Supporting Information

Appendix S1

Additional Information About Covariate Measures

Openness of the adoption (Leve et al., 2019; Ge et al., 2008). The openness of adoption was reported on by birth parents at child age 3 to 6 months and adoptive parents at child age 9, 18, and 27 months as well as 4.5 and 7 years. Adoptive and birth parents reported on the knowledge and contact between the families. The scale ranged from very closed (no information or contact exchanged) to very open (communication several times a month via phone, mail, or email and in person visits at least once monthly). For the covariate tests, we focused only on the reports of openness at the ages of the assessments included in the current investigation.

Covariate Associations

Results showed that BM emotion dysregulation (openness at 9 months: r = .11, p = .013; openness at 18 months: r = .11, p =.014) and behavioral activation (openness at 9 months: r = -.10, p =.023; openness at 18 months: r = -.09, p =.033) were associated with openness of the adoption at child age 9 and 18 months. BM emotion dysregulation was also associated with BM household income ($F(3,512) = 3.66$, p =.012).

Results for child constructs showed that child anger was associated with child sex ($t(455) = 2.10$, p =.036) and that the pattern of missing for child anger ($t(165.22) = 2.21$, p =.028) and sadness ($t(559) = 2.21$, p =.028) were related to obstetric complications. Child sex ($t(318) = -2.99$, p =.003) and child ethnicity ($t(318) = -2.99$, p =.003) were also associated with child social competence and the pattern of missing was associated with openness of the adoption at child age 9 months ($t(556) = 2.26$, p =.024). AP household income was associated with both child externalizing (r = -.12, p =.013) and internalizing problems (r = -.11, p =.032). Also, the pattern

of missing for child internalizing ($t(245) = -2.89$, $p = .004$) and externalizing problems ($t(245) = -2.89$, $p = .004$) was related to the openness of the adoption when the child was 7 years old.

For APs, results showed that AM warmth was related to obstetric complications ($r = -.11$, $p = .024$) and the pattern of missing was associated with AM age at assessment ($t(453) = 2.44$, $p = .015$). AF warmth was associated with child sex ($t(352.44) = -2.04$, $p = .042$) and AF education ($F(2,348) = 5.83$, $p = .003$), and the pattern of missing was related to AF education ($\chi^2(2) = 7.38$, $p = .025$), openness at child age 9 months ($t(556) = -2.17$, $p = .030$), AF ethnicity ($\chi^2(1) = 15.57$, $p = .000$), and AF age at assessment ($t(423) = 3.93$, $p = .000$). In addition, AM hostility was related to AM ethnicity ($t(391) = -2.11$, $p = .036$) and income ($r = -.11$, $p = .035$), and the pattern of missing was related to AM age at assessment ($t(453) = 2.44$, $p = .015$). AF hostility's pattern of missing was related to AF education ($\chi^2(2) = 7.38$, $p = .025$), openness at 9 months ($t(556) = -2.17$, $p = .030$), AF age at assessment ($t(423) = 3.93$, $p = .000$), and AF ethnicity ($\chi^2(1) = 15.57$, $p = .000$). The above confounds were chosen because of previous research showing that parenting constructs are associated with income (Berger & McLanahan, 2015), ethnicity (Hill, 2001), parent age (Ragozin, Basham, Crnic, Greenberg, & Robinson, 1982), and child sex (Chaplin et al., 2005). The covariates mentioned above were controlled for in subsequent analyses by regressing them out of the study constructs and creating standardized z- scores. Z-scores were used because many of the measures used different Likert scales (Colan, 2013) and to reduce the number of controls needing to be modeled in analyses. We also included APs' reports on positive parenting, closeness and conflict with their children, hassles of children's problem behavior, and children's social competence to help improve missing data estimation (Lang & Little, 2018). Constructs related to the patterns of missing discussed above were also included as auxiliary variables.

Birth Parent Latent Factor Analyses

Method

All the measures and additional information regarding the factor analyses are discussed in depth below.

Measures

Adult Temperament Questionnaire - short form (ATQ; Derryberry & Rothbart, 1988; Evans & Rothbart, 2007; Rothbart, Ahadi, & Evans, 2000). This measure consisted of 77 items and included the following subscales: fear, sadness, frustration, discomfort, sociability, positive affect, high intensity pleasure, attentional control, inhibitory control, activation control, neutral perceptual senstivity, affective perceptual sensitivty, and associtve sensitivity. Birth parents completed this questionnire when the child was 18 months. All of the above subscales were assessed on a 7-point scale ranging from 1 (extremely untrue of you) to 7 (extremely true of you). Items were average to created subscales. The control subscales were reverse coded. Reliabilities from the scales included in the final model ranged from .56 to .74.

Temperament Character Inventory (TCI; Cloninger, 1998; Cloninger, Svrakic, & Przybeck, 1993). This measure consisted of 125 items and included the following subscales: novelty seeking, harm avoidance, reward dependence, persistence, self-directedness, cooperativeness, and self-transcendence. Participants responded either true or false. Birth parents completed this questionnaire when the child was 3 to 6 months. Items were summed to create composites. Self-transcendence was the only subscale retained in the final models (BM: $\alpha = .78$; BM: $\alpha = .82$).

Harter Adult Self-Perception Profile (HASPP; Messer & Harter, 1986). This measure consisted of 50 items and the following subscales were included in the analyses: nurturance

(BM: $\alpha = .59$; BF: $\alpha = .71$) and intimate relationships (BM: $\alpha = .76$; $\alpha = .73$). For each item, participants were asked to choose the statement that was the most true for them and rate whether the statement was "really true for me" or "sort of true for me". Each item was then scored from 1 (lowest self-concept) to 4 (highest self-concept). Birth parents completed this questionnaire when the child was 3 to 6 months.

Behavioral Inhibition Scale/Behavioral Activation Scale (BIS/BAS; Carver & White, 1994). This measure consisted of 20 items and following subscales were included in analyses: behavioral inhibtion scale, reward responsiveness, drive, and fun seeking. Birth parents completed the assessment at child age 3 to 6 months (cohort I) and 56 months (cohort II). Responses on items ranged from 1 (*very true for me)* to 4 (*very false for me*). Reliabilities ranged from .62 to .86.

Results

Descriptive and correlational analyses from the raw data are presented in Tables S2 and S4, respectively, for birth mothers, and Tables S3 and S5, respectively, for birth fathers. Before the factor analyses, all the data were standardized (z score).

Missing Data

We examined the amount of missing data across all birth parent indicators included in the final models. Missing data percentages for birth mothers and fathers are presented in Table S2 and Table S3, respectively. Missing data were dealt with using Full Information Maximum Likelihood (FIML; Graham, 2003; Lang & Little, 2018) in Mplus7 Muthén & Muthén, 1998-2012)). We also used auxiliary variables to assist in estimating missing values. As mentioned previously, recent research has shown this to be a superior method to handling missing values (Lang & Little, 2018). We tested several possible auxiliary variables, including openness of the

adoption, obstetric complications, birth parent age at child birth, and birth parent income. The following variables were found to be significantly related to one or more of the indicators' patterns of missing and were included as auxiliary variables: birth mother age at child birth, birth mother household income, openness of the adoption, and obstetric complications.

Analytic Plan

First, we conducted exploratory factor analyses (EFA) to determine the factor structure and then we confirmed the factor structure using confirmatory factor analyses (CFA) for both birth mothers and fathers. All subscales from the Adult Temperament Questionnaire (ATQ), Temperament Character Inventory (TCI), and the BIS/BAS were included in the exploratory factor analysis, and select subscales mentioned above from the Harter Adult Self-Perception Profile. The correlations were specified between factors within birth mother and birth father latent factors. Correlations between indicators were specified for select subscales (see Figure S1). The specified correlations between factors were free to vary. The final temperament factors were held invariant across both birth parents in order to have a more comprehensive characterization of genetic influences.

Factor Analyses Results

We conducted exploratory analyses specifying a range of 3 to 6 factor solutions with goemin rotation. Indicators with factor loadings above .3 were retained. After removing items that cross loaded and had low loadings across all factors, we confirmed the four factor solution was the best fitting solution. We tested for invariance by setting the factor loadings to be equal across birth mothers and fathers. The fit was acceptable (χ^2 (276) = 446.89, CFI = .90, RMSEA = .03, SRMR = .08), and indicated that the factor structed represented both birth mothers and fathers. The final factors included four constructs: emotion dysregulation, orienting sensitivity

(sensitivity to stimulus in one's environment), agreeableness, and behavioral activation. Results of the final solution are presented in Figure S1.

Adoptive Parent Perception of Child Anger and Sadness

We tested potential parent perception differences of child anger and sadness. To accomplish this, we estimated a model where adoptive mothers reported on all constructs estimated in the model except for the birth parent constructs (child anger, child sadness, adoptive mother warmth, adoptive mother hostility, child externalizing and internalizing problems, and child social competence). Similarly, we estimated a separate model where adoptive fathers reported on all constructs. The mother and father results are shown in Figures S2 and S3, respectively. The most noteworthy differences are for parent warmth. Specifically, child sadness reported by adoptive mothers was associated with mother self-report on their warmth, whereas father warmth was not associated with father-reported child sadness. Adoptive mother warmth was also related to mother-reported child internalizing and externalizing problems and social competence, whereas adoptive father warmth was positively associated only with father-reported child social competence. Lastly, we see that adoptive mother hostility was related to mother-reported child internalizing but in the adoptive father-only model it was not. Interestingly, in the combined mother and father model reported in the manuscript (Figure 2), adoptive father hostility was related to child internalizing. It could be that when accounting for mother effects, father effects emerged or that using a combined parent report captured a more comprehensive view of the child's behavior compared to a single reporter (Achenbach, McConaughy, & Howell, 1987).

When comparing the mother-only (Figure S2) and father-only (Figure S3) models to the combined mother and father model reported in the manuscript in Figure 2, we see some

differences. First, mother-reported child sadness was related to mother warmth and mother warmth was related to mother-reported externalizing and internalizing problems and social competence in children. In addition, mother hostility was related to mother-reported child internalizing problems. It could be that once adoptive father paths are included in the model, these paths disappear. There were also several indirect effects, many of which were consistent with the model reported in Figure 2. First, mother-reported child anger was positively associated with mother hostility, which in turn was positively associated with mother-reported child externalizing (indirect effect: $\beta = .11$, $SE = .03$, $p = .000$) and internalizing (indirect effect: $\beta = .05$, $SE = .02$, $p = .018$) problems as well as social competence (indirect effect: $\beta = -.03$, $SE = .02$, $p = .047$). Next, BP behavioral activation was positively associated with mother-reported child anger, which in turn was positively associated with mother-reported child externalizing problems (indirect effect: $\beta = .03$, $SE = .01$, $p = .008$). In addition, there was evidence of evocative *r*GE with BP behavioral activation positively associated with mother-reported child anger, which in turn was associated with mother hostility (indirect effect: $\beta = .03$, $SE = .01$, $p = .003$). Next, BP behavioral activation was positively associated with mother-reported child anger, which in turn was positively associated with mother hostility which was subsequently positively related to mother-reported child externalizing (indirect effect: $\beta = .01$, $SE = .01$, $p = .008$) and internalizing (indirect effect: $\beta = .01$, $SE = .00$, $p = .042$) problems.

When comparing the father-only model to the combined mother-father model reported in the manuscript in Figure 2, we also see some differences. Father-reported child anger was negatively related to father warmth and father warmth was positively related to father-reported child social competence. In addition, there were no evocative *r*GE effects. There were a few indirect effects, which were consistent with the results from the combined models (Figure 2):

father-reported child anger was positively associated with father hostility, which in turn was positively associated with father-reported child externalizing (indirect effect: β = .07, *SE* = .03, *p* = .011) and negatively associated with father-reported child social competence (indirect effect: β = -.06, *SE* = .02, *p* = .015).

To further investigate the potential effects of parent perception of child anger and sadness, we conducted an invariant model (see Figure S4). We set the respective parent-report of child anger and sadness and the respective parent-report on their own hostility and warmth to be equal across adoptive mothers and fathers. The fit was excellent (χ^2 (12) = 12.64 , RMSEA = .01, CFI =1.00, SRMR = .04), indicating that the paths were equivalent across adoptive mothers and fathers. These analyses suggest that though there are differences between the mother and father report models, they are statistically minimal in regard to adoptive parent perceptions of child anger and sadness in the current examination.

These results suggest there are potential differences in how parents are perceiving their children's sadness and anger and that their perceptions of their children's emotions could influence their sensitivity to children's heritable characteristics (in respects to birth parent temperament). This seems to be particularly true for parental warmth, with mother-reported child sadness negatively linked to mother warmth, and father-reported child anger negatively linked to father warmth. In the current examination we were not able to consider both adoptive mother and father reports of children's emotions and outcomes in the same model due to a lack of power and thus cannot make quantitative comparisons between parents. Therefore, an important limitation to consider is the effect of shared rater bias on the reported estimates in Figures S3 and S4. Future research should further consider how parent perceptions of children's emotions can affect potential *r*GE mechanisms using observational methods.

References

Achenbach, T. M., McConaughy, S. H., & Howell, C. T. (1987). Child/adolescent behavioral and emotional problems: Implications of cross-informant correlations for situational specificity. *Psychological Bulletin, 101*(2), 213-232. doi: 10.1037/0033-2909.101.2.213

Berger, L. M., & McLanahan, S. S. (2015). Income, relationship quality, and parenting: Associations with child development in two-parent families. *Journal of Marriage and Family*, *77*(4), 996–1015. doi: 10.1111/jomf.12197

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS Scales. *Journal of Personality and Social Psychology*, *67*(2), 319–333. doi: 10.1037/0022-3514.67.2.319

Chaplin, T. M., Cole, P. M., & Zahn-Waxler, C. (2005). Parental socialization of emotion expression: Gender differences and relations to child adjustment. *Emotion*, *5*(1), 80–88. doi: 10.1037/1528-3542.5.1.80

Cloninger, C. R. (1998). The genetics and psychobiology of the seven-factor model of personality. In K. R. Silk (Ed.), *Review of psychiatry series. Biology of personality disorders* (pp. 63-92). Arlington, VA, US: American Psychiatric Association

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry*, *50*(12), 975–990. doi: 10.1001/archpsyc.1993.01820240059008

Colan, S. D. (2013). The why and how of Z Scores. *Journal of the American Society of Echocardiography*, *26*(1), 38–40. doi: 10.1016/j.echo.2012.11.005

Derryberry, D., & Rothbart, M. K. (1988). Arousal, affect, and attention as components of temperament. *Journal of Personality and Social Psychology*, *55*(6), 958–966. doi: 10.1037/0022-3514.55.6.958

Evans, D. E., & Rothbart, M. K. (2007). Developing a model for adult temperament. *Journal of Research in Personality*, *41*(4), 868–888. doi: 10.1016/j.jrp.2006.11.002

Ge X., Natsuaki M.N., Martin D., Leve L.D., Neiderhiser J.M., Shaw D.S.,…Reiss, D.(2008). Bridging the divide: Openness in adoption and post-adoption psychosocial adjustment among birth and adoptive parents. *Journal of Family Psychology*, 22, 529–540

Graham, J. W. (2003). Adding missing-data-relevant variables to FIML-based structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal*, *10*(1), 80–100. doi: 10.1207/S15328007SEM1001_4

Hill, N. E. (2001). Parenting and academic socialization as they relate to school readiness: The roles of ethnicity and family income. *Journal of Educational Psychology*, *93*(4), 686–697. doi: 10.1037/0022-0663.93.4.686

Lang, K. M., & Little, T. D. (2018). Principled missing data treatments. *Prevention Science*, *19*(3), 284–294. doi: 10.1007/s11121-016-0644-5

Leve, L. D., Neiderhiser, J. M., Ganiban, J. M., Natsuaki, M. N., Shaw, D. S., & Reiss, D. (2019). The early growth and development study: A dual-family adoption study from birth through adolescence. *Twin Research and Human Genetics*, 1–12. doi: 10.1017/thg.2019.66

Messer, B., & Harter, S. (1986). Manual for the adult self-perception profile. Denver: University of Denver.

Muthén, L. K., & Muthén, B. O. (1998-2012). *Mplus user's guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.

Ragozin, A. S., Basham, R. B., Crnic, K. A., Greenberg, M. T., & Robinson, N. M. (1982). Effects of maternal age on parenting role. *Developmental Psychology*, *18*(4), 627–634. doi: 10.1037/0012-1649.18.4.627

Rothbart, M. K., Ahadi, S. A., & Evans, D. E. (2000). Temperament and personality: Origins and outcomes. *Journal of Personality and Social Psychology; Washington*, *78*(1), 122–135.

Table S1. Very short form child behavior questionnaire composite items.

	Anger
030	Gets quite frustrated when prevented from doing something s/he wants to do.
040	Gets angry when s/he can't find something s/he wants to play with.
	Sadness
020	Tends to become sad if the family's plans don't work out.
027	Seems to feel depressed when unable to accomplish some task.
031	Becomes upset when loved relatives or friends are getting ready to leave following a visit.

Table S2. Birth Mother (BM) Descriptives.

Construct	Mean	Std	Range	N	Missing Data
Adult Temperament Questionnaire (ATQ)					
BM Fear	3.74	.97	1.00 – 6.43	465	17.1%
BM Frustration	3.97	1.04	1.00- 6.67	472	15.9%
BM Sociability	4.92	1.17	1.00-7.00	472	15.9%
BM Activation Control	4.72	1.00	1.57-7.00	468	16.6%
BM Attentional Control	4.37	1.20	1.20-7.00	471	16.0%
BM Associative Sensitivity	4.57	1.07	1.00-7.00	463	17.5%
BM Affect Perceptual sensitivity	4.62	1.08	1.00-7.00	461	17.8%
Temperament Character Inventory (TCI)					
BM Self Transcendence	6.24	3.41	0 -14.00	541	3.6%
Harter Adult Self-Perception Profile (HASPP)					
BM Nurturance	3.34	.56	1.25-4.00	549	2.1%
BM Intimate Relationships	2.97	.82	1.00-4.00	550	2.0%
Behavioral Inhibition Scale/ Behavioral Activation Scale (BIS/BAS)					
BM Reward Responsiveness	7.89	2.14	4.00-16.00	512	8.7%
BM Fun Seeking	8.53	2.26	4.00-15.00	512	8.6%
BM Drive	9.26	2.47	3.00-16.00	513	8.7%

Table S3. Birth Father (BF) Descriptives.

Construct	Mean	Std	Range	N	Missing Data
Adult Temperament Questionnaire (ATQ)					
BF Fear	3.11	.99	1.00-6.17	158	71.8%
BF Frustration	3.86	.95	1.33-6.83	159	71.7%
BF Sociability	4.55	1.22	1.75-7.00	160	71.5%
BF Activation Control	4.72	.95	2.57-7.00	157	72.0%
BF Attentional Control	4.46	1.12	2.00-7.00	160	71.5%
BF Association Sensitivity	4.62	1.22	1.20-7.00	160	71.5%
BF Affect Perceptual sensitivity	4.47	1.04	1.00-7.00	159	71.7%
Temperament Character Inventory (TCI)					
BF Self Transcendence	6.23	3.73	0-14.00	187	66.7%
Harter Adult Self-Perception Profile (HASPP)					
BF Nurturance	3.01	.64	1.00-4.00	189	66.3%
BF Intimate Relationships	2.98	.78	1.00-4.00	190	66.1%
Behavioral Inhibition Scale/ Behavioral Activation Scale (BIS/BAS)					
BF Reward Responsiveness	7.90	2.15	5.00-15.00	191	66.0%
BF Fun Seeking	7.80	2.30	4.00-13.00	191	66.0%
BF Drive	8.61	2.38	4.00-14.00	190	66.1%

Table S4. Birth mother (BM) correlations.

Construct	1	2	3	4	5	6	7	8	9	10	11	12	13
1. BM Fear	1												
2. BM Frustration	.40**	1											
3. BM Sociability	-.24**	-.20**	1										
4. BM Activation Control	-.34**	-.36**	.20**	1									
5. BM Attentional Control	-.44**	-.43**	.16**	.53**	1								
6. BM Associative Sensitivity	.17**	.00	.07	-.09	-.21**	1							
7. BM Affect Perceptual Sensitivity	.08	-.06	.10*	.09	-.04	.49**	1						
8. BM Self Transcendence	.10*	-.06	-.02	-.02	-.13**	.31**	.28**	1					
9. BM Nurturance	-.05	-.08	.25**	.12*	.09	.10*	.16**	.16**	1				
10. BM Intimate Relationships	-.12*	-.15**	.32**	.17**	.15**	.03	.06	.01	.35**	1			
11. BM Reward Responsiveness	.00	-.03	-.22**	-.05	.03	-.13**	-.13**	-.15**	-.11*	-.08	1		
12. BM Fun Seeking	-.05	-.09	-.10*	.05	.09	-14**	-.09	-.19**	.02	.03	.42**	1	
13. BM Drive	.00	-.06	-.16**	-.02	.03	-.07	-.04	-.14**	.02	-.02	.46**	.46**	1

Note. Includes control variables before reverse coding. * $p < .05$. ** $p < .01$.

Table S5. Birth father (BF) correlations.

Construct	1	2	3	4	5	6	7	8	9	10	11	12	13
1. BF Fear	1												
2. BF Frustration	.34**	1											
3. BF Sociability	-.43**	-.14	1										
4. BF Activation Control	-.39**	-.27**	.37**	1									
5. BF Attentional Control	-.46**	-.28**	.21**	.50**	1								
6. BF Associative Sensitivity	.04	.10	.10	.06	-.12	1							
7. BF Affect Perceptual sensitivity	.04	-.01	.21**	.19*	.07	.56**	1						
8. BF Self Transcendence	.08	.07	.01	-.09	-.12	.29**	.21**	1					
9. BF Nurturance	-.15	-.25**	.27**	.16	.12	.16*	.23**	.21**	1				
10. BF Intimate Relationships	-.41**	-.19*	.25**	.26**	.31**	.09	.15	-.16*	.44**	1			
11. BF Reward Responsiveness	.07	-.05	-.26**	-.11	-.03	-.37**	-.16	-.32**	-.20**	-.13	1		
12. BF Fun Seeking	.16	-.10	-.25**	-.15	-.08	-.26**	-.14	-.19*	-.17*	-.13	.46**	1	
13. BF Drive	.05	-.24**	-.20*	-.05	-.09	-.17*	-.01	-.23**	-.05	-.04	.53**	.55**	1

Note. Includes control variables before reverse coding. * $p < .05$. ** $p < .01$.

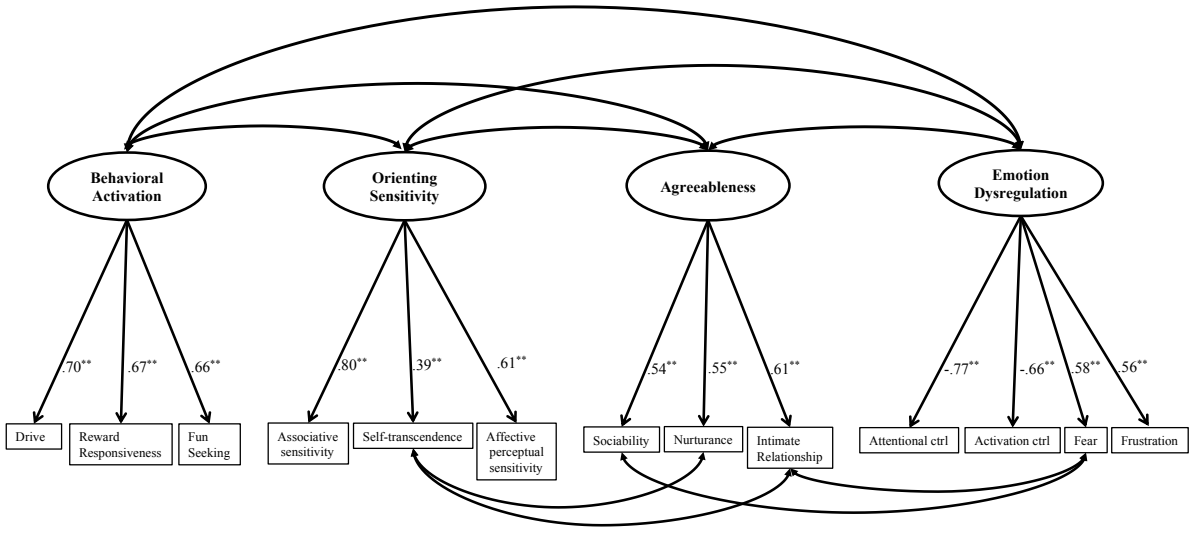

Figure S1. Confirmatory factor analysis loadings for the invariant model across Birth Mother and Birth Father.

*Note. *p<.05, **p<.0.* Fit indices: χ^2 (276) = 446.89, CFI = .90, RMSEA = .03, SRMR = .08.

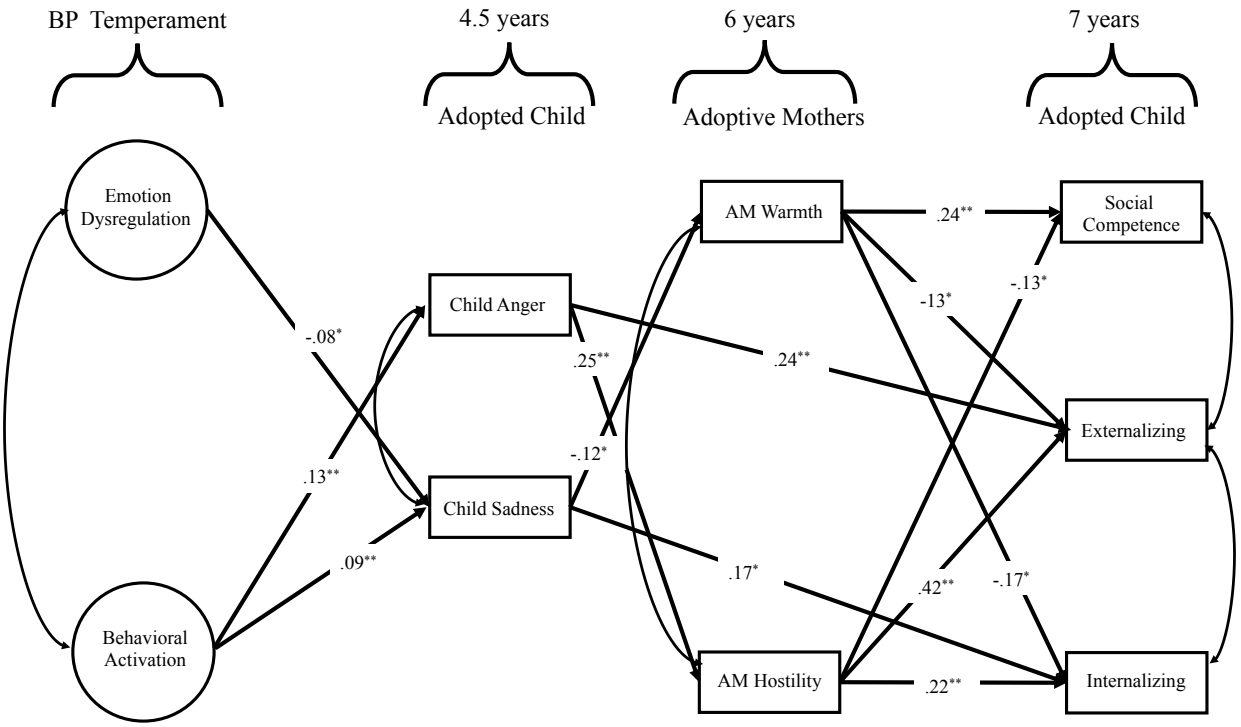

Figure S2. Mother only results.

Note. Standardized values are presented. Adoptive mothers reported on child sadness and anger as well as child externalizing and internalizing problems and social competence. *$p<.05$, **$p<.0$. Fit indices: χ^2 (14) = 17.90, CFI = .99, RMSEA = .02, SRMR = .03. AM = Adoptive Mother.

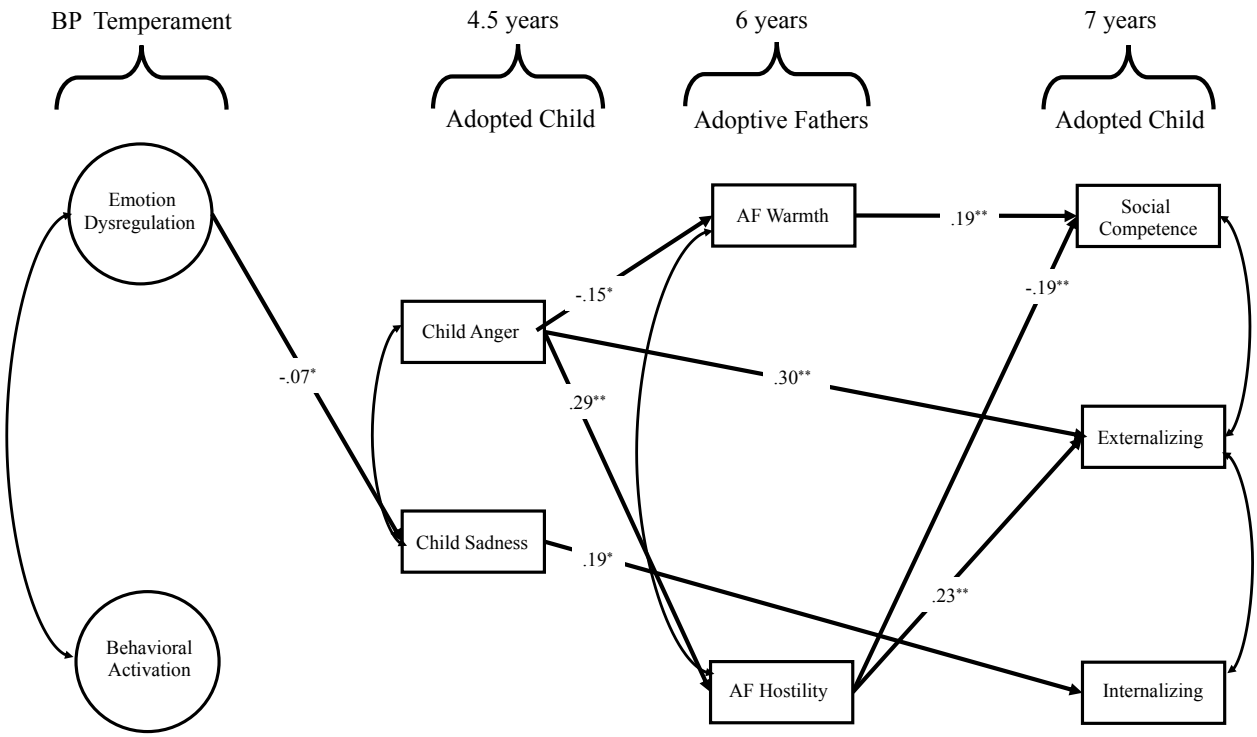

Figure S3. Father only results.

Note. Standardized values are presented. Adoptive fathers reported on child sadness and anger as well as child externalizing and internalizing problems and social competence. *$p<.05$, **$p<.0$.

Fit indices: χ^2 (14) = 6.75, CFI = 1.00, RMSEA = .00, SRMR = .02. AF = Adoptive Father.

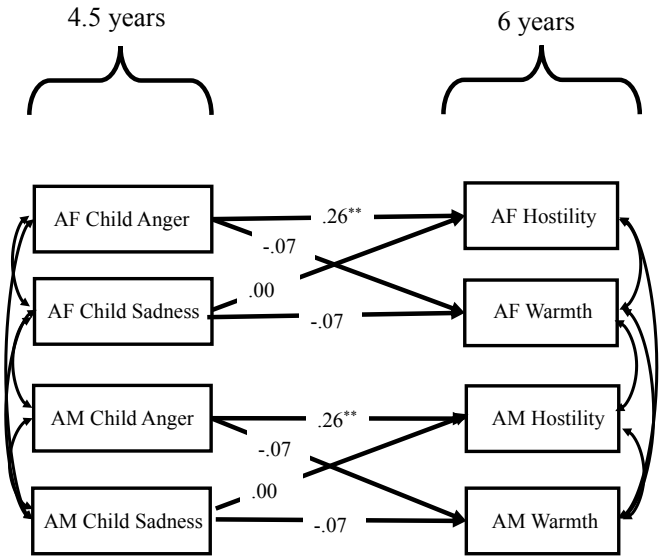

Figure S4. The invariant model.

Note. Standardized values are presented. Fit = χ^2 (12) = 12.64 , RMSEA = .01, CFI =1.00, SRMR = .04. The fit indices for the partial path model indicate that mother and father reports of children's emotions and their parenting are equivalent, suggesting that parents are generally reporting about their children's emotions in the same way.