Associations Between Parent and Child Negative Emotionality and Parenting

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Abstract

Negative emotionality is associated with psychopathology, such as mood and eating disorders, as well as other negative outcomes such as emotion dysregulation and psychological inflexibility. Thus, an improved understanding of the etiology of negative emotionality, specifically in childhood and adolescence, may inform the development of interventions designed to increase emotional stability in children. The present study uses an adoption design to address whether similarity in parents' and children's negative emotionality is due to genetic influences, environmental influences, or both, and whether negative or warm parenting mediates this association. This study examined longitudinal data from participants in the Colorado Adoption Study, including 637 adoptive and 783 non-adoptive parents, 331 adoptees, and 512 non adoptees. We evaluated whether associations between parents' and children's negative emotionality are consistent with environmental mediation or passive gene–environment correlation (passive *r*GE) and examined evidence for evocative gene–environment correlation (evocative *r*GE). Our results indicated that passive *r*GE may play a role in the association between parents' and children's negative emotionality, and there is some evidence that parents' negative emotionality influences children's negative emotionality via negative parenting. Specifically, negative parenting partially mediated the association between biological mothers' negative emotionality and children's negative emotionality, but no mediation was found for biological fathers. Additionally, our results showed no evidence for evocative *r*GE, as both genetically related and genetically unrelated sibling pairs were treated similarly for warm and negative parenting conditions. Our findings suggest the importance for future studies to consider how gene–environment correlations may influence the results, especially when they lack a genetically informed design.

Associations Between Parent and Child Negative Emotionality and Parenting

Temperament has been broadly defined as a set of heritable personality traits that are present early in life and predict later development (Buss & Plomin, 1984). Although this definition of temperament is not universal (e.g., Goldsmith et al., 1987), one construct that is often included in the definition of temperament is negative emotionality. Negative emotionality has been defined as the predisposition to experience unpleasant affective states (Watson & Clark, 1984). It is closely related to the construct of neuroticism (negative emotionality that includes fear, anxiety, and guilt) (Matthews et al., 1998) which is a construct included in most models of personality, such as the Five-Factor Model of Personality (McCrae & John, 1992) and the Eysenck Personality Questionnaire (Eysenck & Eysenck, 1971).

Negative emotionality is associated with psychopathology, such as mood and eating disorders (Malouff, Thorsteinsson, & Schutte, 2005), as well as other negative outcomes such as emotion dysregulation (Coplan, Reichel, & Rowan, 2009) and psychological inflexibility (Paulus et al., 2016). Thus, an improved understanding of the etiology of negative emotionality, specifically in childhood and adolescence, may inform the development of interventions designed to increase emotional stability in children. Previous literature has suggested that parent–child resemblance in negative emotionality and similar constructs such as neuroticism (Ask et al., 2021; Peng et al., 2022; Shewark et al., 2021). Additionally, negative parenting, especially by mothers, is associated with higher negative emotionality in children (Vertsberger et al., 2019). The present study uses the adoption design to address whether parent–child similarity negative emotionality is due to genetic influences, environmental influences, or both, and whether negative or warm parenting mediates this association.

Potential Explanations for Parent–Child Similarity in Negative Emotionality

Previous studies have shown that there is a significant association between parental negative emotionality and their children's negative emotionality (Ask et al., 2021; Peng et al., 2022; Shewark et al., 2021). Children's negative emotionality may be influenced by parents' negative emotionality and parenting characteristics in multiple ways. First, children may have a genetic predisposition for negative emotionality, which is transmitted from parents to children. Both negative emotionality in adolescence (Avinun & Knafo, 2014; Clifford, Lemery-Chalfant, & Goldsmith, 2015) and neuroticism in adulthood (Boomsma et al., 2018; Nivard et al., 2015) are moderately heritable.

Second, parenting has also been cited as a key environmental factor that influences children in both positive and negative ways (American Psychological Association, 2009; Prinzie et al., 2004). Greater perceived parental warmth (i.e., parenting practices such as responsiveness and understanding) in childhood is associated with less negative affectivity—the tendency to experience negative moods and emotions—in children in later years (Diener et al., 1999; Moran, Turiano, & Gentzler, 2018). Additionally, warm parenting practices are associated with less negative affectivity, less neuroticism, and more optimism for children 10 years later (Moran, Turiano, & Gentzler, 2018; Yu et al., 2019). There are also associations between greater negative parenting (i.e. parenting practices characterized by non-reasoning/punitive strategies, physical negativity, and verbal hostility) and greater negative emotionality in children (Vertsberger et al., 2019). Negative parenting is associated with negative emotionality in children through environmental mediation, which occurs when parents' negative parenting has a direct effect on children's negative emotionality. Mothers who showed more negative parenting when their children were 6.5 years old had children who had higher negative emotionality at 8 to 9 years old (after controlling for prior associations between negative parenting and child negative

emotionality) (Vertsberger et al., 2019). Parental negative emotionality and neuroticism is believed to lead to more negative parenting because characteristics associated with negative emotionality and neuroticism, such as tension, anxiety, and lack of emotionality stability may interfere with parents' abilities to be sensitive to and respond in an appropriate way to their children's needs (Bahrami et al., 2018; Prinzie et al., 2009). Therefore, based on previous research, it is important to consider how both warm and negative dimensions of parenting may influence children's later negative emotionality.

Third, parents' genetic characteristics may influence parenting; i.e., parents' genes and the environment they provide may not be independent of each other. A passive gene–environment correlation occurs when children passively inherit family environments that are correlated with the parents' genetic propensities for a trait, such as high negative emotionality (Knopik, 2016; Neiderhiser et al., 2004). For example, parents' genetic predisposition to negative emotionality may lead to less warm and more negative parenting, which may lead to greater negative emotionality in the children. Passive *r*GE has been cited as a potential pathway in which negative emotionality in children increases, as both genetic and environmental influences are found to be significant in the correlation between parents' and children's negative emotionality. For example, Ask et al. (2021) found both genetic influences and environmental issues, such as direct influences of maternal neuroticism, were significantly associated with children's neuroticism.

Finally, parent–child similarity in negative emotionality may be explained by evocative gene–environment correlation. An evocative gene–environment correlation occurs when individuals' genetically influenced traits evoke reactions from others (Knopik, 2016). Greater negative emotionality in children evokes more negative and hostile parenting practices (Coplan,

Reichel, & Rowan, 2009; Shewark et al., 2021). For example, results from a longitudinal study (Shewark et al., 2021) suggested more anger assessed in early childhood evoked more negative and hostile parenting in later childhood; i.e., an evocative gene–environment correlation partially explains this pathway and has a role in the relationship between parents' temperament and children's negative emotionality. In contrast, Klahr et al. (2013) concluded that parental warmth was not explained by evocative gene–environment correlation, as genetic influences on maternal warmth were nonsignificant; i.e., children who were more genetically similar did not have greater similarity in maternal warmth.

The Current Study

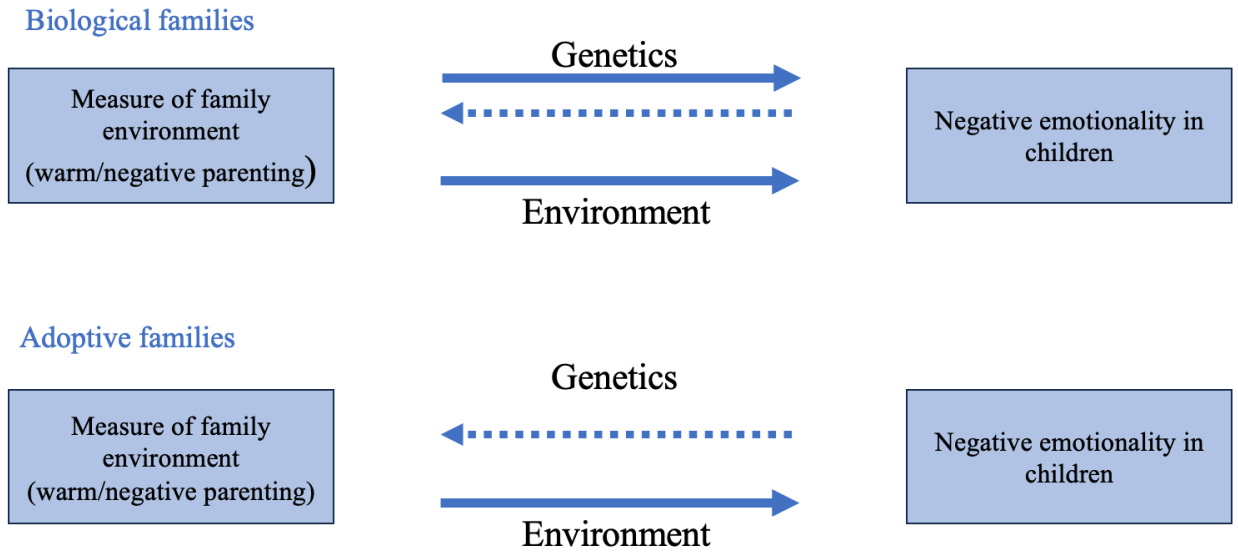

Figure 1

Note: The dashed lines represent evocative *r*GE influences, where more genetically-related siblings may evoke similar parenting styles, regardless of the relationship to the parent. Figure adapted from *Behavioral Genetics, 7th Ed*. (118), by V. S. Knopik et al., 2017, Worth Publishers. Copyright [2017] by Worth Publishers.

We conducted a genetically informative study using data from the Colorado Adoption Project (CAP). Adoption studies are particularly useful for addressing whether the association between a putatively environmental influence and outcome is due to environmental mediation,

passive gene–environment correlation, or both, by comparing the association between a putatively environmental influence and outcome in adoptive and non-adoptive (i.e., biologically related) families (Knopik, 2016; Rhea et al., 2013). Given that adoptive family members are not genetically related, the association between a putatively environmental influence and an outcome is due to environmental mediation only. In contrast, given that non-adoptive family members share both genes and shared environmental influences, the association between a putatively environmental influence and an outcome may be due to either environmental mediation or passive *r*GE. A significant association only in nonadoptive families is evidence of genetic influences or passive *r*GE. A significant association of similar magnitude in both adoptive and nonadoptive families is evidence of environmental mediation. A higher correlation in nonadoptive families than in adoptive families but a significant correlation in both types of families, indicates that there is both environmental mediation and passive *r*GE correlation.

Additionally, we focused on warmth and negativity dimensions of parenting, as these seemed particularly relevant to negative emotionality. Parental warmth is defined, from previous literature, as parental behaviors characterized by affection, responsiveness, and support (Patterson et al., 2017). Parental negativity is defined as parental behaviors characterized by guilt induction, hostility, and withdrawal of relationship (Dibble & Cohen, 1974).

Hypothesis 1

Given earlier research findings that negative emotionality and neuroticism are heritable (Ask et al., 2021; Avinun & Knafo, 2014; Clifford, Lemery-Chalfant, & Goldsmith, 2015; Singh & Waldman, 2010) and similar dimensions of temperament, such as neuroticism are correlated between parents and children (Ask et al., 2021), we hypothesized that parents' negative emotionality will be associated with their children's negative emotionality. Furthermore, we

examined whether this association is due to a passive gene–environment correlation or environmental mediation by comparing the association in adoptive and non-adoptive families.

Hypothesis 2

We hypothesized that the association between parent and child negative emotionality will be mediated by negative and less warm parenting (i.e., parents' negative emotionality will influence their parenting, which will in turn lead to negative emotionality in their children). We expected to see that warm parenting acted as a protective factor and decreased negative emotionality in children, whereas negative parenting would likely increase negative emotionality in children.

Hypothesis 3

We hypothesized that a child's negative emotionality will elicit more negative and less warm parenting from parents (i.e., an evocative genotype–environment correlation). If siblings who are genetically related to each other receive more similar parenting than siblings who are not related to each other, then this is evidence for an evocative gene–environment correlation.

Method

Participants

The Colorado Adoption Project (CAP) is an ongoing longitudinal adoption study (Rhea et al., 2013). The CAP was initiated in 1975 and participants were enrolled until 1983. All protocols were approved by the University of Colorado Institutional Review Board. Parents completed informed consent for themselves and their children and children assented during the age 16 assessment. Birth parents who planned to place their children up for adoption were invited to participate through Denver Catholic and Lutheran Social Services. Infants placed for adoption were placed in foster homes briefly before being placed with their adoptive parents. Control families were matched with the adoptive families based on the proband's gender,

parents' ages, and father's education and occupation were recruited through cards mailed to parents of newborns. The first younger siblings in both types of families were also included in the study originally, but older siblings were later invited to enroll when they turned 16 years old. 95% of adoptive parents and 90% of birth parents reported that their ethnicities were non-Hispanic White.

Analyses in the present study were conducted on individuals who completed any of the assessments (see Table 1). The present study includes data from 637 adoptive parents (322 mothers and 315 fathers), and 783 nonadoptive parents (393 mothers and 390 fathers), 331 adoptees, and 512 non-adoptees; 33 additional individuals were excluded for being biologically related to only one of their parents.

Measures

Warm and negative parenting in childhood and adolescence

The Dibble & Cohen Parenting Report (Dibble & Cohen, 1974) was used to assess warm and negative parenting. This questionnaire was completed at when children were 7 (M = 7.44, SD =0.37), 9 (M = 9.48, SD = 0.37), 10 (M = 10.45, SD = 0.37), 11 (M = 11.43, SD = 0.37), 12 (M = 12.47, SD = 0.40), 13 (M = 13.48, SD = 0.39), 14 (M = 14.50, SD = 0.38), and 15 (M = 15.40, SD = 0.32) years old. Parents were asked questions about their parenting practices and rated each item on a 7-point Likert scale (0 = "never" to 6 = "always"). The warmth domain of parenting (acceptance, child-centeredness, sensitivity, positive involvement, and shared decision-making) consists of 24 questions, and the negativity domain (guilt induction, hostility, withdrawal of relationship) consists of 15 questions. In a few rare cases (~2 people per wave), surveys about parenting were filled out by a legal guardian or a stepmother. These observations were excluded from all analyses.

Negative emotionality in parents and children

Negative emotionality in both parents and children was assessed using the "emotionality-anger" subscale of the Emotionality, Activity, Sociability, and Impulsivity Temperament Scale (EASI Temperament Scale) (Buss & Plomin, 1984). The EASI Temperament Scale consists of 20 items, with 5 items relating to the emotionality-anger subscale. These items include "It takes a lot to get me mad", "I am known as hot-blooded and quick-tempered", "There are many things that annoy me", "When displeased, I let people know it right away", and "I yell and scream more than most people my age". Each item is rated on a five-point Likert scale (1 = "strongly disagree", 5 = "strongly agree"). Parents assessed themselves and their co-parent on the EASI Temperament Scale when their child was, on average, 10 months old. Children assessed themselves using this scale at age 16 years.

Data analysis

All data analyses were conducted in R (v4.1.1; R Core Team, 2021). Structural equation models (SEM) were constructed using the lavaan package (Rosseel, 2012), which uses full information maximum likelihood to address missing data. All analyses were based on the standard assumption that there are equal means and variances across biological and adoptive families and between biological and adoptive siblings. All analyses used an alpha level of .05 and two-tailed tests. Model fit was determined using chi-squared statistics (χ^2), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA), with a CFI > 0.95 and an RMSEA < 0.06 indicating good model fit.

Transparency and Openness

Hypotheses and analysis plans were pre-registered at the following website: https://osf.io/vgb3p/?view_only=b8c9b5d60b4d4dfe9e61b2cd5f364390.

Results

Descriptive statistics are shown in Table 1. Tables A1 and A2 display correlations among study measures separately for biological and adoptive families. Correlations among parenting variables across time were generally high, suggesting that parenting is consistent across time. Additionally, preliminary analyses indicated that a single factor model of parenting fit well for both warm and negative parenting (see Figures A3 and A4, respectively).

Table 1: Descriptive Statistics for Study Measures.

	N	Mean	SD	Skew	Min	Max
Mother EASI self-report	715	11.70	3.53	0.62	5	24
Partner EASI report of mother	709	13.33	3.8	0.44	5	25
Father EASI self-report	705	11.48	3.34	0.60	5	23
Partner EASI report of father	718	11.24	4.41	0.74	5	25
Parental Warmth age 7	585	13.63	1.28	0.00	10	17.4
Parental Warmth age 9	572	13.70	1.42	-0.18	8.2	17.4
Parental Warmth age 10	579	13.73	1.49	-0.22	8	17.2
Parental Warmth age 11	514	13.74	1.48	-0.35	8.6	17.8
Parental Warmth age 12	559	13.65	1.46	-0.32	7	17.4
Parental Warmth age 13	497	13.66	1.47	-0.30	8.2	17.4
Parental Warmth age 14	511	13.73	1.51	-0.40	6.8	17.4
Parental Warmth age 15	380	13.72	15.6	-0.09	8.4	17.4
Parental Negativity age 7	585	6.49	1.82	0.23	1	14.67
Parental Negativity age 9	572	6.09	1.33	0.16	1.33	13.67
Parental Negativity age 10	579	5.95	2.01	0.15	0.33	14.33
Parental Negativity age 11	514	5.84	2.02	0.19	0.67	13.33
Parental Negativity age 12	559	5.92	2.03	0.07	0.67	13.33
Parental Negativity age 13	497	5.87	2.10	0.20	1	13.67
Parental Negativity age 14	511	5.72	2.13	0.16	0	13
Parental Negativity age 15	380	5.67	2.19	0.40	0	14
Child EASI self-report age 16	843	13.23	3.69	0.41	5	25
Parent-reported EASI age 16	572	13.43	4.21	0.29	5	25
Teacher-reported EASI age 16	193	10.93	3.87	0.71	5	24

Note: EASI = Emotionality, Activity, Sociability, and Impulsivity Temperament Scale (Buss & Plomin, 1984)

Are Parents' and Children's Negative Emotionality Related, and Is This Association Due to Passive *r*GE or Environmental Mediation?

Figure 2 shows the association between parents' negative emotionality and children's negative emotionality. Mothers' and fathers' negative emotionality were modeled using two separate latent variables with loadings on the parent's self-reported EASI emotionality-anger

subscale score and their partner's self-reported EASI emotionality-anger subscale score. Children's negative emotionality was modeled using a latent variable with loadings on the child's self-reported EASI emotionality-anger subscale score and the parent-reported EASI emotionality-anger subscale score. Given results of preliminary analyses and inspection of the correlation matrix, a residual correlation between the partner-reported EASI scores was added, as they were significantly negatively correlated, $r = -0.33$ (biological), $r = -0.45$ (adoptive), $p < 0.001$. The decision to add the residual correlations, which improved the fit of the model, $\chi^2_{diff} = 37.651$, was made prior to analyzing the association between parents' and children's negative emotionality. Figure 2 shows a significant association between the parents' negative emotionality and their children's negative emotionality only in biological families. The association between mothers' negative emotionality and children's age 16 negative emotionality was positive and significant for biological families, $r = 0.25$, $p = 0.006$, but not for adoptive families, $r = 0.04$, $p = 0.707$. Similarly, the association between fathers' negative emotionality and children's age 16 negative emotionality was positive and significant for biological families, $r = 0.25$, $p = 0.008$, but not for the adoptive families, $r = 0.06$, $p = 0.542$. The association between fathers' negative emotionality and children's negative emotionality was not significantly different in biological and adoptive families, $p = 0.198$. Likewise, the association between mothers' negative emotionality and children's negative emotionality was not significantly different in biological and adoptive families, $p = 0.098$.

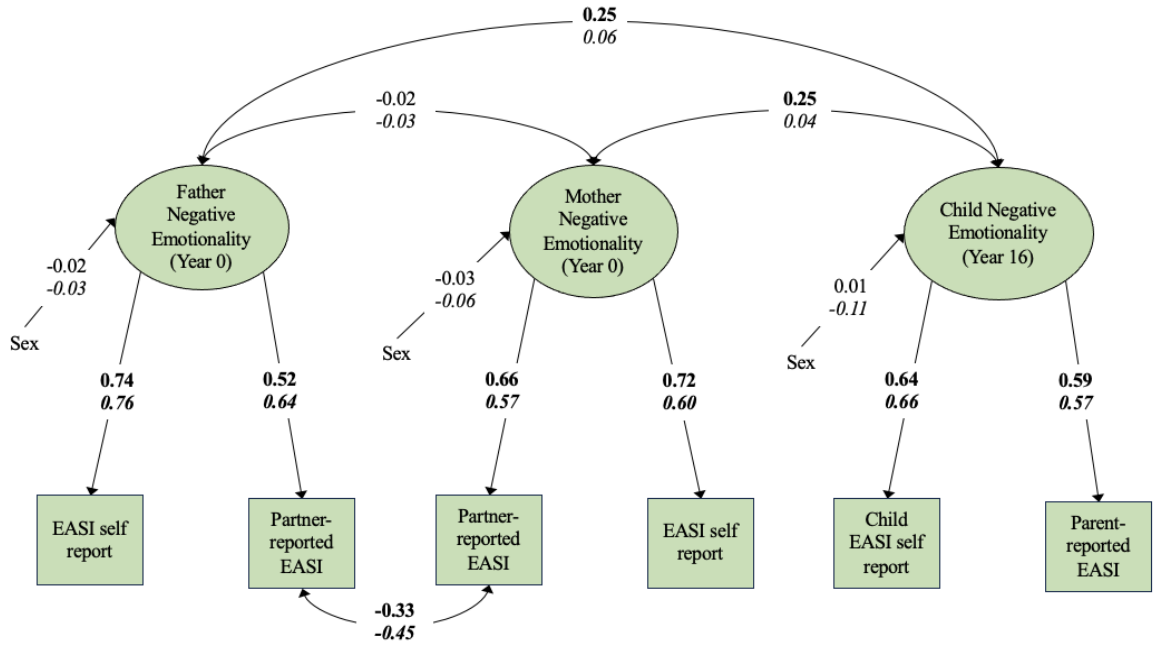

Figure 2: Model fit: χ^2 (24) = 32.96, p = 0.105, RMSEA = 0.028, CFI = 0.974.

Note: Squares indicate measured variables and ovals indicate latent variables. Variance of measured variables explained by latent variables can be computed by squaring the factor loadings on the latent variables. Significant associations and factor loadings are indicated with **bolded** text. Loading index: *italicized = adopted parents*; not italicized = biological parents**.** For direction of effects for sex, females = 0 and males = 1.

Is the Association Between Parents' and Children's Negative Emotionality Mediated by Warm or Negative Parenting?

Our second goal was to evaluate warm and negative parenting as potential mediators in the association between parents' and children's negative emotionality and examine evidence for passive gene–environment correlation vs. environmental mediation as explanations of this association. To do this, we fit a model where parents' warm and negative parenting were both allowed to mediate the association between parents' negative emotionality and children's negative emotionality, controlling for one another. This model is displayed in Figure 3 and fit well. We also decomposed the associations between parent and child negative emotionality into

indirect versus direct paths in Tables A8 (mothers) and A9 (fathers). Additionally, our results show that males generally received less warm parenting and more negative parenting, but these associations with sex were all nonsignificant.

For biological mothers, results suggested partial mediation by negative parenting only. The total association in biological mothers is decomposed into an indirect path of warm parenting of $r = -0.05$, $p = 0.137$, an indirect path of negative parenting of $r = 0.06$, $p = 0.029$, and a direct path of $r = 0.25$, $p = 0.005$. Only the direct path and indirect path through negative parenting were significant, suggesting negative parenting only partially mediated the association between mothers' negative emotionality and children's negative emotionality. Recall from prior analyses that the total association between adoptive mothers' and children's negative emotionality was not significant, $r = 0.07$, $p = 0.570$. Additionally, the difference between biological and adoptive mothers' total associations with children's negative emotionality was not significant, $p = 0.424$.

The total association for biological fathers was explained entirely through the direct path of $r = 0.25$, $p = 0.010$, and not at all through the indirect path of warm parenting, $r = 0.01$, $p = 0.671$, or indirect path through negative parenting, $r = 0.00$, $p = 0.824$. There was no significant total association for adoptive fathers, $r = 0.05$, $p = 0.696$. Additionally, the difference between biological and adoptive fathers' total association with children's negative emotionality was not significant, $p = 0.132$.

In addition, we conducted a sensitivity analysis to compare parenting ratings from mothers and fathers. Because the parenting variables that we focused on were primarily recorded by mothers rather than fathers, we wanted to test whether parenting variables were truly capturing parenting of both parents, or whether they were mostly capturing the mothers'

parenting (see Table A5). To do this, we ran an additional structural equation model in which the parenting latent variable was replaced with separate scores for mothers and fathers at year 7 (i.e., the only year that both parents completed separate ratings regarding their own parenting). The models examining warm and negative parenting as potential mediators are displayed in Figures A6 and A7, respectively. Biological mothers' and fathers' negative emotionality still had significant direct paths to children's negative emotionality in both the warm parenting model, r = .25, p = 0.004; r = .26, p = 0.009, and the negative parenting model, r = .21, p = 0.021; r = .25, p = 0.014. Additionally, the total paths between mothers' negative emotionality and children's negative emotionality were significant for both the warm parenting model, r = .25, p = 0.004, and the negative parenting model, r = .26, p = 0.004. The total path between fathers' negative emotionality and children's negative emotionality is consistent between the models showing warm and negative parenting as mediators, r = .26, p = 0.009. There were no other significant indirect paths for mothers or fathers.

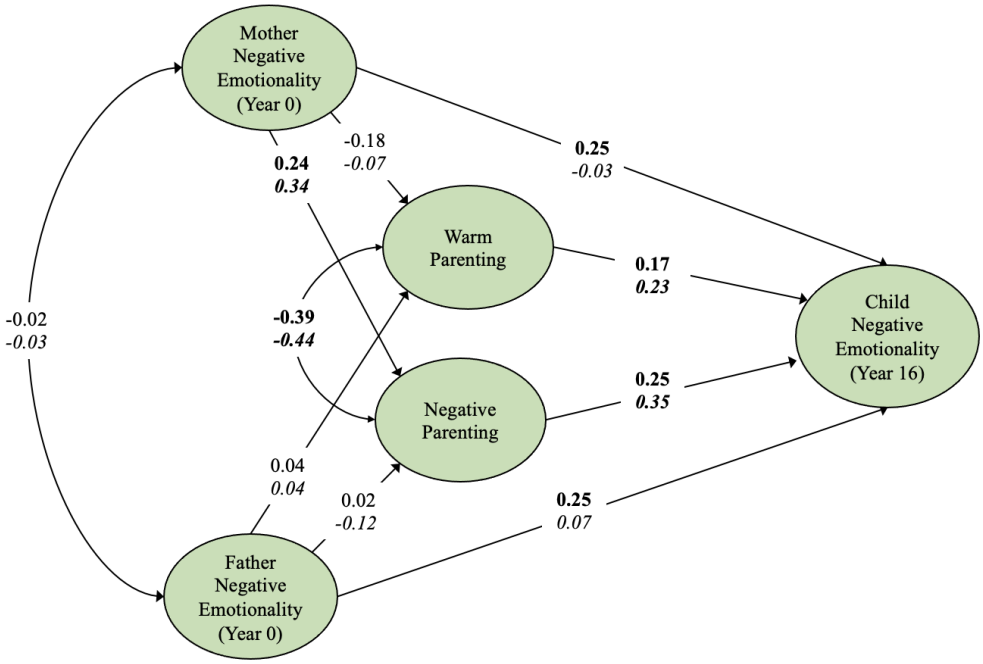

Figure 3: Model fit: χ^2 (452) = 776.56, p < 0.001, RMSEA = 0.039, CFI = 0.941.

Note: Loading index: *italicized = adopted parents*; not italicized = biological parents**.** Significant associations and factor loadings are indicated with **bolded** text. Factor loadings are not displayed but are similar to those from figure 2. All analyses control for sex by regressing all latent variables on sex (not displayed here). Standardized regression paths on sex (i.e. effects for males): mother negative emotionality (r = -0.03 bio, -0.06 adoptive), father negative emotionality (r = -0.02 bio, -0.03 adopt), warm parenting (r = -0.06 bio, -0.04 adoptive), negative parenting (r = 0.09 bio, 0.15 adoptive), child negative emotionality (r = 0.00 bio, -0.15 adoptive). See Tables A8 and A9 for all direct, indirect, and total effects. The association between adoptive mothers' negative emotionality and children's negative emotionality was mediated by their negative parenting, r = .09, p = 0.042, but the overall total effect was nonsignificant, r = .01, p = 0.953.

Are Biological Sibling Pairs Parented More Similarly Than Adoptive Sibling Pairs? (Is There Evidence for Evocative *r*GE?)

Our third hypothesis, aimed to understand whether there is an evocative gene–environment correlation between children's negative emotionality and parenting. Evidence for evocative gene–environment correlation would exist if more genetically related siblings (i.e., biological siblings) receive more similar parenting. Figures 4 and 5 show the magnitude of the associations between parenting received by sibling 1 and sibling 2 in biological sibling pairs versus adoptive sibling pairs for warm parenting and negative parenting, respectively. In all cases, parenting was strongly correlated across siblings (e.g., all r's > 0.68, all p's < 0.001). These associations were not significantly larger in biological sibling pairs compared to adoptive sibling pairs, p = 0.396 (warm parenting), p = 0.292 (negative parenting), suggesting little evidence of evocative *r*GE.

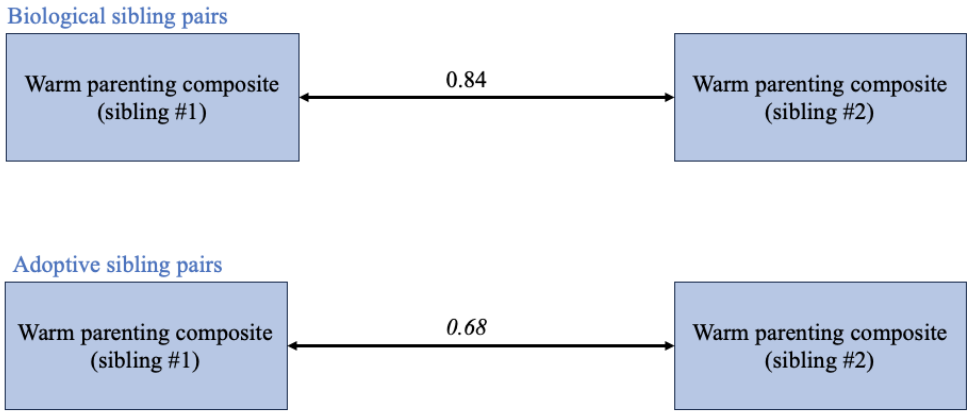

Figure 4: Model fit: χ^2 (4) =3.01, p = 0.557, RMSEA = 0.000, CFI = 1.000.

Note: Loading index: *italicized = adopted parents*; not italicized = biological parents**.** Significant associations and factor loadings are indicated with **bolded** text. Standardized regression paths on sex (0 = F, 1 = M): sibling 1 (*r* = -0.08 bio, -0.06 adoptive), sibling 2 (*r* = -0.04 bio, 0.00 adoptive).

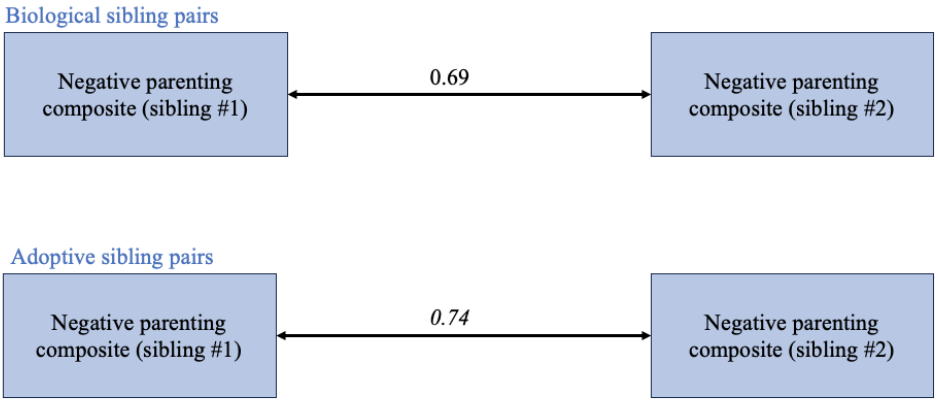

Figure 5: Model fit: χ^2 (4) =2.256, p = 0.689, RMSEA = 0.00, CFI = 1.0.

Note: Loading index: *italicized = adopted parents*; not italicized = biological parents**.** Significant associations and factor loadings are indicated with **bolded** text. Standardized regression paths on sex (0 = F, 1 = M): sibling 1 (*r* = 0.08 bio, 0.03 adoptive), sibling 2 (*r* = -0.03 bio, **0.14 adoptive**).

Discussion

The goal of this study was to increase understanding of the mechanisms explaining parent–child similarity in negative emotionality, viz., the roles of passive *r*GE, environmental

mediation, and evocative *r*GE. We also examined whether the association between parents' and children's negative emotionality was mediated by warm or negative parenting.

Are Parents' and Children's Negative Emotionality Related, and Is This Association Due to Passive *r*GE or Environmental Mediation?

Our results are consistent with previous literature suggesting a significant parent-child similarity in negative emotionality (Ask et al., 2021).We proposed that parents' negative emotionality is associated with children's negative emotionality. Our results showed that only biological mothers' and fathers' negative emotionality was significantly associated with children's negative emotionality. While adoptive parents' negative emotionality was not significantly associated with children's negative emotionality, there isn't a significant difference in association between biological and adoptive families. A significant association only in nonadoptive families would be evidence of genetic influences or passive *r*GE, while a significant association of similar magnitude in both adoptive and nonadoptive families would be evidence of environmental mediation. A higher correlation in nonadoptive families than in adoptive families but a significant correlation in both types of families, indicates that there is both environmental mediation and passive *r*GE correlation. Our results therefore tell us that there may be evidence of passive *r*GE or genetic influence, as there was a significant correlation in nonadoptive families, but there was not a significant correlation in adoptive families.

Additionally, these results are consistent with previous literature suggesting that there is a moderate heritability of negative emotionality in childhood (Avinun & Knafo, 2014; Clifford, Lemery-Chalfant, & Goldsmith, 2015) and adulthood (Nivard et al., 2015). This association therefore provides evidence that there may be a passive gene–environment correlation or genes

influencing both parent and child negative emotionality. Given the results of significant indirect effects discussed in the next section, there is a possibility of passive *r*GE.

Is the Association Between Parents' and Children's Negative Emotionality Mediated by Warm or Negative Parenting?

Our hypothesis that the association between parents' and children's negative emotionality will be mediated by negative and less warm parenting was partially supported, as we found that negative parenting acts as a partial mediator between mothers' negative emotionality and their children's negative emotionality. An interesting finding from the mediation model is that there is some evidence that warm and negative parenting may influence child negative emotionality via environmental mediation, and this association is significant in both adoptive and biological families. In biological families, negative parenting accounted for about 21% of the total association between biological mothers' negative emotionality and children's negative emotionality. These results provide evidence for passive *r*GE, at least for mothers. The lack of mediation in biological fathers suggests there may be no passive *r*GE for fathers, but we discuss some potential alternative interpretations of these results in more detail below.

Given these results, we should consider the possibility that negative parenting may not be truly an environmental variable for children. It may be that negative parenting is due to parents' genes influencing their parenting, which is partially explaining the association between parents' negative emotionality and their children's negative emotionality. Therefore, it is important to think of negative parenting as influenced by both genes and the environment. Mothers who struggle with negative emotionality may be more likely to put their child in a more negative parenting environment; therefore, efforts to reduce the negative parenting environment by

addressing mothers' negative emotionality may be more successful, and ultimately help reduce children's negative emotionality.

An important consideration is that most warm and negative parenting variables were based on mothers' (rather than fathers') ratings of parenting, which may have impacted our ability to detect passive *r*GE for fathers. Specifically, between ages 9 and 15, only 8.7% of responses, on average, were based on fathers' judgements. To understand whether the parenting variables capturing mostly maternal parenting influenced the results, we conducted sensitivity analyses examining warm and negative parenting as mediators of the parent–child similarity in negative emotionality at age 7 years, when separate maternal and paternal ratings of parenting were available. The results from figures A6 and A7 are similar to those presented in Figure 3, which showed that there were direct effects of biological mothers' and fathers' negative emotionality on children's negative emotionality, and that this effect was not significant for adoptive mothers or fathers. One difference was that biological fathers' negative emotionality did predict their negative parenting in this analysis. However, there was no indirect effect through fathers' negative parenting, because fathers' negative parenting did not predict childrens' negative emotionality. These results should be considered while interpreting the results, as the measures used may not assess fathers' parenting as well as of mothers' parenting.

Approximately 80% of the association between mothers and children wasn't explained by negative parenting mediation. This could be due to other factors, such as direct genetic influences or other aspects of parenting that were not measured in this study. One study found that maternal-adolescent congruence in high neuroticism was associated with a more punitive parenting style when compared to low-neuroticism congruence (Peng et al., 2022). It will be important to further understand what the remaining 80% of the association is explained by, and

whether this is direct genetic effects, or if there is potential additional passive *r*GE that was not measured.

Are Biological Sibling Pairs Parented More Similarly Than Adoptive Sibling Pairs? (Is There Evidence for Evocative *r*GE?)

Our third hypothesis focused on sibling pairs rather than parent-child relationships, and whether siblings receive similar parenting. Our model estimates suggest that evocative *r*GE is unlikely, as the associations are similar between adoptive and biological sibling pairs. This means that both nonadoptive and adoptive sibling pairs were treated similarly for warm and negative parenting conditions, and therefore individuals who were more related to one another did not appear to receive more similar parenting styles (as predicted if there was evocative *r*GE). Our results are partially supported by previous findings, such as that parental warmth was not explained by an evocative gene–environment correlation (Klahr et al., 2013). However, our results differed from other literature stating that greater negative emotionality in children evoked more negative and hostile parenting practices (Coplan, Reichel, & Rowan, 2009; Shewark et al., 2021), as our results did not show evidence for evocative *r*GE in the context of negative parenting.

It will be important to examine these associations in larger sample sizes, which have greater power to detect differences between biological and adoptive sibling pairs. Additionally, correlations may be high for both groups because the same reporter (parent) reported on parenting of both sibling 1 and sibling 2. If we had observed evidence that had suggested that evocative *r*GE was significant, then this would have serious implications for people who study parenting. Evidence of evocative gene–environment correlations would suggest that parenting variables are influenced by children, which means it becomes important for researchers to have

other measures and information about a child to understand the true nature of the relationship between parent and child. In this case, the lack of evidence for an evocative *r*GE suggests that the feedback loop (between children influencing parents, who influence the child, and so on) does not exist.

Strengths and Limitations

One strength of this study is that it is one of the first adoption studies of parenting and negative emotionality. This is helpful in that our study has the ability to distinguish between passive gene–environment correlation and environmental mediation, which may not have been detected in other methods, such as a twin study. Additionally, this study design is unique in that it assessed children's negative emotionality in the exact same way that parents were assessed 16 years earlier, which allowed us to conduct some interesting analyses. Another strength of this study is that data on parenting variables spans across childhood and adolescence in 8 assessments. Furthermore, a strength of our study design is that the association between parent-child similarity in negative emotionality or between parenting and child negative emotionality cannot be explained by method covariance given different informants. Our different informants enabled us to look at associations with latent variables, which minimized the impact of measurement error.

The results of this study should also be considered in relation to some limitations. One limitation of this study is that the participants are almost exclusively non-Hispanic White (95% of adoptive parents; 90% of birth parents). This severely limits the generalizability of these findings to individuals of other ethnic and racial groups. Another weakness in this study is that adoptive and nonadoptive fathers' data were not represented as well as mothers' data. From our additional sensitivity analyses, the measures are largely an assessment of mothers' parenting,

which could lead to incorrect conclusions. In the future, it will be important to gather more data from fathers to understand the associations between father and child better. Another limitation of this study is that there is an implicit assumption that adoptive families are exactly the same as biological families, except for genetic relatedness differences between parents and offspring. The Colorado Adoption Project matched adoptive and control families to ensure this assumption would be met, but to the extent that adoptive families are not representative of nonadoptive families, that could impact study findings. Nevertheless, there are not many studies of this kind, and this unique study design enabled us to evaluate hypotheses concerning passive and evocative *r*GE. These are difficult to disentangle in the context of most psychological study designs.

Conclusion

This study aimed to understand the mechanisms explaining parent–child similarity in negative emotionality using a longitudinal adoption design. Our results indicate that passive *r*GE may play a role in the association between parents' and children's negative emotionality, and there is some evidence that parenting influences children's negative emotionality via environmental mediation. Parents who are genetically predisposed to negative emotionality may transmit this genetic predisposition to negative emotionality to their children, but parents' negative emotionality may also lead to negative parenting, which in turn leads to higher negative emotionality in their children. Additionally, negative parenting partially mediates the association between biological mothers' negative emotionality and children's negative emotionality. Our study is one of the first to look at passive and evocative *r*GE in this association, although there was no evidence of evocative *r*GE. Future studies should consider how gene–environment correlations may influence their results, especially when they have a non-genetically informed design.

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Appendices

Table A1: Correlations Among Study Measures in Biological Families.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1.Mother EASI self report	1.00																							
2. Partner EASI report of mother	0.47	1.00																						
3. Father EASI self report	-0.08	-0.06	1.00																					
4. Partner EASI report of father	0.01	-0.15	0.40	1.00																				
5. Parental Warmth age 7	-0.05	-0.13	0.04	0.03	1.00																			
6. Parental Warmth age 9	-0.06	-0.08	-0.03	0.00	0.60	1.00																		
7. Parental Warmth age 10	-0.12	-0.09	-0.01	-0.05	0.57	0.71	1.00																	
8. Parental Warmth age 11	-0.15	-0.19	0.04	0.00	0.55	0.69	0.66	1.00																
9. Parental Warmth age 12	-0.16	-0.15	0.07	0.05	0.54	0.64	0.63	0.64	1.00															
10. Parental Warmth age 13	-0.10	-0.13	0.09	0.11	0.38	0.62	0.56	0.67	0.66	1.00														
11. Parental Warmth age 14	-0.10	-0.08	0.05	0.05	0.43	0.61	0.56	0.58	0.62	0.71	1.00													
12. Parental Warmth age 15	-0.06	-0.20	-0.04	0.03	0.46	0.61	0.61	0.65	0.60	0.67	0.69	1.00												
13. Parental Negativity age 7	0.11	0.19	0.12	-0.06	-0.34	-0.25	-0.29	-0.26	-0.27	-0.18	-0.06	-0.11	1.00											
14. Parental Negativity age 9	0.12	0.12	0.04	-0.06	-0.18	-0.28	-0.31	-0.28	-0.24	-0.20	-0.14	-0.06	0.55	1.00										
15. Parental Negativity age 10	0.20	0.20	0.02	-0.06	-0.22	-0.33	-0.32	-0.29	-0.29	-0.30	-0.16	-0.23	0.49	0.71	1.00									
16. Parental Negativity age 11	0.18	0.21	-0.03	-0.08	-0.24	-0.24	-0.30	-0.36	-0.24	-0.24	-0.14	-0.18	0.54	0.72	0.70	1.00								
17. Parental Negativity age 12	0.15	0.11	-0.03	0.00	-0.15	-0.25	-0.29	-0.26	-0.33	-0.26	-0.20	-0.17	0.52	0.67	0.65	0.71	1.00							
18. Parental Negativity age 13	0.16	0.12	-0.05	-0.11	-0.04	-0.16	-0.22	-0.20	-0.19	-0.30	-0.11	-0.12	0.42	0.71	0.67	0.76	0.71	1.00						
19. Parental Negativity age 14	0.19	0.16	-0.02	-0.04	-0.12	-0.25	-0.26	-0.22	-0.20	-0.26	-0.27	-0.12	0.47	0.63	0.62	0.69	0.74	0.74	1.00					
20. Parental Negativity age 15	0.20	0.13	-0.04	-0.11	-0.04	-0.16	-0.16	-0.15	-0.17	-0.14	-0.11	-0.17	0.33	0.53	0.53	0.61	0.62	0.68	0.68	1.00				
21. Child EASI self report age 16	0.06	0.03	0.11	0.14	-0.01	0.01	-0.04	-0.01	0.01	-0.07	-0.09	-0.06	0.09	0.06	0.08	0.11	0.11	0.09	0.17	0.09	1.00			
22. Parent EASI report age 16	0.17	0.15	0.07	0.09	-0.09	-0.08	-0.10	-0.08	-0.13	-0.13	-0.15	-0.16	0.18	0.26	0.29	0.33	0.31	0.32	0.39	0.29	0.39	1.00		
23. Teacher EASI report age 16	-0.04	0.03	0.12	-0.04	-0.09	-0.01	0.06	-0.05	0.03	0.10	0.04	-0.05	0.06	-0.06	-0.08	-0.05	0.01	0.05	0.07	-0.15	0.25	0.29	1.00	
24. Sex	-0.03	0.02	0.00	-0.06	-0.03	-0.06	-0.03	-0.07	-0.07	-0.11	0.02	-0.01	0.07	0.10	0.09	0.11	0.04	0.09	0.00	0.05	0.03	-0.05	0.01	1.00

Note: For direction of effects for sex, females = 0 and males = 1.

Table A2: Correlations Among Study Measures in Adoptive Families.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1.Mother EASI self report	1.00																							
2. Partner EASI report of mother	0.35	1.00																						
3. Father EASI self report	0.01	0.11	1.00																					
4. Partner EASI report of father	-0.05	-0.32	0.45	1.00																				
5. Parental Warmth age 7	0.00	-0.02	0.08	0.05	1.00																			
6. Parental Warmth age 9	-0.06	0.11	0.05	-0.10	0.56	1.00																		
7. Parental Warmth age 10	0.04	0.03	0.01	-0.10	0.60	0.70	1.00																	
8. Parental Warmth age 11	-0.04	0.02	0.09	-0.04	0.53	0.73	0.76	1.00																
9. Parental Warmth age 12	-0.05	0.06	0.06	-0.10	0.53	0.61	0.64	0.68	1.00															
10. Parental Warmth age 13	-0.08	0.05	0.06	-0.04	0.50	0.61	0.66	0.71	0.67	1.00														
11. Parental Warmth age 14	-0.12	-0.01	0.03	-0.06	0.50	0.66	0.66	0.72	0.66	0.73	1.00													
12. Parental Warmth age 15	-0.04	-0.14	-0.06	-0.06	0.42	0.45	0.58	0.60	0.52	0.68	0.74	1.00												
13. Parental Negativity age 7	0.15	0.12	-0.09	-0.09	-0.28	-0.35	-0.19	-0.24	-0.19	-0.19	-0.26	-0.17	1.00											
14. Parental Negativity age 9	0.22	0.01	-0.20	-0.02	-0.14	-0.42	-0.28	-0.35	-0.25	-0.24	-0.30	-0.19	0.63	1.00										
15. Parental Negativity age 10	0.22	0.05	-0.08	0.00	-0.16	-0.39	-0.31	-0.30	-0.26	-0.29	-0.29	-0.25	0.54	0.73	1.00									
16. Parental Negativity age 11	0.14	0.08	-0.10	-0.03	-0.22	-0.48	-0.37	-0.42	-0.37	-0.38	-0.41	-0.30	0.59	0.75	0.71	1.00								
17. Parental Negativity age 12	0.26	0.13	-0.10	-0.07	-0.18	-0.34	-0.25	-0.31	-0.35	-0.31	-0.34	-0.29	0.54	0.70	0.70	0.73	1.00							
18. Parental Negativity age 13	0.20	0.11	-0.06	0.03	-0.16	-0.34	-0.26	-0.33	-0.31	-0.40	-0.38	-0.38	0.56	0.67	0.70	0.71	0.74	1.00						
19. Parental Negativity age 14	0.12	0.09	-0.01	0.06	-0.13	-0.33	-0.21	-0.26	-0.25	-0.25	-0.33	-0.30	0.54	0.62	0.68	0.72	0.71	0.75	1.00					
20. Parental Negativity age 15	0.17	0.22	0.03	-0.04	-0.16	-0.23	-0.19	-0.23	-0.29	-0.27	-0.37	-0.41	0.54	0.61	0.61	0.67	0.68	0.75	0.80	1.00				
21. Child EASI self report age 16	0.06	0.12	0.02	-0.05	-0.10	-0.12	-0.08	-0.15	-0.09	-0.09	-0.14	-0.13	0.26	0.16	0.15	0.16	0.17	0.13	0.22	0.28	1.00			
22. Parent EASI report age 16	-0.11	-0.06	0.10	0.04	-0.03	-0.09	-0.08	-0.14	-0.08	-0.05	-0.17	-0.11	0.20	0.19	0.20	0.22	0.26	0.21	0.31	0.37	0.37	1.00		
23. Teacher EASI report age 16	-0.04	-0.02	-0.06	0.06	0.06	-0.11	-0.12	-0.19	-0.11	-0.21	-0.17	-0.26	0.24	0.33	0.22	0.28	0.26	0.35	0.33	0.33	0.30	0.35	1.00	
24. Sex	-0.02	-0.05	-0.02	-0.02	-0.06	-0.04	-0.06	0.00	-0.07	-0.03	-0.01	0.00	0.10	0.11	0.10	0.11	0.04	0.14	0.09	0.14	-0.03	-0.15	0.03	1.00

Note: For direction of effects for sex, females = 0 and males = 1.

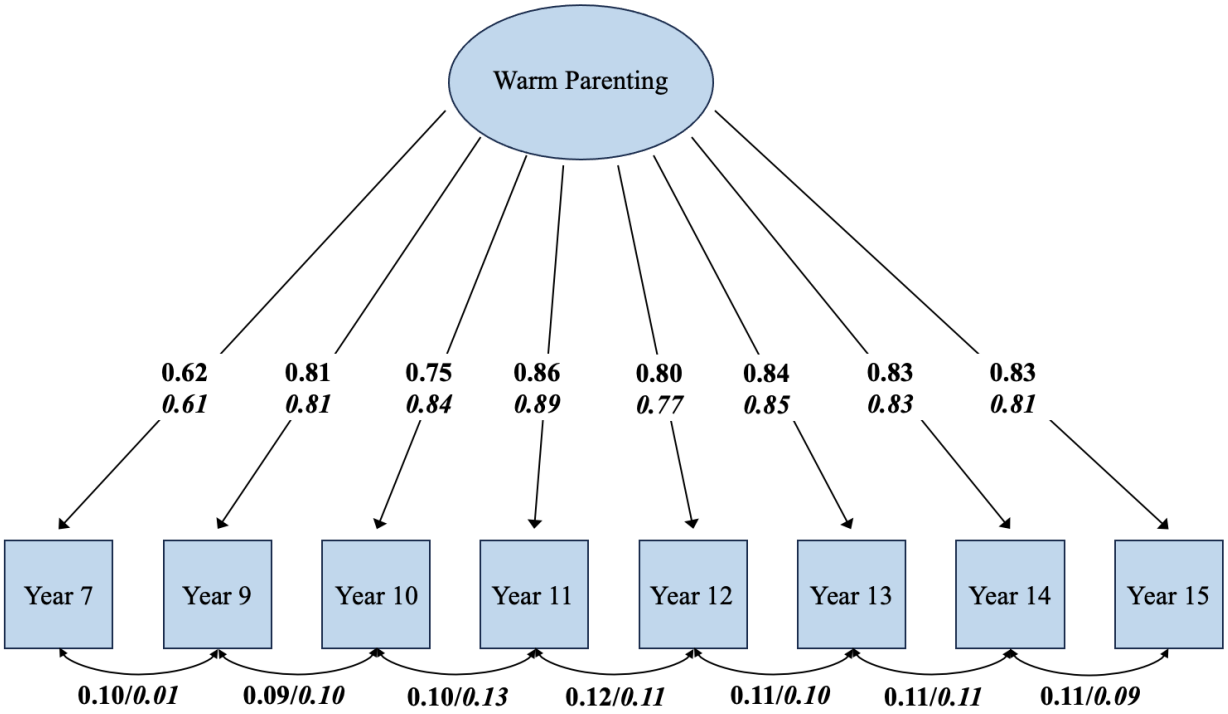

Figure A3: Model fit: χ^2 (46) = 69.38, p = 0.015, RMSEA = 0.065, CFI = 0.981.

Note: Measured variables are in boxes and latent variables are in ovals. Variance of measured variables explained by latent variables can be computed by squaring the factor loadings on the latent variables. Significant associations and factor loadings are indicated with **bolded** text. Loading index: *italicized = adopted parents*; not italicized = biological parents**.**

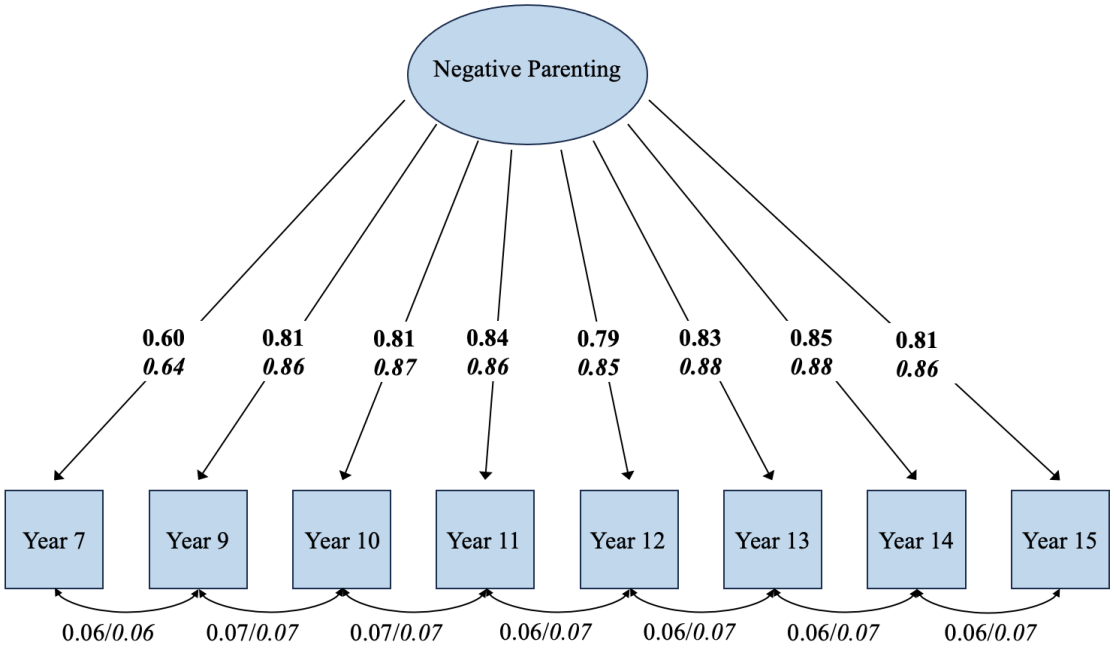

Figure A4: Model fit: χ^2 (46) = 83.067, p <0.001, RMSEA = 0.082, CFI = 0.970.

Note: Measured variables are in boxes and latent variables are in ovals. Variance of measured variables explained by latent variables can be computed by squaring the factor loadings on the latent variables. Significant associations and factor loadings are indicated with **bolded** text. Loading index: *italicized* = *adopted parents*; not italicized = biological parents**.**

Table A5: Number of Parents Surveyed for the Dibble and Cohen Parenting Report

	Age 7	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15
Number of mother reports	539	604	588	593	511	421	450	322
Number of father reports	356	16	32	24	57	62	64	53
Total reports	895	620	620	617	568	483	514	375
Percent of mother reports	60	97	95	96	90	87	88	86

Note: Adoptive and biological parents included as one group.

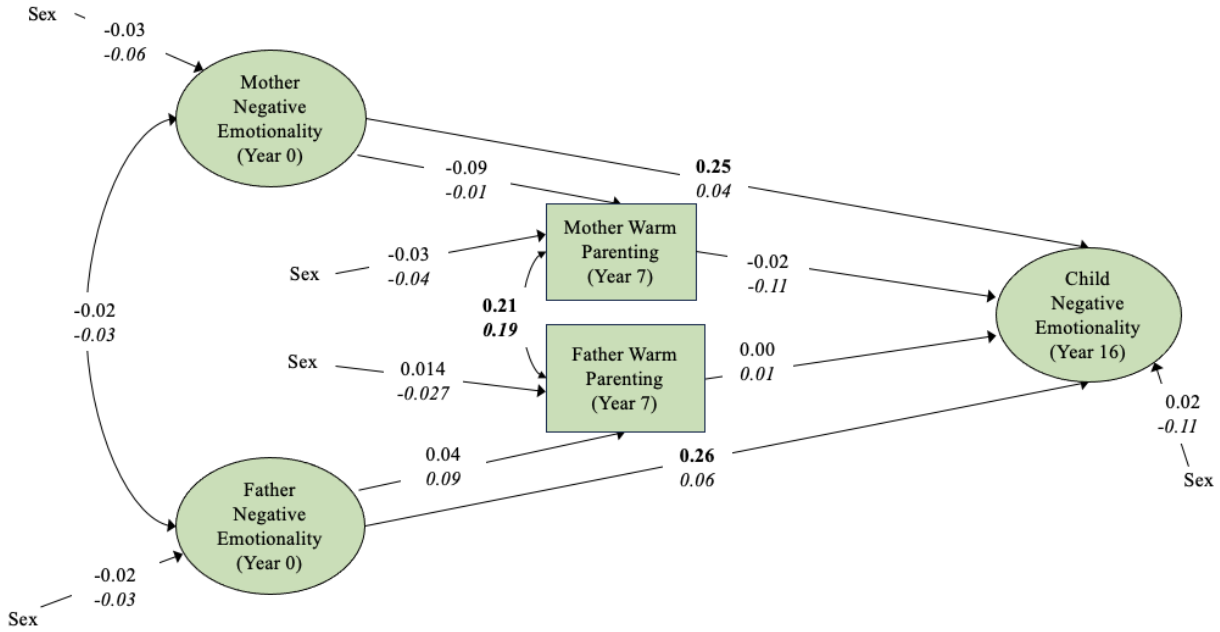

Figure A6: Model fit: χ^2 (41) = 49.462, p = 0.171, RMSEA = 0.021, CFI = 0.976.

Note: Measured variables are in boxes and latent variables are in ovals. Variance of measured variables explained by latent variables can be computed by squaring the factor loadings on the latent variables. Significant associations and factor loadings are indicated with **bolded** text. Loading index: *italicized = adopted parents*; not italicized = biological parents**.** For direction of effects for sex, females = 0 and males = 1.

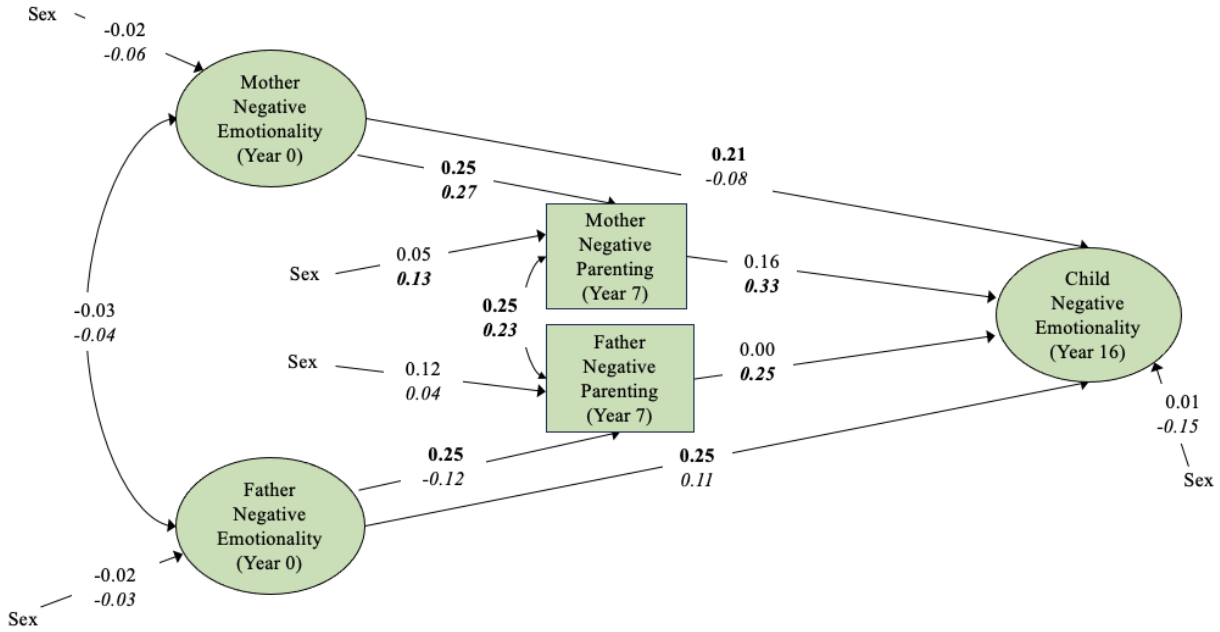

Figure A7: Model fit: χ^2 (41) = 79.544, p < 0.001, RMSEA = 0.045, CFI = 0.913.

Note: Measured variables are in boxes and latent variables are in ovals. Variance of measured variables explained by latent variables can be computed by squaring the factor loadings on the latent variables. Significant associations and factor loadings are indicated with **bolded** text. Loading index: *italicized = adopted parents*; not italicized = biological parents**.** For direction of effects for sex, females = 0 and males = 1.

Table A8: Results of Models Testing Maternal Warm and Negative Parenting as Mediators of the Association between Parents' and Children's Negative Emotionality

Mothers	Biological		*Adoptive*	
	Path	*p*	Path	*p*
Direct	**0.25**	**0.005**	-0.03	0.875
Indirect (Warm Parenting)	-0.05	0.137	-0.02	0.529
Indirect (Negative Parenting)	**0.06**	**0.029**	**0.12**	**0.021**
Total	**0.26**	**0.002**	0.07	0.570

Note: Significant associations and factor loadings are indicated with **bolded** text.

Table A9: Results of Models Testing Paternal Warm and Negative Parenting as Mediators of the Association between Parents' and Children's Negative Emotionality

Fathers	Biological		*Adoptive*	
	Path	*p*	Path	*p*
Direct	**0.25**	**0.010**	0.07	0.506
Indirect (Warm Parenting)	0.01	0.671	0.01	0.711
Indirect (Negative Parenting)	0.00	0.824	-0.04	0.260
Total	**0.26**	**0.010**	0.05	0.696

Note: Significant associations and factor loadings are indicated with **bolded** text.