significant and are not presented here due to space considerations.

<sup>a</sup>(0 = female, 1 = male).

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$  (2-tailed tests).

Table 3

*Gene by Environment Interactions Between Adolescent Cumulative Polygenic Sensitivity and Paternal Parenting Quality Predicting Change in Adolescent Adjustment*

| <i>Predictors</i>                                 | Depression |             |         |              | Anxiety  |             |         |              | Hostility |             |         |              |
|---|------------|-------------|---------|--------------|----------|-------------|---------|--------------|-----------|-------------|---------|--------------|
|   | <i>B</i>   | <i>SE B</i> | $\beta$ | $\Delta R^2$ | <i>B</i> | <i>SE B</i> | $\beta$ | $\Delta R^2$ | <i>B</i>  | <i>SE B</i> | $\beta$ | $\Delta R^2$ |
| Main Effects                                      |            |             |         |              |          |             |         |              |           |             |         |              |
| Adolescent sex <sup>a</sup>                       | -.11       | .05         | -.12*   |              | -.05     | .05         | -.05    |              | -.01      | .05         | -.01    |              |
| Previous adolescent symptoms                      | .40        | .04         | .51***  |              | .39      | .05         | .44***  |              | .41       | .04         | .51***  |              |
| Paternal parenting quality                        | .01        | .02         | .02     |              | .01      | .02         | .02     |              | .02       | .02         | .03     |              |
| Adolescent polygenic sensitivity                  | .01        | .02         | .03     |              | -.02     | .02         | -.04    |              | -.02      | .02         | -.04    |              |
| $R^2$   |            |             | .294*** |              |          |             | .201*** |              |           |             | .265*** |              |
| Interaction Effects                               |            |             |         |              |          |             |         |              |           |             |         |              |
| Paternal Parenting $\times$ Polygenic Sensitivity | .02        | .01         | .06     | .004         | .03      | .02         | .11*    | .012*        | .04       | .02         | .10*    | .011*        |

*Notes.* ( $N = 323$ ). Predictors were measured at Time 1. Psychiatric symptoms assessed using the *SCL-90-R*. All main effect predictor variables were entered simultaneously in Step 1. Socioeconomic indicators including parent education and family income-to-needs ratio were included as statistical controls; however, none were statistically significant and are not presented here due to space considerations.

<sup>a</sup>(0 = female, 1 = male).

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$  (2-tailed tests).

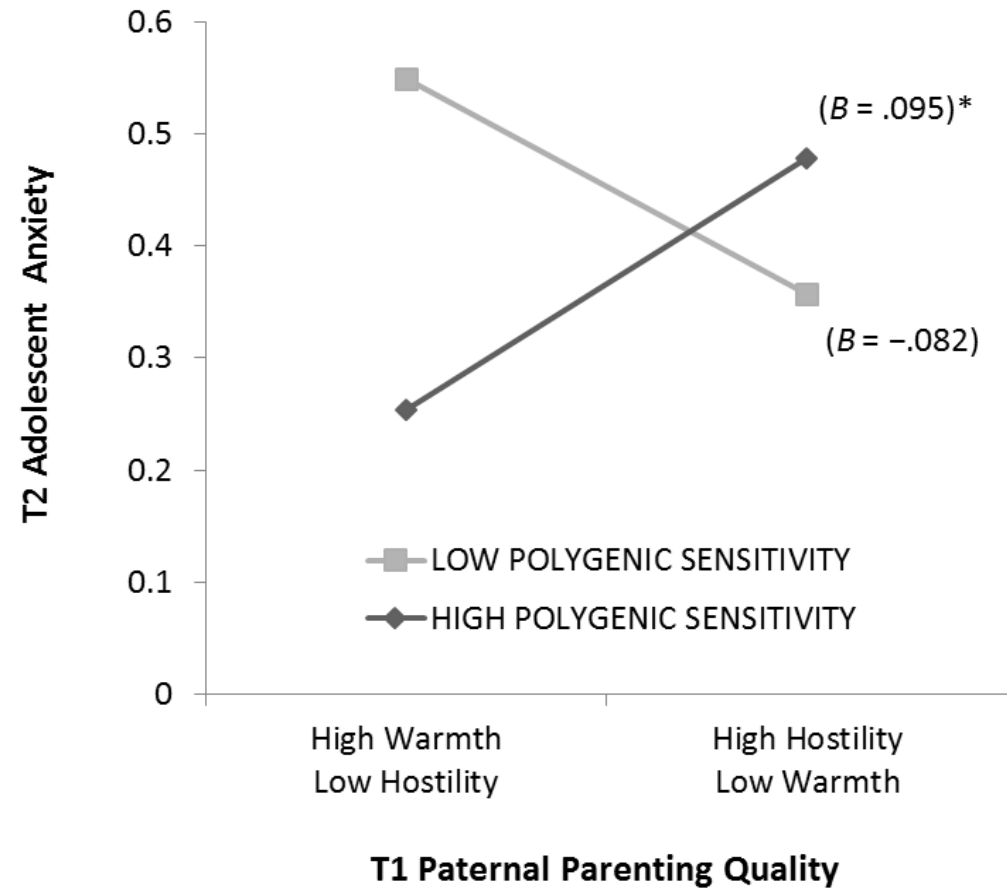


Figure 4. The prospective association between observed paternal parenting quality and adolescent *SCL-90-R* Anxiety at high (+2 SD) and low (-2 SD) levels of adolescent polygenic sensitivity.  $B$  = unstandardized regression coefficient. \* $p < .05$ .

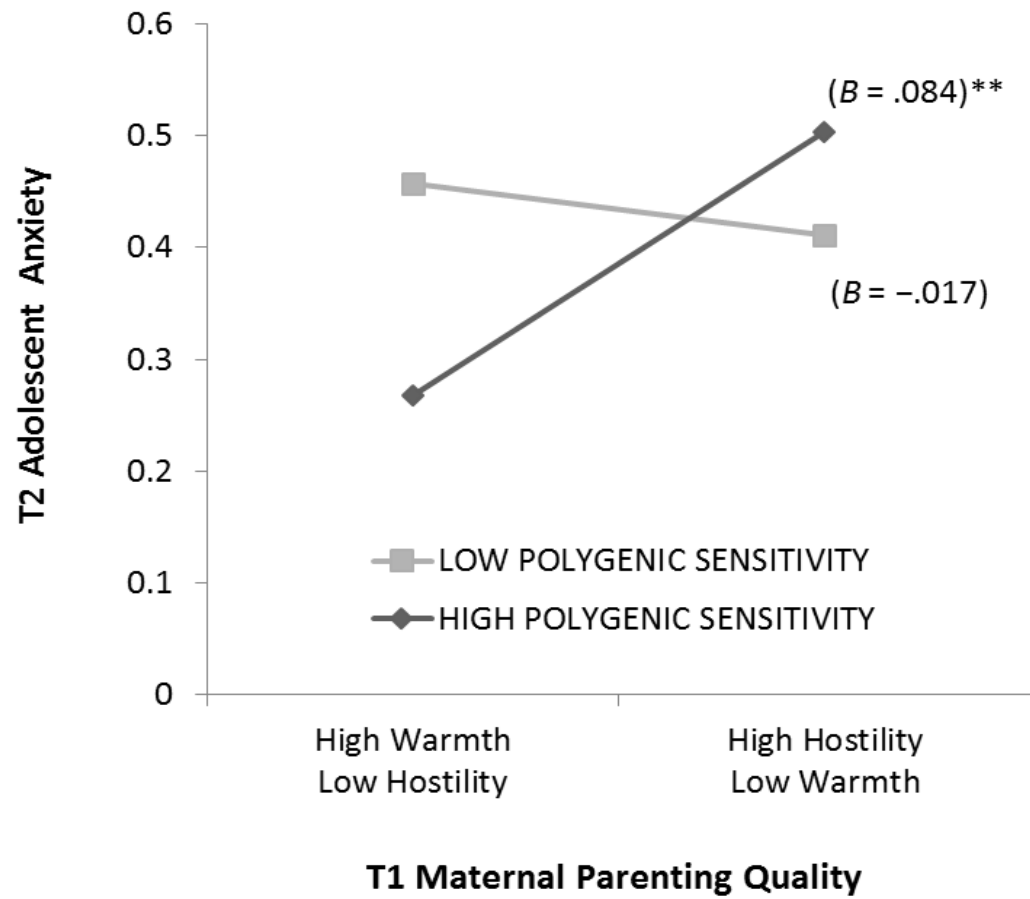
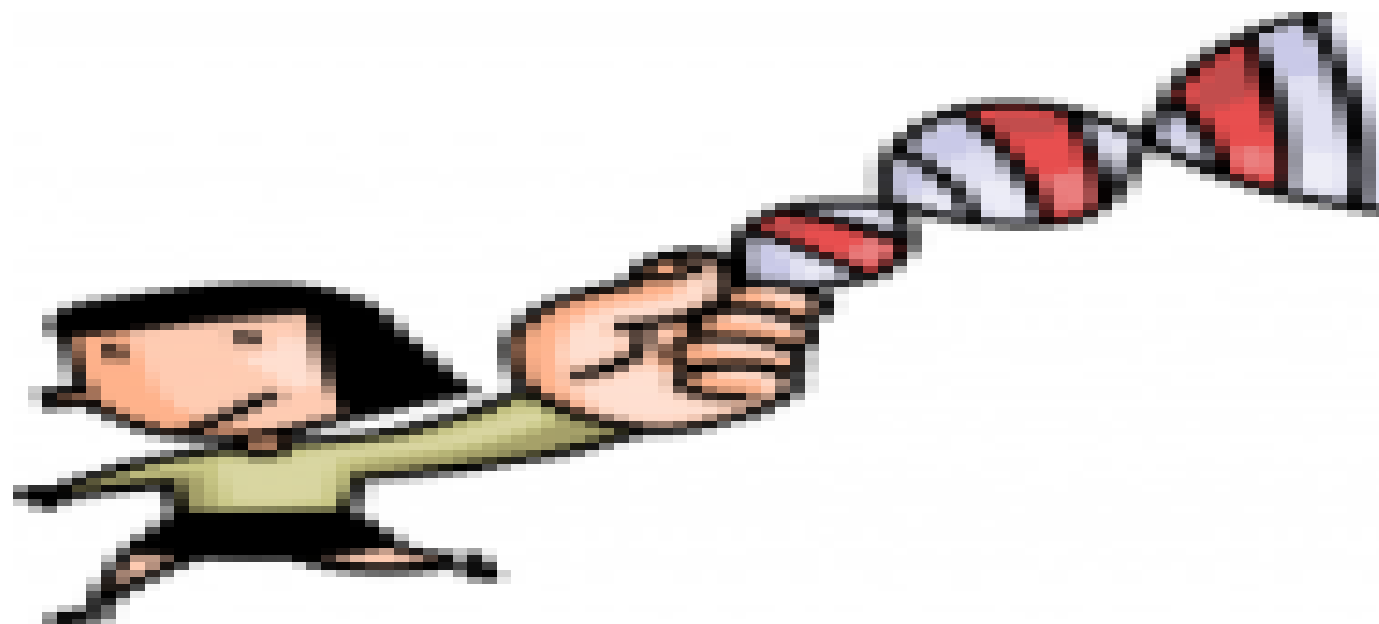


Figure 2. The prospective association between observed maternal parenting quality and adolescent *SCL-90-R* Anxiety at high (+1 *SD*) and low (−1 *SD*) levels of adolescent polygenic sensitivity. *B* = unstandardized regression coefficient. \*\*  $p < .01$ .

# Genes Influence Adolescent Adjustment



# Parenting and Adolescent Adjustment

Warm / supportive  
parenting



Adolescent  
Positive  
Adjustment

Hostile  
parenting



Adolescent  
Negative  
Adjustment